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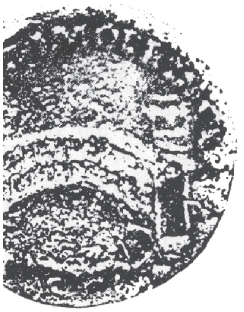

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PROF. UNIV. DR. VLAD A. CODREA AT HIS 60TH ANNIVERSARY. SCIENTIFIC REFERENT OF DROBETA REVUE, NATURAL SCIENCES SERIES

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PROF. UNIV. DR. VLAD A. CODREA AT HIS 60TH ANNIVERSARY. SCIENTIFIC REFERENT OF DROBETA REVUE, NATURAL SCIENCES SERIES

Abstract: This paper is dedicated to the collaboration of Prof. Univ. Dr. Vlad Codrea with the Natural Sciences Series of the Iron Gates Region Museum from Drobeta Turnu Severin, now at his 60 anniversary. His contribution was represented by the presentation at the annual symposium organized by the museum, by several publications in the museum's Drobeta Natural Sciences Series, especially to improving of the scientific level that scientific referent of this revue.

The first editorials regarding the research of the natural sciences in the Drobeta magazine are the ones from the anniversary number (vol. VI, 1985), where it was first created a special chapter entitled "Natural Sciences".

Between 1997–2003, the scientific research of the Natural Sciences team, have correlated with current trends regarding the research and conservation of nature in the context of integration into the European landscape. The issues addressed in the conservation of nature have generated the division of the already enshrined chapter, in chapters "Research Geology" and "Iron Gates Natural Park".

The scientific research in the natural sciences domain, both curators of the Iron Gates Region Museum and their collaborators, have led to the development of the two chapters, so that in 2004 the Drobeta revue, Natural Sciences Series makes its appearance. The year 2004 is significant for organizing the first scientific symposium "Environment – research, conservation, valorization ". This symposium was organized mostly around World Environment Day, it brought together scientific concerns of scientists from various culture media, research institutes, universities, Romanian Academy and abroad. As a corollary of these scientific "*meetings*", Drobeta, Natural Sciences Series was published annually until now.

DROBETA, Ştiinţele Naturii, XXVI/2016, p. 7–14

A special contribution to the emergence of revue Drobeta Series Natural Sciences, have had collaborators of the Museum of Severin, curators, researchers, university teachers, academics who contributed directly to raising the scientific journal through the complexity of the subjects addressed, and the rigor of scientific articles. Among the contributors, the contribution of Professor Dr. Vlad Codrea at the Department of Geology, Paleontology Babes-Bolyai University of Cluj-Napoca is remarkable.

More than that, he offered his expert and generous consultancy on paleontology topics, as well as on general professional aspects. Through Prof. Univ. Dr. Vlad Codrea, the Natural Sciences Department of the Iron Gates Region Museum from Drobeta Turnu Severin has initiated and strengthened in time a long-term scientific and professional relationship with the Babeş-Bolyai University in Cluj-Napoca and with other museums in Romania.

For the curators of the paleontological collection of the museum in Drobeta Turnu Severin, the chance of working together with Prof. Univ. Dr. Vlad Codrea represented the opportunity for learning about fossils vertebrate, paleoecology, Quaternary geology, Regional geology, and so many others...

The fossil vertebrates were virtually unknown in Husnicioara open pit (Mehedinţi District) until the discovery of the remains of rhinoceros (cf. *Stephanorhinus jeanvireti*) and mastodon (cf. *Anancus arvernensis*), Pleistocene species of mammals, determined and described by Prof. Univ. Dr. V. Codrea (2003).

The mastodon molars found in Husnicioara open pit and in Hurduceşti from Mehedinti District (southwestern Romania) were relieved from its matrix in the vertebrate laboratory at Babeş-Bolyai University in Cluj-Napoca, then curate at Iron Gates Region Museum (years 2007 and 2010). Although the *Mammut borsoni* species is very common in the Pliocene vertebrate faunas from this part of Europe, until now it was missing from the Lower Pliocene (Dacian) assemblages from our country. In fact, his mastodon species is particularly rare in western Oltenia. In 2007, was reported for the first time the Pliocene fish discovered in Husnicioara (Mehedinţi District).

Through the study a fragment of right mandible documents the presence of the mastodon *Anancus arvernensis* at Fântâna Domnească, in Mehedinţi District (2011). This species of mastodon is extremely frequent in the Pliocene of Oltenia, this locality being a new one for this species in Mehedinţi District.

The collaboration between the Prof. Univ. Dr. V. Codrea and the muzeologists of the Iron Gates Region Museum (more than 17 years) was a provided by his generous support in improving of the museum patrimony by introduction in the paleontology collection the rare and valuable proofs for natural history of the southwestern Romania.

As scientific referent of the Drobeta revue, Natural Sciences Series Professor Vlad Codrea imposed a high scientific rigor, both in terms of actual content articles, and the accuracy of specialized international language. He also, coordinated

the editorial board of the revue by selecting articles specialized with high scientific and adapting graphics of revue at high levels editorial.

The pictures below illustrate better the constant presence of Professor Vlad Codrea at the scientific symposium "*Environment – researcher, conservation, valorization*" and documentary excursions organized on this occasion. As recognition to his contribution, the department of Natural Sciences Team Iron Gates Region Museum addressed his esteem and consideration by this entire article dedicated to the anniversary of Prof. Univ. Dr. Vlad Codrea.

In this anniversary year of the Prof. Univ. Dr. Vlad Codrea we are honored to address our discrete but warm acknowledgements for his collaboration and knowledge transfer to his disciples in paleontology.

The symposium "Environment – researcher, conservation, valorization" (2005)

The symposium *"Environment – researcher, conservation, valorization"* (2008)


Documentary excursions (2008)


The symposium *"Environment – researcher, conservation, valorization"* (2009)


The symposium *"Environment – researcher, conservation, valorization"* and documentary excursions in Park National Đerdap (Serbia) (2010)


The symposium *"Environment – researcher, conservation, valorization"* and doumentary excursions at Zaječar National Museum (Serbia) (2012)


The symposium "Environment – researcher, conservation, valorization" (2015)

Appendix

List of publications – Prof. Univ. Dr. Vlad Codrea, Drobeta Revue, Natural Sciences Series: vol. IV, Editure MJM, 2004; vol. V – XXIII Ed. Universitaria Craiova, 2005–2013; vol. XXIV – XXVI, Ed. Mega Cluj-Napoca, 2014 –2016.

Ovidiu Barbu, **Vlad Codrea**, Sorin Şerban (2004) *Landscape restoration of the area affected by the sterile dump in the Lotrului Valley Basin* (p. 99–103)

Abstract: *The mining field Cataracte is situated on the right bank of the upper flow of the Lotru River in a mountainous region, 15 km upstream from Voineasa. The afferent dumps were stocked on the right bank of the Lotru River. These dumps lead to a very important problem, namely they polluted the Lotru River Valley, spreading downstream the deposited material under the circumstances of direct erosion caused by the frequent changes in the water level and due to the uncontrolled action of torrents. This action is increased by the lack of cohesion in the deposited material and by the morphological configuration of the Lotru Valley. It was, therefore, considered necessary to*

collect and drain the gushing water from the slope, to protect the slope basis at the level of the valley by means of consolidation, plant seeding on the dumps and landscape restoration.

Cristina Fărcaş, **Vlad Codrea** (2005) *Dâncu formation (Rupelian): an exemple of land/marine transition from Transylvanian Depression* (p. 33–37)

Abstract: *The Dâncu Formation (Rusu, 1972; Rupelian) appares developed in the N-W side of Transylvanian Depression, and it is preponderant localised in the sedimentation area of Gilău. The Fauna Associations relative rich, noticed in the outcrops from the formation's superior side, caracterises the continental lacustrine facies. The transition from the continental system of the Dâncu Formation to the marine one it is gradually realised, untill it reaches the salmastre deposits of the Gruia Formation.*

Vlad Codrea, Ovidiu Barbu, Mircea Rebrişoreanu, Eugen Traistă (2005) *Géologie et exploitation des travertins en Roumanie* (p. 38–50)

Abstract: *The paper is a round-up on the main travertine occurrences from Romania, pointing out their genesis, geology, palaeontology as well as the economic value. The Romanian travertine genesis is due either to remnant Neogene volcanic effects, or to regional anomalous thermal areas, located in various tecto-structural units (Transylvanides, Neogene volcanic zone of Eastern Carpathians, Strei and Pannonian depressions). In both situations, deep crust fractures are involved too. Some travertine sites belong to Pleistocene, some to Holocene. Older travertine is presumed too, but without hard proofs. At present, travertine is mined in two open-pits only (Geoagiu and Cărpiniş, both in Hunedoara district), but reserves are significant large in other sites too as Borsec or Banpotoc. In other situations, e.g. at Sândominic, the reserve is only of local value.*

Mircea Rebrişoreanu, **Vlad Codrea**, Ovidiu Barbu (2006) *Studies on the Şuşiţa granitoids mined at Meri open-pit (Gorj District)* (p. 47–50)

Abstract: *In Southern Carpathians, the Lower Danubian Units are exposed on large areas. One of their peculiar features concern the existence of several granitoids intruded into the metamorphic series forming the basement. One of them is the Şuşiţa granitoid. This type of rock is mined at Meri, in Gorj District. The paper deals with the mineralogy, petrology and technical characteristic of this rock, stressing out its economic value.*

Ovidiu Barbu, **Vlad A. Codrea** (2008) *New Sarmatian plants from the former Iris open pit in Cluj-Napoca* (p. 7–11)

Abstract: *This contribution refers to two new Sarmatian plant species discovered in the former Iris open pit, in Cluj-Napoca. The first one is an algae widespread in the Paratethys realm in Early-Middle Sarmatian, the second a Pinus representative, now firstly reported in the Transylvanian Basin.*

Cristina Fărcaş, **Vlad A. Codrea** (2008) *Overview on the Eocene/Oligocene boundary formations bearing land mammals in northwestern Transylvania* (p. 24–32)

Abstract: *The northwestern side of the Transylvanian Basin bears the most numerous Paleogene non-marine formations exposures in Rumania. Among these, the ones*

referring to the Eocene/Oligocene boundary are of main interest in stressing out the bioevents related to "Grande Coupure" events in this part of the continent. This contribution try to make an overview on the formations bearing land mammals in this area: Mortănuşa, Valea Nadăşului, Turbuţa, Jebucu (all Late Eocene), Mera, Miograd, Dâncu, Var (Early Oligocene). The mammal taxa list from each formation is given further.

Book reviews: **Vlad A. Codrea** (2008) – Florina Diaconu: *Reconstituirea paleomediilor carbogeneratoare pliocene dintre Dunăre şi Motru*, 321 p., 2008, Editura Universitaria Craiova, Drobeta Turnu Severin (p. 194–196)

Vlad A. Codrea, Florina Diaconu (2010) *Borson's mastodon (Mammut borsoni) find in Hurduceşti, Mehedinţi District* (p. 7–12)

Abstract*: Borson's mastodon (Mammut borsoni) find in Hurduceşti, Mehedinţi District. The paper refers to a Borson's mastodon upper tooth fragment found in the alluvia of Huşniţa Valley, in Mehedinţi District. The geology of the river draining area concerns exclusively Pliocene deposits, as possible origin rocks for this fossil. However, the level that yielded the fossil can not be recognized any more. These Pliocene deposits are part of Southern Carpathians Foredeep, a heritage of the Dacian Basin late evolution. This mastodon species is particularly rare in western Oltenia.*

Ovidiu Barbu, **Vlad A. Codrea** (2010) *The Seciuril Landslide: a case study in Oltenia* (p. 13–19)

Abstract*: The landslide from Seciuri (May 2006) affected more than 500 people and severely damaged the coal band at Seciuri-Ruget open pit. This paper presents some data in a tentative to explain and interpret how the landslide process happened.*

Vlad A. Codrea, Florina Diaconu (2011) *Anancus arvernensis (Mammalia: Proboscidea) at Fântâna Domnească (Mehedinţi District)* (p. 7–12)

Abstract*: A fragment of right mandible documents the presence of the mastodon Anancus arvernensis at Fântâna Domnească, in Mehedinţi District. The fossil was found in 1930 by a home-born, Barbu Lăcătuşu and remained for decades in a local school collection. The mastodon remains originated from ferruginous pebbles, belonging to the Late Pliocene (Romanian). This species of mastodon is extremely frequent in the Pliocene of Oltenia, this locality being a new one for this species in Mehedinţi District.*

Vlad A. Codrea, Ovidiu Barbu (2012) *The Shale Gas as a New Energetic Option: Advantages vs. Risks* (p. 5–8)

Abstract*: In the last decades, Romania had to challenge the increasing requirement of natural gas. Although the country remains among the leading conventional natural gas producers in Europe, the needs of this energetic resource lead to higher and costly imports, mainly from East suppliers. In such a context, the non-conventional energetic resources, mainly the extraction and use of the shale gas could be an alternative for the Romanian economy. The paper deals with the advantages of such a tendency, but underline also in same time the high risks related to the extraction works.*

Predoiu Ionuţ, Aninoiu Daniel, Barbu Ovidiu, **Codrea Vlad** (2016) *The coal mining basin Jilţ – some remarks about the production capacity* (p. 7–15)

Abstract: *The coal mining basin Jilţ is located on northwestern Oltenia region (Gorj County), in southwestern Romania. There, the coal extraction is actually active in a couple of open-pits, i.e. South (since 1978) and North (since 1980) Jilţ. The production capacity in this coal basin is reaching almost 7.6 millions of tons yearly.*

THE COAL MINING BASIN JILŢ – SOME REMARKS ABOUT THE PRODUCTION CAPACITY

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THE COAL MINING BASIN JILŢ – SOME REMARKS ABOUT THE PRODUCTION CAPACITY

Abstract: The coal mining basin Jilţ is located on northwestern Oltenia region (Gorj County), in southwestern Romania. There, the coal extraction is actually active in a couple of open-pits, i.e. South (since 1978) and North (since 1980) Jilţ. The production capacity in this coal basin is reaching almost 7.6 millions of tons yearly.
Keywords: lignite, Jilţ mining basin, production, Oltenia, Romania.

Introduction

Among the primary energy resources, coal is the most important in the energy mix worldwide. In our country, according to the NAMR, the situation of coal resources was as follows (Table1, from Energetic Strategy of Romania 2011–2020):

Table 1. Situation of coal resources

Type of resource	Mining active areas	Non-leased areas	Total
UM	mil.t	mil. t	mil. t
Huila	592	1,614	2,206
Lignite	986	11,606	12,592
Total	1,578	13,220	14,798

Out of coals, lignite is mainly used to produce electricity and heat. In 2013, thermoelectric energy produced from lignite accounted for about 30% of the total produced in Romania.

To us, just as in other European countries, the lignite production – with a few exceptions as Hungary, Poland or Slovakia – decreased. If in the EU the decline was 6% in 2013 compared with 2012, in Romania this fall was much higher, about 27% (Romanian Energy Strategy 2011–2020; Table 2).

Table 2

Type of resource	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
UM	t	t	t	t	t	t
Lignite	34,058,631	29,301,153	28,837,223	33,882,246	31,550,016	22,902,291

Since 1997, in the coal mining as part of the Romanian energy system, we produced a series of processes of reorganization and restructuring that have resulted in a number of positive aspects, such as streamlining process production, but also some negative ones, such as reducing coal production and the staff too.

An example of this is the Jilţ Mining Basin (abbreviated, JMB), which over the years has been part of various organizational structures.

In 2004, this mining basin – together with the open pits Peşteana and Roşia – was integrated in the Energy Complex Turceni SA, which had as activities: the production of heat and electricity based on lignite (code 4011) and mining and processing of lignite (code 1020).

Later, in 2012 there was a new re-organization whereby the Energy Complex Turceni, as well as the ones of Rovinari and Craiova and the Lignite Society Oltenia Târgu-Jiu joined into the Energy Complex Oltenia (ECO), the largest producer of energy out of coal in Romania, with an estimated production of 3900 MW. This production could provide about 30% of the electricity consumption from the National Power System, with higher energy efficiency due to rehabilitation programs of groups and environmental impact reduction through the rehabilitation process. The Ministry of Economy stated that the new structure will lead to an enhanced energy security of Romania and achieving new medium-term capacities generating energy based on lignite.

As a perspective of the development of the strategy of mining activity in the ECO the following trends were established: i. structuring and organizing the work based on market rules; ii. modernization of gears and technologies, abandoning the outdated ones; iii. bringing the production to European quality standards; iv. implementation of measures for environmental protection and rehabilitation of areas affected by mining.

General data on Jilţ mining basin

From administrative viewpoint, Jilţ Mining Basin (JMB) is located in the northwestern part of Oltenia region (Fig. 1), namely in the southwestern part of

Gorj County, sharing territories from Mătăsari, Runcurel, Dragoteşti, Croici and Miculeşti communes.

Fig. 1. Location of the Jilţ Mining Basin in Romania (without scale; Google Earth, 2009)

In JMB, the coal mining works are conducted in two open pits: Jilţ South (1978) and Jilţ North (1980), with two additional smaller open pits, Cercheze I and II (Fig. 2).

From a structural viewpoint, Jilţ coal mining basin belongs to the Getic Sector of the Dacian Basin, portion of the Southern Carpathians Foredeep (Paleocene – Pleistocene; Săndulescu, 1984). The Pliocene is corresponding to the stage of waters sweetening that led to the formation of a paralic basin (Jipa & Olariu, 2009). The sedimentation evolved to fluvial environments, which gradually extended from west towards easts and from north to south (Andreescu, 2009; Andreescu et al., 2011, 2013; Jipa & Olariu, 2009). Inside the sandy and clay succession, 25 coal (lignite) seams are interleaving, some of them laterally extended on dozens of kilometers. Usually, the majority are thin.

The cumulative thickness of the layers of coal is extremely low relative to the

entire thickness of the sedimentary complex. The first coal seams occurred in the latest Miocene (Pontian) and continued to develop mainly in Early Dacian (Early Pliocene) and Romanian (Late Pliocene) (Marinescu, 1978) (Fig. 3).

Fig. 2. The open pits Jilţ North and Jilţ South; satellite view (without scale; Google Earth, 2009)

Awareness of deposit of lignite basin Jilţ increased permanently by execution of openness and preparation for exploitation. Thus, in 1974 they started the first opening works at the Mătăsari and Dragoteşti mines, and in 1978 and 1979 at the Tehomir and Cojmăneşti mines. Preparatory works for shaping panels began in 1977 at the mine Mătăsari and in 1978, 1979, 1982 at the mines Dragoteşti, Tehomir, Cojmăneşti and Negomir.

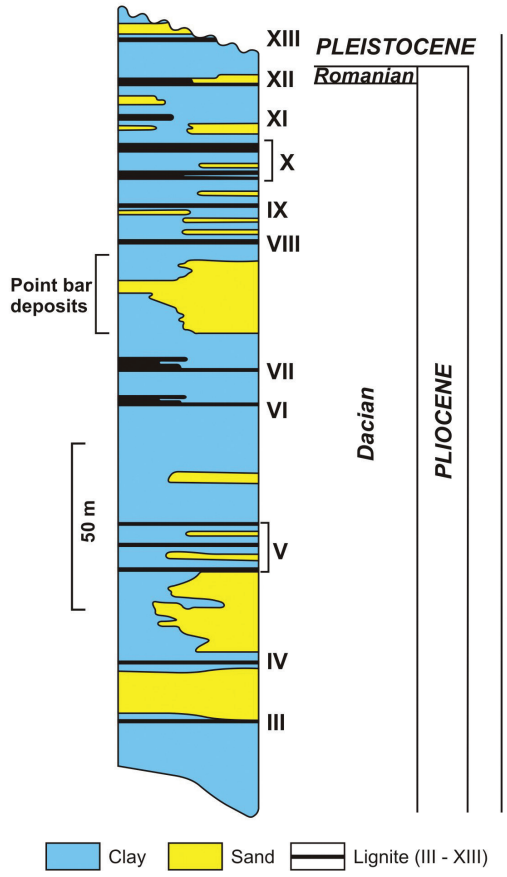

Fig. 3. Lithostratigraphic sequence in South Jilţ open pit

Production capacity for lignite in the coal mining basin Jilţ is about 7.6 million tons/year. The following tables expose the productions of the rock mass and volumes of lignite unrocked from operating the quarries of the basin Jilţ, until 2003.

Table 3 Situation of the startup production until 1990

	1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1999**	**1990**	**1980-1990**
South Jilţ	67	1,771	1,785	1,701	1,524	1,690	1,431	1,019	1,425	2,478	1,897	16788
North Jilţ				910	441	563	270	89	195	370	610	3448
Total Jilţ	67	1,771	1,785	2,611	1,965	2,253	1,701	1,108	1,620	2,848	2,507	20236

Table 4 Situation of the production starting with 1991 till 2003

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
South Jilț	1,568	2003	1,695	2,203	2,612	3,050	2,604	2,180	2,000	2,200	2,271	2,240	2,450
North Jilț	330	564	470	391	775	844	777	855	1,000	1,250	1,799	1,585	2,205
Total Jilț	1,898	2567	2,165	2,594	3,387	3,894	3,381	3,035	3,000	3,450	4,070	3,825	4,655

Current situation and future prospects for coal mining in the area

At the moment, demand factors are result of joint action of the mechanisms of the energy market. They are influenced by available or potential financial and material resources, prices, wages, consumption level and traditions. Quantitative and qualitative sizing of the demand and its variation during certain periods of time are influenced by the factors, acting individually or as a system with direct or indirect effects in the medium or long term.

In the mining sector, restructuring strategies aim the following directions: i. upgrading of existing facilities and technologies, particularly to reduce material consumption, improve technical production and quality performance; ii. concentration of investment funds in research and development to ensure better use of the product and to respond promptly to beneficiaries requests; iii. avoidance of adverse social impacts that may occur from reduction of some production capacities by creating of some redeployment of labor programs; iv. financial strategies that ensure revenue and business profit growth.

Restructuring of the mining basin Jilţ was imposed by the drastic reduction in coal demand, production levels adaptation to the deliveries becoming an indispensable requirement. Lignite production forecast for the next period is based on the energy strategy of the country, which envisages: i. adequate energy needs of a modern economy; ii. ensuring the conditions for food quality and safety; iii. limiting the impact on the environment at levels permitted in Europe.

The rehabilitation program of the existing equipment in the pits represents the complex of actions that runs on process lines designed to ensure: realization of expected production; improving the quality of production; reducing the consumption of materials and energy; development of technical and economic indicators comparable to those in countries with a tradition in energetically coal mining.

Bringing the technical status of the complexes of excavation, transport and dump at the original state by replacing parts of the facilities with more modern and reliable one, as improving communication and interventions in the pit is the subject of *the rehabilitation process*.

The bulk of the technologic lines from the coal mining Jilț basin were rehabilitated, referring to:

– The technologic gear, meaning: i. initiation of long life materials (rubber belts, electric cables, curing materials); ii. initiation of high reliability compounds (rolls, seals, electric plants etc.); iii. completion of safety devices; iv. upgrade of the communication system.

– Actions for rehabilitation of the technologies: i. shortening of the transport distances and of the number of conveyor belts; ii. upgrade of the dumping systems and development of the direct dumping technology; iii. detailed planning of the mining works; iv. monitoring of the dewatering works.

– Rehabilitation of overhaul capacities.

– Rehabilitation of the accessory gear park.

The revamping of gears from the coal open pit has as main target the optimization of the technical parameters, by redesign of some mechanisms and units to the actual technical exigencies for a longer endurance, safety function and low costs. This target can be reached by: right choice of the mechanical and electrical components that need very few maintenance works; rising the reliability degree of installations; changes in the gears construction, in order to upgrade the working regime.

The revamping has as aim the rise of gears' performances, the cutting costs of energy, maintenance, periodical repairs, all leading to fair economic results.

Another way of the reorganization concerns the reconfiguration of the coal mining fields, meaning the allocation of funds of investment to the promising areas and exploration works for new reserves. As the methodology of determination of the area parameters of the mining unit – i.e., the whole surface of the mining field, production capacities, industrial reserve – as first stage of design is not of actuality any more, analytical methods should be applied based on mathematic modeling. In this manner, one may obtain the correlation of these parameters with economic efficiency.

According this conception for sizing of the coal mining, some elements should be taken into consideration, as: the optimal sizes of the basic units of production and the compounds of the technological flux are established in accordance to the geological and mining conditions, keeping always in mind the economic directive of the investment; the size of the parameters of the coal field are established in the ultimate stage, taken into account the market requests.

The reshaping of the mining fields needs a detailed analysis of the economic results, defended by the following arguments: possibility of application of some technologies appropriates to mining fronts exceeding 2 km, resulted by the joint of two neighbored mining fields; the possibility to include in mining of reserves from neighboring coal fields, with thick opening-up rocks, devoid of economic efficiency if exploited separately; limitation of distances of transport; dump areas allowing conditions for inner dumping; efficient mining of the reserves placed into pillars located nearby the limit of the mined coal fields.

The criteria of reshaping of perimeters may be established in relationship with the geological and mining factors and the level of predicted economical results, classified as: technical-mining and economic. The first ones depend on the geological and mining limitations, as: stratigraphy, tectonics, hydrogeology of the deposit; organization (open-pit organization, staff structure, enclosure etc.); technology (distances of transport, the surface involved in works, technical endowment etc. The second ones refer to the extended time operation availabilities resulted by using upgraded excavators.

Conclusions

The coal still is a participant that will have a determinant long-lasting contribution in energy. Almost 98.66% of the national production of lignite on 2013 originated from the mining works of the Oltenia Energetic Complex, trough Tg. Jiu Mining Division.

In Romania, the lignite was in the last three decades – and will be also – an important component of the energy portfolio. The building of new, modern power plants based on coal could lead to the lowering of dust and carbon dioxide emissions. The lignite mining and energy generation based on this coal will be basically determinate by the environment compatibility (e.g. noise and carbon dioxide emissions lowering).

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DATA ON FOSSIL DISSEMINULES IN MIO-PLIOCENE DEPOSITS FROM MEHEDINŢI DISTRICT, ROMANIA

Florina Diaconu

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Abstract: Herein, is presented a repertory of the macroscopic remains from Mio-Pliocene deposits from Mehedinţi District, represented mainly by fruits, seeds, bracts fruits, etc, discovered in Pârlagele, Batoţi, Morilor Valley, Dedoviţa, Balota Hill, Husnicioara open pit and Bâcleş sites. In this paper are reported for the first time the fruits in Pontian deposits from Batoţi; the pods and bracts in the Dacian deposits of the Husnicioara coal open pit.
Keywords: Mio-Pliocene, fossil disseminules, southwestern Romania.

Introduction

The research carried out on the Mio-Pliocene deposits from Mehedinţi District led to recover of vegetal remains, representing not only leaf imprints, but also fruits, seeds, bracts fruits, all united under the name of "*disseminules*". All were discovered in Pârlagele, Morilor Valley, Batoţi, Balota Hill, Dedoviţa, Husnicioara open pit and Bâcleş sites.

Generally, the study of a fossil flora is based on rigorous systematic assignation of the remains found in rocks. There are rare cases where besides imprints of leaves, there are also preserved fruits and seeds. In such situations, they add precision in determination, mainly when flowers are also found (Barbu, 1954).

Previous research

In the Badenian deposits exposed on Neagonea Valley near Pârlagele (Mehedinţi District), Stancu & Ţicleanu (1974) reported among the plants seeds, fossils of samaras and bract fruits: *Pinus* sp.1-semina, *Pinus* sp.2-semina, *Tilia*

josephinae n. sp. Ticleanu, *Acer* sp. aff. *A. angustilobum* Heer, *Acer* sp. aff. *A. trilobatum* (Sternberg) A. Braun. Later, Diaconu & Meilescu (2011) reconfirmed the presence of the species *Tilia josephinae* Ticleanu based on a bract.

Among the Dacian deposits from Dedoviţa (Mehedinţi) Ţicleanu et al. (1982) pointed out in their studied flora, a poor preserved cone of *Pinus* sp. and *Carpinus pyramidalis* Gaudin- bracts. In the outcrop from Balota Hill site, Diaconu & Enache (2007) found *Carpinus betulus* – bracts.

In the summary presented by Ţicleanu (1992) 91 plant taxa are presented; later the same author (in Ţicleanu et al., 1997) added another 7 taxa. There is also reported *Quercus* sp.-fruit and seeds of *Stratiotes dacicus*.

Paraschiv (2004) reported a Sarmatian flora from Morilor Valley represented manly by leaf imprints and fruits (samaras, flowers), as follow: seeds of *Pinus* sp. 1, *Pinus* sp. 2, *Piceea* sp., *Ulmus parschlugiana* Kovar-Eder & Z. Kvaček, *Carpinus betulus* Linnaeus *fossilis* Engelhardt & Kinkelin, *Ulmus* sp. and *Seminae* sp.; samaras of *Engelhardia macroptera* (Brongniart) Unger, *Acer* sp.1 and *Acer* sp. 2; pods of *Leguminosites parschlugianus* (Unger) Kovar-Eder & Z. Kvaček; flowers of *Antholithes* sp. and ament of *Populus* sp.

In a description of the lithology of Husnicioara coal open pit, Diaconu (2004b) also reported *Stratiotes dacicus* seeds.

The assemblages of fossil plants identified near the village Brigleasa – at north of Bâcleş –, were presented by Ţicleanu et al. (2001) and Diaconu (in Enciu et al., 2006). In these Dacian fluvial clay besides the leaf imprints there are also samaras of *Acer* cf. *tricuspidatum* Bronn.

Diaconu & Ţicleanu (2008) identified in the clay forming the roof of the coal seam I *Carpinus betulus* – leave and bracts.

In the Pontian deposits from Batoţi, among other fossils vegetal remains, prevalent are the leaf imprints, the most common being *Fagus, Quercus, Liquidambar* etc. Sometimes, there are fragments of *Typha*, *Phragmites* and muscle (rare), but also fruits of *Ulmus* and *Carpinus* too (Diaconu, 2008).

Material and method

The macroflora fossils originate from: the Badenian marls of Pârlagele, the Pontian grey clays of Batoţi, and the Dacian grey clay of Husnicioara coal open pit. The studied material consists in fruits, seeds and bracts.

Results and discussions

Through this study, in the Badenian deposits from Pârlagele one report seeds of *Pinus* sp. and bracts of *Tilia josephinae* (Pl. I, fig. 1, 2), in Ponţian deposits Batoţi fruits of *Fagus silesiaca* (Pl. II, fig. 1), *Quercus* sp. (Pl. II, fig. 2), *Carpinus grandis* (Pl. II, fig. 3–6) and *Ulmus pyramidalis* (Pl. II, fig. 7), in Dacian deposits Husnicioara

Table 1: Repertory of fruits, seeds and bracts reported in previous researches

Taxon		**Sites**					
	Pârlagele (Badenian) (Stancu & Ticleanu, 1975)	**V. Morilor (Sarmatian) (Paraschiv, 2004)**	**Baţoţi (Pontian) (Diaconu, 2008)**	**Dedoviţa (Dacian) (Ticleanu et al., 1982)**	**Balota Hill (Dacian) (Diaconu & Enache, 2007)**	**Husnicioara (Dacian) (Ticleanu, 1992; Diaconu, 2008)**	**Bâcleş (Dacian) (Enciu et al., 2006)**
Pinus sp. 1- semina	seeds	seeds	-	cone	-	-	-
Pinus sp. 2- semina	seeds	seeds	-	-	-	-	-
Picea sp.	-	seeds	-	-	-	-	-
Antholithes sp.	-	flower	-	-	-	-	-
Engelhardia macroptera (Brongniart) Unger	-	samara	-	-	-	-	-
Carpinus grandis Unger	-	-	fruits	-	-	-	-
Leguminosites parschlugianus (Unger) Kovar-Eder & Z. Kvaček	-	pods	-	-	-	-	-
Carpinus betulus Linnaeus fossilis Engelhardt & Kinkelin	-	seeds	-	-	-	-	-
Carpinus betulus L. –	-	-	-	-	bracts	-	-
Carpinus pyramidalis Gaudin	-	-	-	bracts	-	-	-
Quercus sp.-fruit	-	-	-	-	-	fruits	-
Ulmus pyramidalis Goeppert	-	-	fruits	-	-	-	-
Ulmus parschlugiana Kovar-Eder & Z. Kvaček	-	seeds	-	-	-	-	-
Acer sp. Aff. *A. angustilobum* Heer	samara	-	-	-	-	-	-
Acer tricuspidatum Bronn	-	-	-	-	-	-	samara
Acer sp. aff. *A. trilobatum* (Sternberg) A. Braun	samara	-	-	-	-	-	-
Acer sp.1	-	samara	-	-	-	-	-
Acer sp.2	-	samara	-	-	-	-	-
Byttneriophyllum tiliaefolium (Al. Braun) Knobloch et Kvacek	-	-	-	-	-	samara	-
Tilia josephinae n. sp. Ţicleanu	bracts	-	-	-	-	-	-
Populus sp.	-	ament	-	-	-	-	-
Stratiotes dacicus	-	-	-	-	-	seeds	-
Ulmus sp.	-	seeds	-	-	-	-	-
Seminae sp.	-	seeds	-	-	-	-	-

open pit samaras of *Acer* sp. (Pl. III, fig. 1), bracts of *Carpinus betulus* (Pl. III, fig. 2) and pods of *Gleditsia* sp. (Pl. III fig. 3, 4).

The high diversity in *Pinus* seeds shape doesn't allows a sharp specific determination. The presence of numerous imprints of *Pinus* in the Badenian deposits from Pârlagele, shows (Stancu &Ticleanu, 1975) a limited transport and probably presence of the groups of *P. laricoides* in higher and dryer areas located nearby the sea shore. The wings fruits of *Pinus* and *Acer* could be brought on larger distances.

Byttneriophyllum tiliaefolium is one of the dominant species of the Pliocene swamps from Danube – Motru area. Its fruits were pack saddled with big wings and heavy seeds, which made their transport difficult. The dissemination couldn't be done on wider areas, but only in the close vicinity of swamps (Diaconu, 2004a).

The leaves and samaras of *Bytneriophyllum tiliaefolium* identified in Husnicioara open pit are large and very hardly can preserve integral. *B. tiliaefolium* was a tree that contributed a lot to the accumulation of the parental vegetal material that formed the Dacian coal between Danube and Motru (Diaconu, 2008).

In the same area, the seeds of *Stratiotes* were identified in three of five biotopes described, as follows:

– in the areas almost permanently covered by water dominated by *Glyptrostrobus europaeus*;

– in the biotope permanently covered by water, from a few centimeters up to 2m dominated of vegetable assemblage with *Phragmites oeningensis*;

– in the biotope immerged up to 3 m dominated by aquatic plants assemblage.

Among the aquatic plants, seeds of *Stratiotes dacicus* are frequent in Husnicioara open pit, as in all coal-bearing deposits of Oltenia. It proves that in the coaly facies with aquatic plants, *Stratiotes* had an important participation. In fact, among the monocenoza with important role in coal generation is one of *Stratiotes dacicus*.

The large number of leaf imprints of *Acer tricuspidatum* at Bâcleş (over 30 imprints in 80 samples) and the presence in the same place of both small and large-sized leaves is indicative for the absence of any transportation before burial. Another proof is the presence of leaves besides samaras.

Conclusions

In the Mio-Pliocene deposits of Pârlagele, Batoţi, Morilor Valley, Dedoviţa, Balota Hill, Husnicioara and Bâcleş, fruits, seeds and bracts fruit were reported. This study brings the following contributions:

– in the Badenian deposits from Pârlagele, seeds of *Pinus* sp. and bracts of *Tilia josephinae* are once again confirmed;

– in the Pontian deposits from Batoţi, here are firstly reported fruits of

Fagus silesiaca and *Quercus* sp., besides the species *Carpinus grandis* and *Ulmus pyramidalis*;

– in the Dacian deposits of the Husnicioara coal open pit, samaras of *Acer* sp., bracts of *Carpinus betulus* and pods of *Gleditsia* sp. are present.

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Plates

Plate I

Fig. 1 *Pinus* sp. – seeds
Fig. 2 *Tilia josephinae* – bract

Plate II

Fig. 1 *Fagus silesiaca* – fruit
Fig. 2 *Quercus* sp. – fruit
Fig. 3–6 *Carpinus grandis* – fruits
Fig. 7 *Ulmus pyramidalis* – fruit

PLATE III

Fig. 1 *Acer* sp. – samara
Fig. 2 *Carpinus betulus* – bract
Fig. 3a, 3b *Gleditsia* sp. – pod

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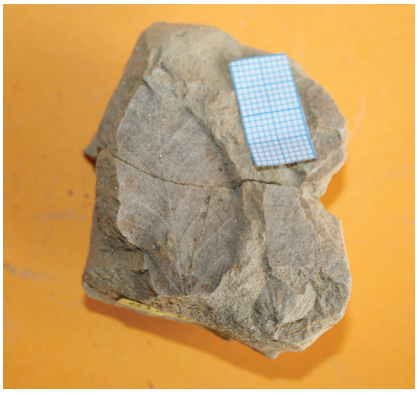
Plate I



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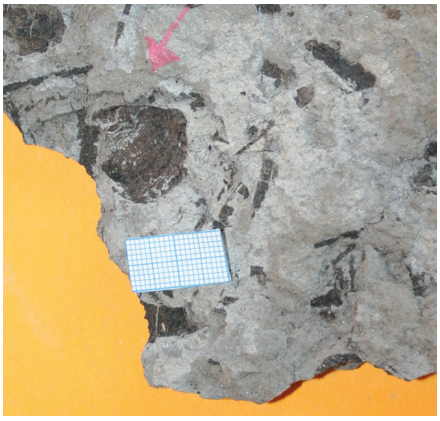

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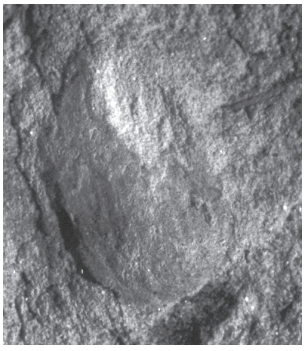

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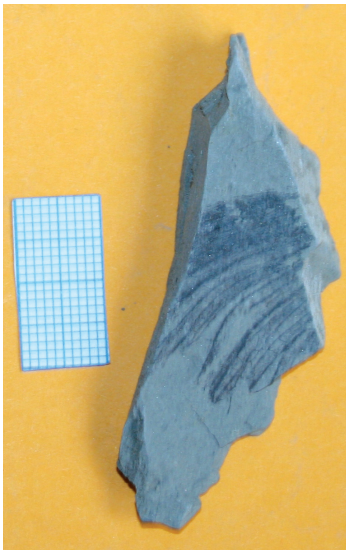
Plate II



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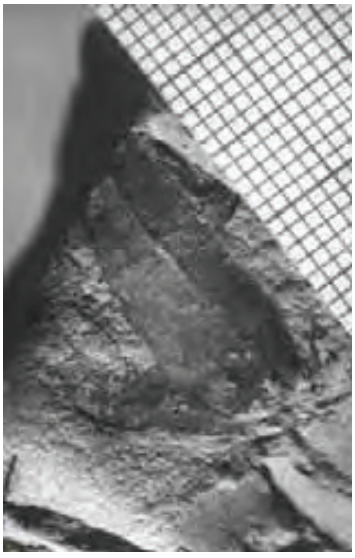

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Plate III

"FLOWERS OF DARKNES AND LIGHT" – TEMPORARY EXHIBITIONS

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***"FLOWERS OF DARKNES AND LIGHT"* – TEMPORARY EXHIBITIONS**

Abstract: The cultural – educational valorization of the mine flowers collection from the Heritage of Iron Gates Region Museum was achieved by various means specific to museum activities. In this paper are presented only some of the ways to exploit cultural, scientific and educational valorization: itinerant and temporary exhibitions, photo exhibitions.

Keywords: flowers of mine, temporary exhibitions, photo exhibitions, Iron Gates Region Museum

In general, mine flowers are recovered either through private collectors or through museums specialist. The beauty and uniqueness of minerals have attracted people's interest and the samples discovered in mine were brought to the surface and stored. Due to outstanding aesthetic qualities of these underground values, they should be included in the museums heritage or in collections specialized institutions.

Natural Sciences section heritage of the Iron Gates Region Museum contains a collection of 612 pieces that include mineralogy and mining flower mainly from donations and purchases. The provenance of these pieces is justified, given that Mehedinti District is an area rich in mining flower. Because this exhibition of the Iron Gates Gorge, as is the name of the museum mineralogy collection holds some samples from Moldova Nouă. Also in this area originate 25 samples of mine flowers donated by Gh. Mitroescu received in 1996 and which was exposed in Hall 1 of the Natural Sciences Department (Diaconu, 1998). Among the pieces donated prevail quartz, pyrite, calcite, galena, blend, single mineral samples or association of minerals. Some of these samples are likely to be classified as national cultural heritage.

Cultural – educational valorization of the mining flower collection during

(1996–2016) was materialized through themed presentations and temporary exhibitions. The selection of parts for exposure was made exclusively on aesthetic criteria: the shape and color spectacle.

Temporary exhibitions

The first temporary exhibition with a suggestive name "Flowers of darkness and light", with the opening of Women's Day was exposed during March-April 1997 (Photo 1). Modern Silk exposure using mirrors and lights put even more value to the beauty of these "flowers" growing in the depths of the earth and are brought to light by the miners. Compared with the flowers in the vegetable world, the mine flowers do not wither after being picked, but, on the contrary they shine out of darkness and delight with their incomparable beauty.

Photo 1 Images from the exhibition "Flowers of darkness and light" (7 March 1997)

The mine flowers from the department of natural sciences museum collection were also part of the temporary exhibition "*Patrimony in natural sciences department collections*." This exhibition was organized by the European Heritage Days in September – December 1999.

"*Stone story*", temporary exhibition realized with the occasion of the anniversary of Earth Day and inaugurated on 22 April 2007, was another opportunity to exploit the mine flowers. The exhibition was structured around the following themes: diversity Stone; organic stone; stone jewel created by nature; stone jewel created by man; Stone-building material; stone-symbol; stone tools and weapons; petrified plants and animals (Diaconu, 2014). The exposure of mine flowers was included in the theme-stone jewelry created by nature (Photo 2, 3).

Photo 2 Image from the exhibition "*Stone story*" (22 April 2007)

Photo 3 Image from the exhibition "*Stone story*" (22 April 2007)

Since 2010 the Iron Gates Region Museum is in rehabilitation and the premise from Street Independence no. 2 is closed. In these circumstances, the capitalizing of the exhibition of the museum heritage was done in other offices of the museum or in unconventional spaces. The temporary exhibition "*Jewels of the earth*" was

organized in the round room of the Art Museum (Photo 4, 5) with the occasion of Earth Day (April 22, 2013) and in the context of the "Days of Severin".

Photo 4 Image from the exhibition "*Jewels of the earth*" (22 April 2013)

Photo 5 Image from the exhibition "*Jewels of the earth*" (22 April 2013)

Itinerant exhibitions

The exhibition "*Magic of mine flowers*" was itinerated from Banat Museum in Timisoara and exposed in the hall of honor of the Iron Gates Region Museum (Photo 6), from 30 June to 11 October 2000. The mine flowers impressed since ancient times spirit and human imagination, creating artwork, giving rise to mysticism and legend, uniting feuding or those attracted by the lure of them. Whether the prehistoric silexs or precious minerals, they were regarded with magical

properties. Thus, through an auxiliary material represented by images and texts, it tried presenting a history of magical traditions. During the Middle Ages, a great vogue resumed today, the belief in the symbolic value, generally auspicious influence on the fate of human relationships include stone-sign, stone-month birth, stone-planet.

Photo 6 Image from the exhibition "*Magic of mine flowers*" (30 June 2000)

During 28 May 2013–15 October 2013 as part of a cultural exchange of thematic exhibitions, the "Iron Gates I" Hydro-electric Power Station Museum, section of the Iron Gates Region Museum hosted the traveling exhibition "*Mine Flowers*" from the Mineralogical Museum in Baia Mare comprising 90 mineral samples from Baia Mare. This cultural program aimed exchange of museum exhibitions with museums in Romania, diversifying and enriching exchange intermuseum cultural offer of museums, facilitating wider access to culture to the public. The large number of mineral samples found, provides to Baia Mare region the right to be considered the richest region in this regard in Romania and is also known worldwide.

The theme of the exhibition gives the contours and the geological specific to Mining Basin Baia Mare – following geological evolution for over 14 million years, showing the formation of crystals, properties of minerals collectors and some general aspects of samples of Baia Mare, are highlighted pieces with unusual qualities that are: aggregated massive with unusual form, single samples mineral with remarkable size, independent crystal developed perfect form associations of hydrothermal minerals, crystals of the same mineral in several generations reared on a single sample and samples of colors or combinations of special colors.

Those who visited the Iron Gates hydroelectric Museum during the period had the opportunity to admire a variety of shapes, colors, sizes and twinning of crystals, some of them unique in the world (Photo 7–10).

Photo 7 Image from the exhibition “Mine Flowers” (28 May 2013)

Photo 8 Image from the exhibition “Mine Flowers” (28 May 2013)

Photo 9 Image from the exhibition "Mine Flowers" (28 May 2013)

Photo 10 Image from the exhibition "Mine Flowers" (28 May 2013)

Promoting the exhibition "*Mine Flowers*" at the Museum of Mineralogy of Baia Mare was realized by organizing themed exposures supported at ecological and cultural events: World Environment Day and the Day of the Teacher (Photo 11) Day of Geologists (Photo 12) Day of Tourism (Photo 13, 14).

Photo 11 Themed exposure "*Mine Flowers*" held by the World Environment Day and Teacher's Day (5 June 2013), Art Museum, Drobeta Turnu Severin

Photo 12 Interactive lesson "Mine Flowers-Earth Jewels" World Day of Geologists (18 September 2013) Technical College Mr. Tudor, Drobeta Turnu Severin

Photo 13 Interactive lesson "*Mine Flowers-Earth Jewels*" (25 September 2013), "Iron Gates I" Hydro-electric Power Station Museum, Gura Văii

Photo 14 Interactive lesson "Flowers mine-Earth Jewels" Tourism Day

Photo exhibition

The temporary photo exhibition "*Daces in stone*" was organized with the occasion of Earth Day (April 22nd 2016) and exposed in the museums multipurpose pavilion (Photo 15), under the "Otherwise School: To know more, to be better in 2016" (between 18 –30 April 2016).

Photo 15 Images from the photo exhibition "*Daces in stone*" (22 April 2016)

The theme of the exhibition was suggested by ditches from the cave complex Ponoarele. Clints is karsts forms that water has carved in limestone and true form lattices in stone. They are shaped grooves while being true wrinkles furrowed limestone surfaces. The fields of ditches from Ponoarele expansion

are characterized by variety and expressiveness being given by the sight ditches depth and diversity of forms that went rock carvings. The best known and most interesting are the Cave Hill ditches forming two distinct fields, dubbed Cleopatra and Aphrodite field, truly unique in Europe.

Besides flowers ditches, the mine crystals can also be considered laces in stone. Mine flowers are single mineral samples or polymineral who have outstanding aesthetic qualities due to crystals, colors, shapes and sizes of crystal components. In this respect, they were displayed posters with images of pieces from the Mineralogy collection of the Museum Iron Gates Region representing samples of quartz, barite, stibnite, pyrite, marcasite.

Renowned for the diversity and color of crystals, flowers or stone mine have always been a great fascination, and a focal point for all amateur collectors. An amateur collector moral duty, supported by law is to check if the pieces collected are not a particularly scientific interest to enter the national heritage.

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STEPS TAKEN IN ESTABLISHMENT OF "TRIVALE FOREST PARK" RESERVE (PITESTI, ARGES COUNTY)

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STEPS TAKEN IN ESTABLISHMENT OF "TRIVALE FOREST PARK" RESERVE (PITESTI, ARGES COUNTY)

Abstract: Trivale Forest is considered a true green lung for Pitesti. It belongs to the vast forest unit of middle Arges County, being located in the Getic Piedmont. It is located at the boundary between beech and oak subzone, here also being the southern boundary of the birch, its flora and vegetation being characterized by a consistent blend of mountain, hills and plain flora elements. In 1994, through Decision no. 18 of Arges County Council, Trivale Forest was declared as a Forest Reserve of local interest. Since April 2010, has begun the initial steps in order to establish a natural reserve in Trivale Forest, being faced with a strong real estate pressure, with threats concerning biodiversity, respectively with irreversible degradation of natural capital trend, especially through land use change. The status as Natural Reserve contributes to the conservation of natural habitats and of important natural species regarding flora, fauna and forestry, as well as keeping of its strong landscape and recreational character.
Keywords: Natural Reserve, sozological categories, forest habitat, forest-park.

Introduction

In terms of territorial administrative point of view, Trivale forest covers a total area of 1904.7 hectares, of which 1171.3 ha is the forest-park, being administered by the Piteşti Forest Division – Arges County Forestry Inspectorate. It is located on Pitesti municipality territory as well as on the following communes territory Bascov, Băbana and Moşoaia. To the south and west it is bordered by Poiana Lacului Forest Division, to the north by Cotmeana Forest Division and to the east by Dobrogostea Production Unit III from Piteşti Forest Division.

From botanical point of view, Trivale Forest has been less studied. Romanian flora cites a number of 44 Systematic Cormophytes unites. D. Grecescu has

botanized this area and P. Cretzoiu cites in Trivale, the *Quercus* × *pseudodalechampii* hybrid species. In 1966, Aurel Popescu made a floristic study on Trivale Forest and its surroundings. In Arges County Museum's Herbarium and in the University of Pitesti Herbarium, there are 453 herbarium sheets of botanized plants, in this forest area by botanists such as: Ioan Todor, Stelian Săraru, Bibica Drăghici, Petruţa Pestroiu, Teodora Mavrodin, Aurel Popescu, D. Mitu, Gh. Ilie, Valeriu Alexiu.

For the people of Pitesti, Trivale forest represents a resting place, a place for promenade and entertainment, but also the most important fresh air reservoir against the numerous pollutants.

Since 1902, there have been concerns of Arges County authorities for converting in park a part of Trivale Forest. Redont and Pinard architects have made a landscaping plan for a park, and then ordered abroad various ornamental trees. In 1913 is approved "the landscaping development of Trivale park and the pond creation". The documents found in the National Archives of Arges County Division, in the Pitesti Hall found, especially in the first half of the XXth Century, it helps us to figure out the efforts made by City Hall for converting a part of Trivale Forest in a very nice entertainment and leisure park.

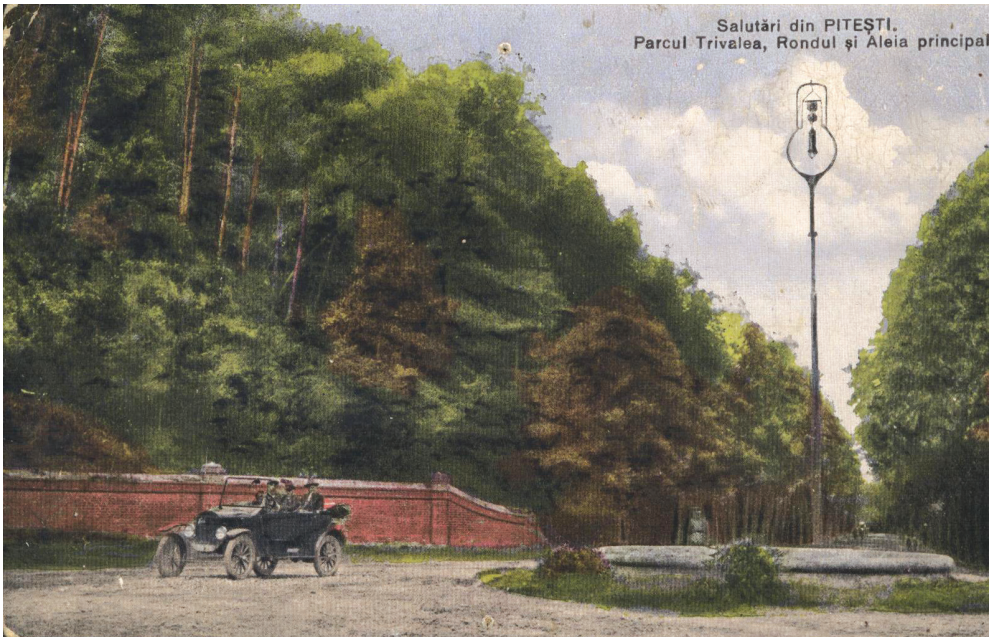

Fig. 1. Trivale Forest-Park

From this period there are planted various exotic species: *Juniperus horizontalis, Juniperus virginiana, Picea excelsa, Hybiscus syriacus, Picea pungens ssp. argentea, Chamaecyparis lawsoniana, Thuja orientalis, Thuja occidentalis, Acer*

negundo, Taxus baccata, Pawlownia imperialis, Liriodendron tulipifera etc. There are built pergolas, kiosks, bridges, beltways, a wooden pavilion, an artificial grot, a lake with a dam etc.

In 1939, upon the proposal of City Hall Technical Service to declare the Trivale Forest as a Natural Monument, the Ministry of Agriculture and Areas and the Commission of Natural Monuments could not comply with the request because the forest does not fulfil the criteria of a natural monument. It was recommended addressing to the Forestry Department from Ministry of Agriculture and Areas, for its further declaration as protection forest. As a result of this action, at 20 of December 1939 the City Hall asks the Forestry Department, to have "fulfilling the necessary forms to declare Trivale forest as forest protection, taking into account that this forest has an area of about 800 hectares, it is located in proximity of Pitesti, a part of it being used today as a place of recreation, under the name of Trivale Park".

Only in 1994, by Direction no. 18 of Arges County Council, Trivale forest was declared as a Forest reserve of local interest.

By Order no. 39/09.04.2010 of Arges Prefect, it was formed a working group whose membership included representatives of the following institutions: Arges Prefecture, County Council, City Hall, Regional Agency for Environmental Protection Pitesti, Environmental Guard, Forestry Division, The Commission of Romanian Academy for Protection of Natural Monuments, Romanian Ornithological Society, University of Pitesti, Foundation "Aspretele" Arges, Association "Parcul Lalelelor" etc. The aim of this commission was the documentation realisation of the proposal for the establishment of Forest-Park Trivale Natural Reserve. Documentation has been approved by the Romanian Academy, under the favourable approval no. 3378/09.02.2011. The Ministry of Environment and Forests, Ministry of Administration and Interior, Ministry of Regional Development and Tourism, Ministry of Justice and the delegated Minister for Administration have endorsed the substantiation study. Is expected the "Government Decision regarding the regime establishment as natural protected area and introduction in the category of Natural Reserve of Trivale Forest".

Results and discussions

From specialized literature, from the information collected from the County Museum and from the University of Pitesti herbaria, also taking into consideration my own research, it was achieved a floristic abstract that includes 764 taxa, distributed in 95 families.

The elements of mountain flora are kept especially on damp and shady valleys: *Athyrium filix-femina, Crocus vernus, Hepatica nobilis, Libanotis montana* etc.

Fig. 2. *Hepatica nobilis* in Trivale Forest

In forest clearings with the south exposure and especially on the areas without forest there are found the characteristic species of plain as: *Moenchia mantica, Trifolium incarnatum, Lathyrus nissolia, Lychnis coronaria* etc.

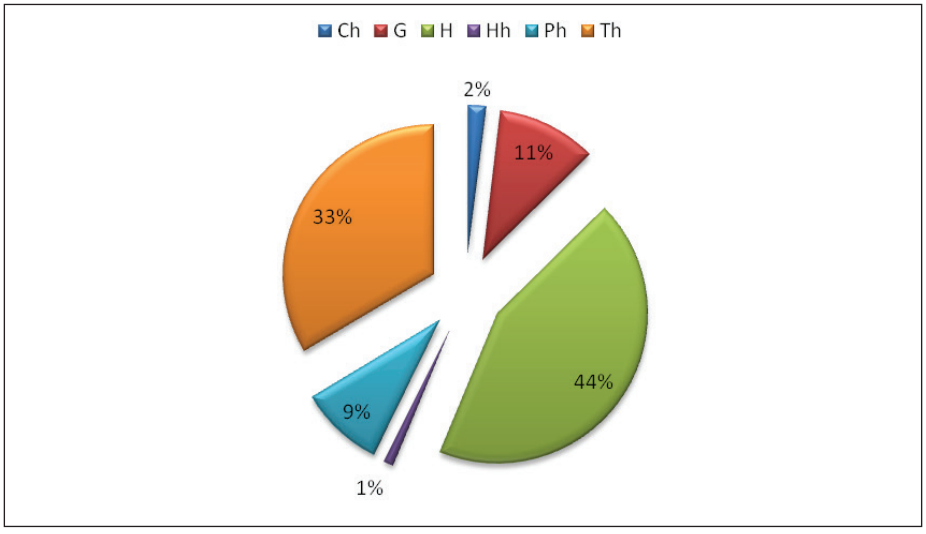

Fig. 3. Bioforms spectrum in Trivale Forest

Regarding bioforms, in Trivale Forest the prevailed species are hemicryptophytes (44%), followed by therophytes (33%), geophytes (11%), phanerophytes (9%), chamaephytes and helohydatophytes being represented in smaller percentages (2% respective 1%). The hemicryptophytes illustrates a moderate climate, the abundance of herbaceous formations being edified by perennial Poaceae species. In the case of their increasing percentage in a woody group, as Trivale

Forest, they will indicate a beginning of the subsidiary groups installation or an anthropic interference with variable intensity. The therophytes suggest a more or less arid climate and a high degree of flora and vegetation anthropization of Trivale Forest. Geophytes suggest the existence of short vegetation periods or some of stationary conditions which offer the ecologic optimum for a limited time, the cause of these situations being the low temperatures or prolonged periods of drought and dryness. Phanerophytes characterize the woody vegetation on Earth, being the best numerically represented in the rainforest and decreasing in diversity as it approaches the poles.

As a consequence of geographical position, in Trivale Forest the dominant phytoelements are the Eurasian ones (42.9%), followed by European (14.6%), Central-European (10.2%), Circumpolar (8.3%) and Cosmopolite (7.3%).

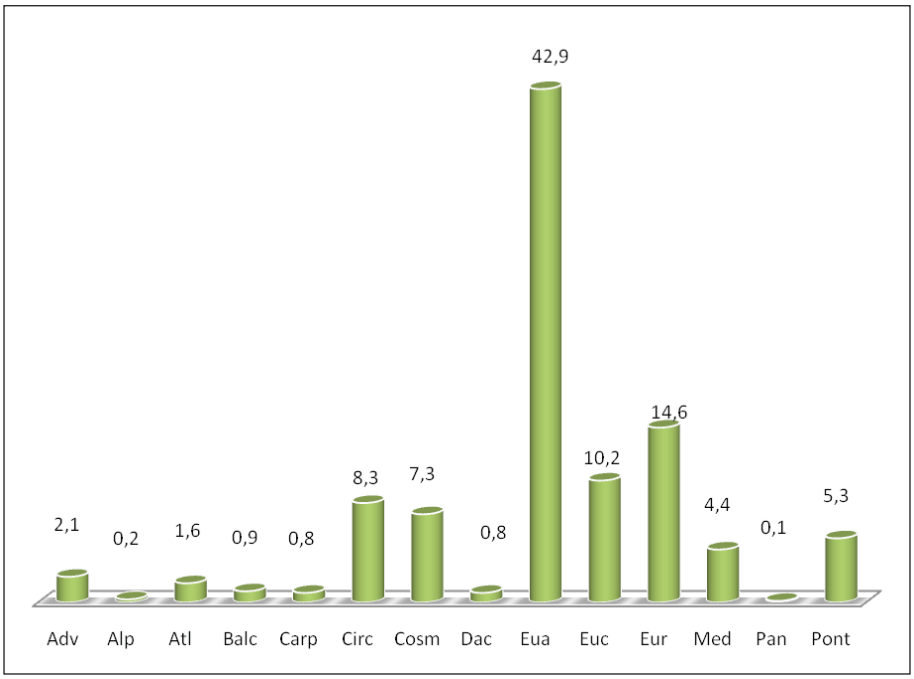

Fig. 4. Floristical elements in Trivale Forest

In the chormoflora of Trivale Forest there can be found phytogeographical elements with a particular scientific value as: Panonic: *Rorippa sylvestris* (L.) Besser ssp. *kerneri* (Menyh.) Soó, *Chamaecytisus hirsutus* (L.) Link ssp. *leucotrichus* (Schur) A. et D. Löve, *Euphorbia epythimoides* L.; Atlantic and Atlantico-Mediterranean: *Trifolium incarnatum* L., *Kohlrauschia prolifera* Kunth, *Lathyrus nissolia* L., *Ornithogalum pyrenaicum* L., *Genistella sagittalis* (L.) Gams; Pontic, Ponto-Anatolian, Ponto-Balcanic, Ponto-Mediterranean: *Geranium collinum* Stephan, *Galium octonarium* (Klokov) Pobed., *Quercus pedunculiflora* C. Koch, *Galium*

humifusum Bieb., *Sisymbrium orientale* L.; Mediterranean: *Lychnis coronaria* (L.) Desr., *Cruciata pedemontana* (Bellardi) Ehrend., *Moenchia mantica* (L.) Bartl., *Potentilla micrantha* Ramond ex DC; Balcanic**:** *Rorippa prolifera* (Heuffel) Neilr., *Quercus frainetto* Ten., *Digitalis lanata* Ehrh.

In Trivale Forest flora, meso-hygrophilic (U3–3.5=37.7%) and meso-xerophylic (U2–2.5=35.2%) species are dominant, which indicates that there are plants that grow in soil with moderate humidity. Regarding the temperature, the meso-termophilous species hold the biggest percentage (T3–3.5=65.9%) followed by subtermophilous species (T4–4.5=14.5%) and the eurithermal ones (T0=13.9%).

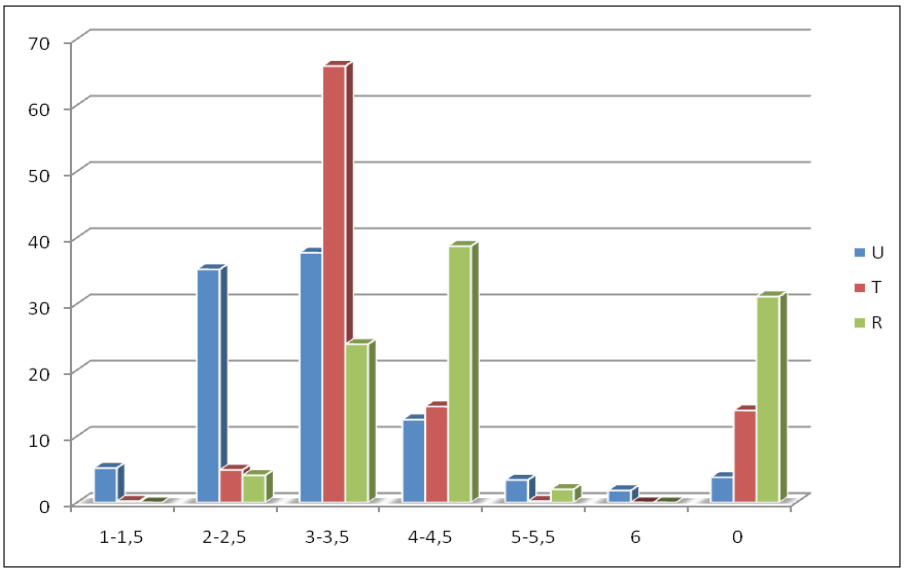

Fig. 5. Ecological parameters flora in the Trivale Forest

The prevalence of meso-termophilous species indicates the presence of plants that have medium requirements to heat, which are widespread in the cool and wet temperate climate, between the annual isotherms 4.5–7.5°C, mostly corresponding to beech sublevel, being located between 800–1300 m altitude. Subtermophilous are plants with medium to big demands to heat, spread between isotherms 7.5°C and 10.5°C; here dominates the continental climate of hills. The most species have preferences of neutral to slightly acid soils, this statement being proved by the high percentage of weak acid-neutrophylous plants (R4=38.7%).

To analyse the sozological categories were used the Red list of the superior plants in Romania elaborated by M. Oltean and col. (1994) and the List of threatened taxa at the global, European and national level, by Anca Sârbu and col., in 2007. In Trivale Forest are quoted by different authors, the following sozological categories: *Montia fontana* L.*,* (endangered taxon from Red List of Romania), *Moenchia mantica* (L.) Bartl., (vulnerable taxon from Red List of Romania),

Peucedanum rochelianum Heuff., (subendemic threatened taxon), *Valerianella costata* (Steven) Betcke, (vulnerable taxon from Red List of Romania), *Orchis morio* L. subsp. *morio,* (vulnerable taxon from Red List of Romania), *Alopecurus aequalis* Sobol., (endemic and threatened taxon), *Typha minima* Funck, (threatened taxon at European level) and *Ferulago confusa* Velen. (vulnerable taxon from Red List of Romania).

Fig. 6. Oaks in the Trivale Forest

On small valleys, *Quercus robur* is mixed with *Carpinus betulus, Tilia cordata, Cerasus avium, Acer platanoides, Acer pseudoplatanus*. Also on the shady and deeper valleys appear *Fagus sylvatica* individuals, being able to form pure beech at Aninoasa valley.

Floristic composition of the forest is not uniform throughout its extent. In the south-eastern part is located a plain land (the actual Trivale Forest), the arboretum consisting in species as *Quercus polycarpa, Q. petraea, Q. dalechampii*, with few individuals of *Q. frainetto* and *Q.* × *pseudodalechampii*. In the highest part of the territory, the forest is composed by the species: *Quercus petraea* and *Q. polycarpa*, so that in the southern part, in addition to a small number of *Quercus frainetto* to appear a few individuals of *Quercus cerris*.

Following the research, in Trivale Forest were observed 87 bird species (over

20% of Romania avifauna) belonging to 10 orders: Ciconiiformes (1 species), Falconiformes (5 species), Charadriiformes (1 species), Columbiformes (2 species), Cuculiformes (1 species), Strigiformes (1 species), Apodiformes (1 species), Coraciiformes (2 species), Piciformes (8 species) and Passeriformes (63 species).

According to the protection status at European level, 7 species (*Ciconia ciconia*, *Picus viridis*, *Lullula arborea*, *Phylloscopus sibilatrix*, *Phoenicurus phoenicurus*, *Carduelis cannabina* and *Miliaria calandra*, 8.05%) belong to SPEC 2 category (species concentrated in Europe but with unfavourable conservation status), 18 species (20.69%) belong to SPEC 3 category (species which are not concentrated in Europe and with no favourable conservation status), 26 species (29.88%) are Non SPEC E (species that are concentrated in Europe and have favourable conservation status) also 36 species (41.37%) are Non SPEC (species which are not concentrated in Europe and have a favourable conservation status).

As for the Birds Directive, 8 species (*Ciconia ciconia*, *Pernis apivorus*, *Picus canus*, *Dendrocopos syriacus*, *Dendrocopos medius*, *Lullula arborea*, *Lanius collurio* and *Ficedula albicollis*, 9.20%) are included in Annex I (A I, species that are subject to special conservation measures concerning their habitat, in order to ensure their survival and reproduction in their area of distribution) and 15 species (17.24%) are in Annex II/2 (A II/2, species that may be hunted only in the Member States which they are listed for) (source: R. Gava, Denisa Conete, A. Mestecăneanu).

Conclusions

Trivale Forest has way long to wait until it will be protected against abusive deforestation. If in the mass-media was announced that it's still a matter of days, a maximum of few weeks until Trivale Forest Park will be declared natural reservation, after the change of leadership of the Ministry of Environment, as a result of the investiture of another government, things got complicated. The documentation regarding this project seems to have "lost" and the procedures started over again. A perfect break to carry on with the unimpeded allotment and with the abusive deforestation.

Since 2010, when was formed the working group for documentation drafting, the years have passed and Trivale Forest, increasingly reduced by deforestation, is waiting for the achievement of this long expected goal!

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FRESHWATER HABITATS OF NATURAL PROTECTED AREA IN ROSCI0299 THE DANUBE AT GÂRLA MARE – MAGLAVIT

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FRESHWATER HABITATS OF NATURAL PROTECTED AREA IN ROSCI0299 THE DANUBE AT GÂRLA MARE – MAGLAVIT

Abstract: This study presents a comparative analysis of *Lemnetum minoris* Oberd. ex T. Müller et Görs 1960, *Hydrocharitetum morsus – ranae* van Langendonck 1935, *Salvinio – Spirodeletum* Slavnić 1956 associations, which have been identified in the Gârla Mare zone, and *Oenantho – Rorippetum* Lohmeyer 1950 association, identified in the Salcia zone. Also, study presents the measures for the protection and preservation of freshwater habitats in ROSCI0299 The Danube at Gârla Mare – Maglavit.
Keywords: freshwater habitats, ROSCI0299 The Danube at Gârla Mare – Maglavit.

Introduction

In the actual natural protected area ROSCI0299 The Danube at Gârla Mare – Maglavit, the Gârla Mare – Salcia wetlands were declared as a reservation protected at the county level by Decision of the Mehedinţi County Council no. 13/10.07.2000 on the addition of the Decision of the Mehedinţi County Council nr. 26/1994 on the protection of reservations and natural monuments in the Mehedinţi County. The zone between Gârla Mare and Maglavit has been declared as a community importance site based on the Order of the Minister for Environment and Forests no. 2387/29.09.2011 on the amendment of the Order of the Minister for Environment and Sustainable Development no. 1964/13.12.2007 on the establishment of the status of protected natural area of sites with community importance, as an integral part of the Natura 2000 European ecological network in Romania. The site ROSCI0299 The Danube at Gârla Mare – Maglavit includes a surface of 9422 hectares, integrated in the continental region from a bio-geographical point of view. The localities in Dolj occupying surfaces within the site are: Calafat (5%), Cetate

(18%), Maglavit (20%), and Pristol (2%), Gârla Mare (22%), Vrata (45%) and Salcia (25%) belong to the Mehedinți County (Study of the protected areas and wetlands along the Danube in Mehedinti County, 2016).

Results and discussion

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition – type vegetation

LEMNETEA de Bolós et Masclans 1955

Lemnetalia minoris de Bolós et Masclans 1955

Lemnion minoris de Bolós et Masclans 1955

Lemnetum minoris Oberd. ex T. Müller et Görs 1960

The association of duckweed (Lemna minor) has optimum in mountain boreal stagnant waters. The coenoses of this association have been identified in the Gârla Mare area. The association is characterized by a small number of species. Bioforms spectrum indicate the predominance helohydatophytes (55%) (Fig. 1). According to the main ecological indices, it appears that phytocoenosis are hydrophilic, predominantly micro-mesothermal and euriionic (Fig. 2). In terms of the number of chromosomes is observed predominance of polyploid species (63.63%), compared to the diploid species (36.36%) (Fig. 3). The diploids index (I.D. = 0.65) has subunitary values. The geoelements spectrum (Fig. 4) is dominated by Eurasian species (37%) and Cosmopolitan (36%) (Matacă, 2007).

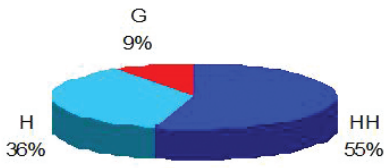

Fig. 1. Bioform spectrum of Lemnetum minoris association

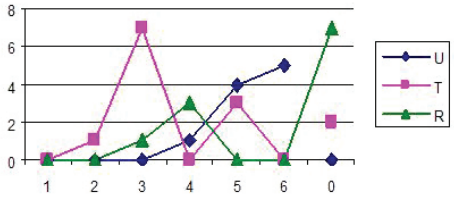

Fig. 2. Ecological indices of Lemnetum minoris association

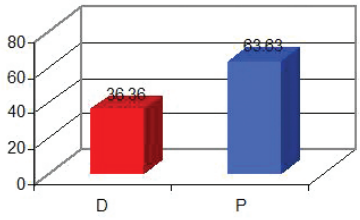

Fig. 3. Karyological spectrum of Lemnetum minoris association

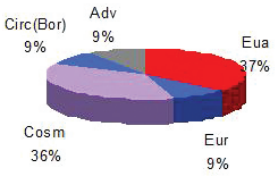

Fig. 4. Geoelements spectrum of Lemnetum minoris association

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition – type vegetation

LEMNETEA de Bolós et Masclans 1955
Hydrocharitetalia Rübel 1933
Hydrocharition Rübel 1933
Hydrocharitetum morsus-ranae van Langendonck 1935

Fragments of this association have been identified in the Gârla Mare. Bioforms spectrum (Fig. 5) indicate the predominance helohydatophytes, and according to the main ecological indices, the phytocoenosis are hydrophilic, micro-meso-thermal and euriionic (Fig. 6). Karyological spectrum (Fig. 7) indicate the higher frequency of polyploid species (76.92%) compared to diploid species (23.07%). The diploids index (I.D. = 0.41) has subunitary values. Cosmopolitan species (46%) and the Eurasian species (23%) represent the basic fund of the association (Fig. 8) (Matacă, 2007).

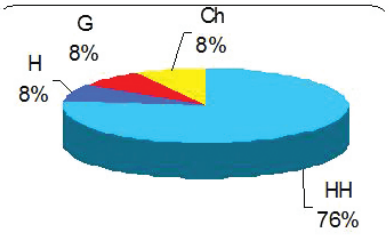

Fig. 5. Bioform spectrum of Hydrocharitetum morsus-ranae association

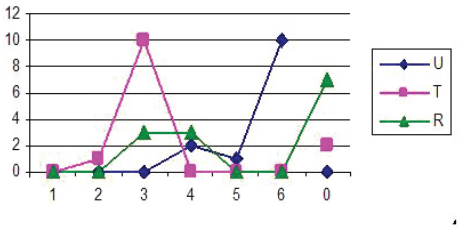

Fig. 6. Ecological indices of Hydrocharitetum morsus-ranae association

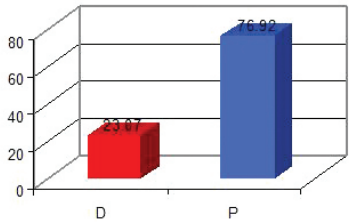

Fig. 7. Karyological spectrum of Hydrocharitetum morsus-ranae association

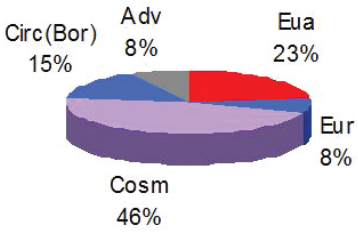

Fig. 8. Geoelements spectrum of Hydrocharitetum morsus-ranae association

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition – type vegetation

LEMNETEA de Bolós et Masclans 1955
Hydrocharitetalia Rübel 1933
Hydrocharition Rübel 1933
Salvinio-Spirodeletum Slavnić 1956

The association is not spread in Romania. From Gârla Mare territory were investigated 5 releve of the Salvinio-Spirodeletum Slavnić 1956 association. In composition of the association participate 100% helohydatophytes. According to the main ecological indices (Fig. 9), most species are hydrophilic, micro-mesothermal and euriionic. In the karyological spectrum (Fig. 10) is observed that polyploid species (75%) is predominance. The diploids index (I.D.) has value 0.52. Geoelements spectrum (Fig. 11) indicate a great participation of Eurasian species (49%), followed by the Cosmopolitan species (25%), Circumboreal species (13%) and Adventive species (13%) (Matacă, 2007).

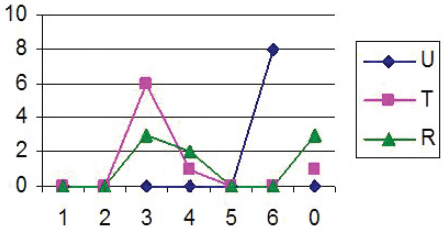

Fig. 9. Ecological indices of Salvinio-Spirodeletum association

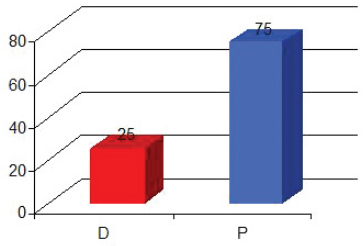

Fig. 10. Karyological spectrum of Salvinio-Spirodeletum association

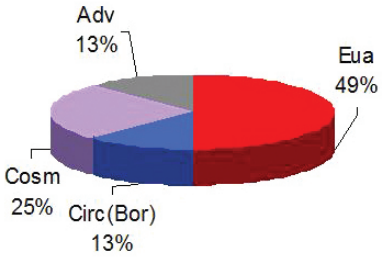

Fig. 11. Geoelements spectrum of Salvinio-Spirodeletum association

R5303 Danube communities with Oenanthe aquatica and Rorippa amphibia

PHRAGMITETEA Tx. et Prsg. 1942

Phragmitetalia Koch 1926

Phragmition Koch 1926

Oenantho – Rorippetum Lohmeyer 1950

Coenoses of this association is common in lowland areas (Cris Plain, inter – river Timis-Bega), Danube Delta and rarely in hilly areas. This association is develops in floodplains with eutrophic waters, sometimes poorly salinized (Coldea, 1997). The coenoses of this association were found in Salcia (Fig. 16, Table 1). The characteristic and dominant species are *Oenanthe aquatica* and *Rorippa*

amphibia. Among the species hygrophilic with high frequency, characteristic of the alliance and order, was identified *Schoenoplectus lacustris*, *Alisma plantago-aquatica*, *Sium latifolium*, *Eleocharis palustris*, which add *Polygonum amphibium*, *Lythrum salicaria*, *Lemna minor*. Bioforms spectrum (Fig. 12) indicates the predominance helohydatophytes (39%), followed by geophytes (21%) and hemicryptophytes (26%). According to the main ecological indices (Fig. 13), coenoses are predominance hydrophilic, micro-mesothermal and euriionic. The diploids index is subunitar (I.D. = 0.57), polyploid species are more common than diploid species (Fig. 14). Basic fund of the association is composed of Cosmopolitan and Circumboreal species (Fig. 15).

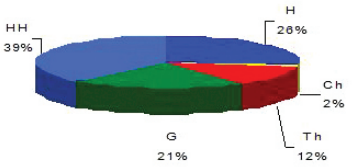

Fig. 12. Bioform spectrum of Oenantho - Rorippetum association

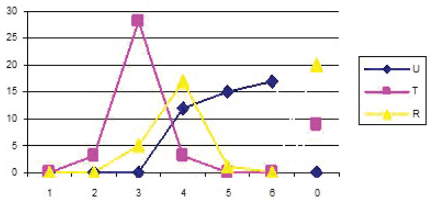

Fig. 13. Ecological indices of Oenantho - Rorippetum association

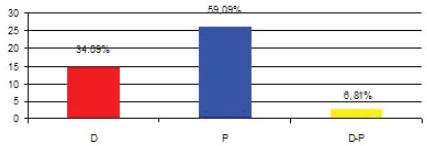

Fig. 14. Karyological spectrum of Oenantho - Rorippetum association

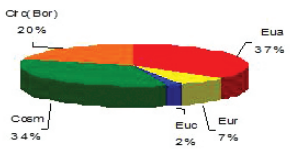

Fig. 15. Geoelements spectrum of Oenantho - Rorippetum association

Fig. 16. Oenantho – Rorippetum association (Salcia, 2016)

Table 1. Ass. *Oenantho – Rorippetum* Lohmeyer 1950

F.b.	E.f.	Cyt.	Releve Exposition Covering (%) Surface (m^2)	1 SW 60 30	2 SW 90 30	3 SW 100 40	4 SW 90 30	5 SW 70 30	K
HH	Eua	D	*Oenanthe aquatica*	3	4	4	4	4	V
HH	Eua (Med)	D-P	*Rorippa amphibia*	2	2	3	2	1	V
G-HH	Cosm	D	*Typha angustifolia*	+	+	-	-	+	III
HH-G	Cosm	P	*Bolboschoenus maritimus*	-	+	-	+	-	II
HH-G	Cosm	P	*Schoenoplectus lacustris*	-	+	+	-	-	II
HH-H	Circ (Bor)	P	*Glyceria maxima*	+	-	+	-	-	II
G-HH	Cosm	D	*Typha latifolia*	-	-	-	-	+	I
HH	Eua	D	*Sparganium erectum*	+	-	-	-	-	I
G (HH)	Circ (Bor)	D	*Thelipteris palustris*	+	-	-	-	-	I
			Phragmition et Phragmitetalia						
H	Circ (Bor)	D	*Galium palustre*	+	+	+	-	-	III
H-HH	Eua	D	*Lycopus europaeus*	-	+	+	-	-	II
HH	Cosm	D	*Alisma plantago-aquatica*	-	-	+	-	+	II
H-G	Circ (Bor)	P	*Stachys palustris*	-	+	-	+	-	II
G-HH	Cosm	P	*Eleocharis palustris*	+	-	-	-	+	II
HH	Cosm	P	*Phragmites australis*	-	-	-	-	+	I
H-HH	Eur	P	*Mentha aquatica*	+	-	-	-	-	I
G-HH	Eur	P	*Iris pseudacorus*	-	+	-	-	-	I
G-HH	Eua	P	*Carex riparia*	-	-	-	+	-	I
HH	Eua (Med)	D-P	*Butomus umbellatus*	-	-	-	-	+	I
HH	Euc	D	*Sparganium neglectum*	-	-	+	-	-	I
G-HH	Eua	P	*Carex acutiformis*	+	-	-	-	-	I
HH	Eua	D	*Sium latifolium*	-	+	-	-	-	I
HH-H	Eua	P	*Glyceria fluitans*	-	-	-	+	-	I
H	Circ (Bor)	P	*Scutellaria galericulata*	-	-	+	-	-	I
HH	Eua	D-P	*Cicuta virosa*	+	-	-	-	-	I
HH	Circ (Bor)	P	*Glyceria plicata*	-	-	-	-	+	I
			Variae Syntaxa						
HH	Cosm	P	*Lemna minor*	+	+	+	-	-	III
H-HH	Cosm	P	*Lythrum salicaria*	-	-	+	+	-	II
G (HH)	Cosm	P	*Polygonum amphibium*	-	-	+	+	-	II
HH	Cosm	P	*Lemna trisulca*	-	+	-	-	+	II
HH	Cosm	D	*Ceratophyllum demersum*	-	-	+	+	-	II
H-HH	Eua	P	*Lysimachia vulgaris*	+	-	-	-	-	I
Th	Eua	D	*Polygonum hydropiper*	-	-	+	-	-	I
Th	Cosm	D	*Polygonum lapathifolium*	-	+	-	-	-	I
HH	Eua (Med)	D	*Sagittaria sagittifolia*	-	+	-	-	-	I
H	Cosm	P	*Juncus effusus*	-	-	-	+	-	I
Ch	Eur	P	*Lysimachia nummularia*	-	-	+	-	-	I

H	Eua	P	*Epilobium parviflorum*	+	-	-	-	-	I
G	Circ (Bor)	P	*Equisetum palustre*	+	-	-	-	-	I
Th	Circ (Bor)	P	*Ranunculus sceleratus*	-	-	+	-	-	I
H-HH	Eua (Cont)	D	*Euphorbia palustris*	-	-	-	-	+	I
Th	Cosm	P	*Polygonum persicaria*	-	+	-	-	-	I
Th (TH)	Eua	P	*Rumex palustris*	-	-	-	-	+	I

Place and date of releves: 1, 2, 3, 4, 5 – Salcia (18.05.2016).

Conclusions

In coenoses of the 4 association, predominate helohydatophytes, which indicates a fairly uniform aquatic environment. There is a modest participation of other types of bioforms. Generally, the PRESENCE of hemicryptophytes suggests a thermal or hydric deficit, coenoses analysed recording a hydric deficit in summer droughty periods. Even if it notices a low percentage of therophytes, this fact indicates a moderately stage of anthropization.

Uniformity of the phytocoenoses of associations studied with environmental requirements is attested by almost identical values UTR. Thus, predominate hydrophilic species, micro-mesothermal species and euriionic species.

The predominance of Cosmopolitan and Circumboreal species directly correlates with the high frequency of polyploid species present in phytocoenosis of associations analysed, characterized by a greater capacity of competition as against the diploid species, as well as with subunitary value of index of polyploidy. Regardless of altitude, vegetable groups with structures influenced by strong pressure of perturbation factors, have a lower diploid index than those who have evolved into more stable ecological conditions.

The measures for the protection and preservation of freshwater habitats

The management of ROSCI0299 The Danube at Gârla Mare – Maglavit site should consider the preservation of biodiversity, as it has been maintained so far, in harmony with the traditional economic activities of human communities, as well as their sustainable development, without endangering the preservation status of these natural areas. Drainage, operation of sand and gravel dunes, chemical treatments used in agriculture is forbidden in the areas of fresh water habitats, which are vulnerable in the current climate conditions. Seasonal water courses should be monitored and grazing should be limited. The establishment of these measures for the protection and preservation of habitats in ROSCI0299 The Danube at Gârla Mare – Maglavit have favourable effects on the preservation of species with a community importance (Study of the protected areas and wetlands along the Danube in Mehedinti County, 2016).

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NEW CONTRIBUTIONS TO THE STUDY OF BEETLES FAUNA IN BOTANICAL GARDEN OF THE NATIONAL MUSEUM OF ETHNOGRAPHY AND NATURAL HISTORY IN CHISINAU

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NEW CONTRIBUTION TO THE STUDY OF BEETLES FAUNA IN BOTANICAL GARDEN OF THE NATIONAL MUSEUM OF ETHNOGRAPHY AND NATURAL HISTORY IN CHIŞINĂU

Abstract: This paper describes species of beetles in the Botanical Garden of the National Museum of Ethnography and Natural History in Chişinău. In total, 33 species of beetles belonging to 24 genera and 8 families have been identified. The synecological analysis, trophic spectrum and geographical distribution of species reported are also presented.
Keywords: Coleoptera, fauna, Botanical Garden, National Museum of Ethnography and Natural History.

Introduction

Beetles are among the most numerous and widespread insects in the world. With a high ecological plasticity, they can be found in all ecosystems. The Botanical Garden of the National Museum of Ethnography and Natural History (NMENH) which holds areas with forest, grassy, rocky, aquatic and wetland vegetation is a perfect habitat for fauna of beetles. The forest vegetation consists of 26 species of trees, including species *Quercus robur, Q. petrea, Fagus silvatica,* and *Populus alba* that are relevant for the Moldova's flora; 23 species of shrubs and about 80 species of herbaceous plants (Mihailov et al., 2010).

The Botanical Garden of the NMENH was founded in the early twentieth century, on the site of the garden-park that existed on this territory since the mid-nineteenth century (Cojuhari, 2007). Under the botanical aspect, there have been performed many research on the floristic composition and monitoring of

its status (Cojuhari, 2007; Pană, Cojuhari, 2014). As for the fauna, especially the beetles, the information are quite fragmented, with some references in the works of authors Ruscinsky (Ruscinsky, 1933–1934) and Mihailov (Mihailov et al., 2010). The present research aimed to identify the species diversity of beetles and their role within this habitat.

Materials and methods

Entomological materials were collected in the Botanical Garden of the National Museum of Ethnography and Natural History, which has an area of 0.5 hectares and a rich flora (Postolache, Cojuhari, 2008). In May-September 2012, nine Barber traps were installed, which worked continuously throughout this period. In whole, 90 samples were taken. Extraction was done once every 10–14 days. Also, there have been made direct collections of beetles in the soil, on grass plants, as well as on the trees and shrubs. The materials were determined using the binocular magnifier MBS 10. For identifying the species the recommended guide was used [Bei-Bienko, G.Y. (Ed.) 1965].

Results and discussions

As a result of research conducted in the Botanical Garden of the National Museum of Ethnography and Natural History, there have been identified 33 species of beetles belonging to 24 genera and 8 families (Table 1). The largest was found to be the Carabidae family with 10 species, followed by Scarabaeidae and Chrisomelidae families with 5 species each, Silphidae and Coccinellidae with 4 species each; Cerambycidae and Tenebrionidae families were represented by two species each, and the Meloidae family – just by a single species. Also, it has been performed the synecological analysis and determined the trophic affiliation and geographical distribution of species found in Barber trap and identified 21 species of beetles in 14 genera and 4 families (Carabidae, Scarabaeidae, Silphidae and Tenebrionidae) (Table 2).

Table 1: Ecological and fauna characteristics of beetles identified in the territory of the Botanical Garden of the National Museum of Ethnography and Natural History (Chișinău, 2012)

No	Taxon	Trophic group	Zoo-geographical distribution	Specimens collected
Family Carabidae				
1	*Amara familiaris* (Duftschmid 1812)	Phytophagous	Transpalearctical	1
2	*Amara ovata* (Fabricius, 1792)	Phytophagous	Transpalearctical	3
3	*Carabus coriaceus* Linnaeus, 1758	Zoophagous	European	1
4	*Carabus intricatus* Linnaeus, 1761	Zoophagous	European	1

No	Taxon	Trophic group	Zoo-geographical distribution	Specimens collected
5	*Cychrus caraboides* (Linnaeus 1758)	Zoophagous	European	1
6	*Harpalus latus* (Linnaeus, 1758)	Phytophagous	Transpalearctical	4
7	*Harpalus rubripes* (Duftschmid, 1812)	Phytophagous	Westpalearctical	1
8	*Harpalus rufipes* (De Geer, 1774)	Phytophagous	Transpalearctical	5
9	*Lebia humeralis* Dejean, 1825	Zoophagous	Euro-Mediterranean	2
10	*Ophonus rufibarbis* (Fabricius, 1792)	Phytophagous	Transpalearctical	2
Family Silphidae				
11	*Necrodes littoralis* (Linnaeus, 1758)	Necrophagous	Eurasian	6
12	*Oiceoptoma thoracicum* (Linnaeus, 1758)	Necrophagous	Holarctic	5
13	*Silpha carinata* Herbst, 1783	Necrophagous	Euro-Siberian	7
14	*Silpha obscura* Linnaeus, 1758	Necrophagous	Euro-Siberian	4
Family Scarabaeidae				
15	*Cetonia aurata* (Linnaeus, 1761)	Phytophagous	Transpalearctical	2
16	*Onthophagus coenobita* (Hbst., 1783)	Coprophagous	Transpalearctical	9
17	*Onthophagus fracticornis* (Preyssler, 1790)	Coprophagous	Transpalearctical	12
18	*Onthophagus verticicornis* (Laich., 1781)	Coprophagous	Euro-Caucasian	13
19	*Oryctes nasicornis* (Linnaeus, 1758)	Phytophagous	Transpalearctical	1
Family Chrysomelidae				
20	*Chrysolina fastuosa* (Scopoli, 1763)	Phytophagous	Eurasian	3
21	*Cryptocephalus sericeus* (Linnaeus, 1758)	Phytophagous	Eurasian	1
22	*Gastrophysa viridula* (Degeer, 1775)	Phytophagous	European	2
23	*Gastrophysa polygoni* (Linnaeus, 1758)	Phytophagous	Holarctic	1
24	*Galeruca tanaceti* (Linnaeus, 1758)	Phytophagous	Palearctic	2
Family Coccinellidae				
25	*Adalia bipunctata* (Linnaeus, 1758)	Zoophagous	Holarctic	1
26	*Adalia decempunctata* (Linnaeus, 1758)	Zoophagous	Palearctic	1
27	*Coccinella septempunctata* Linnaeus, 1758	Zoophagous	Palearctic	2
28	*Harmonia axyridis* (Pallas, 1773)	Zoophagous	Palearctic	2
Family Cerambycidae				
29	*Cerambyx scopolii* Füssli, 1775	Phytophagous	European	1
30	*Dorcadion pedestre* (Poda, 1761)	Phytophagous	European	1
Family Tenebrionidae				
31	*Gonocephalum pusillum* (Fabricius, 1791)	Phytophagous	Mediterranean	2
32	*Opatrum sabulosum* (Linnaeus, 1761)	Phytophagous	Eurasian	6
Family Meloidae				
33	*Lytta vesicatoria* Linnaeus, 1758	Phytophagous	European	2

Table 2: Distribution of beetles investigated by families, genera, species and collection methods

Families	Genera	Species	Barber Trap	Direct collection
Carabidae	10	6	+	-
Scarabaeidae	5	3	+	-

Families	Genera	Species	Barber Trap	Direct collection
Silphidae	4	3	+	-
Tenebrionidae	2	2	+	-
Chrysomelidae	5	4	-	+
Coccinellidae	4	3	-	+
Cerambycidae	2	2	-	+
Meloidae	1	1	-	+

The analysis of ecological indices of beetles collected in the Barber trap (Table 2) showed the following: eudominant species (D5) – 3, dominant species (D4) – 5, subdominant species (D2)–7, and recedent species (D2) – 6. According to the constancy index (C), all species collected in the Barber trap were accidental (C1). After the ecological significance index (W) there were recorded 15 accompanying species (W2) and 6 accidental species (W1).

The results obtained demonstrate that the fauna of edaphical beetles in the Botanical Garden of NMENH is quite poor compared to some natural ecosystems. This is explained by hygiene works undertaken in the Botanical Garden such as extraction of foliage and dead trees that are necessary to saprophagous species, which are food for other groups of beetles. In the Botanical Garden, a rare and threatened species of beetles, *Oryctes nasicornis,* has been identified, which is included in the Red Book of Moldova (Red Book, ed. III, 2015).

Also, some species of beetles were collected manually. These belong to Chrisomelidae, Coccinellidae, Cerambycidae and Meloidae families (Table 1).

There have been identified five species of the family Chrisomelidae, belonging to four genera. The species *Cryptocephalus sericeus* (Linnaeus, 1758) was collected on the plant *Taraxacum officinale* Weber ex Wiggers; the *Chrysolina fastuosa* (Scopoli, 1763) – on the plant *Leonurus cardiaca* L.; the *Gastrophysa polygoni* (Linnaeus, 1758) – on the plant *Polygonum aviculare* L.; the *G. viridula* (Degeer, 1775) – on plants of the genus *Rumex*. The species *Galeruca tanaceti* (Linnaeus, 1758) has been collected on the plant *Stellaria media* (L.) Vill (Gavrilović, Ćurčić, 2013).

There have been identified four species of three genera belonging to the Coccinellidae family, collected on different inflorescences of plants, particularly of those affected by aphids: *Harmonia axyridis* (Pallas, 1773) (Havelka et al., 2015); *Coccinella septempunctata* Linnaeus, 1758; *Adalia bipunctata* (Linnaeus, 1758) and *A. decempunctata* (Linnaeus, 1758) (Serafim, 1997).

Two species of the Cerambycidae family have been identified: *Cerambyx scopolii* Füssli, 1775 and *Dorcadion pedestre* (Poda, 1761), both being phytophagous species.

The Meloidae family was represented by a single species – *Lytta vesicatoria* Linnaeus, 1758, collected on the ash.

According to specialized sources, the existence of phytophagous beetles of Cerambycidae, Chrisomelidae and Meloidae families in the Botanical Garden of

NMENH was reported earlier, but without specifying the species (Mihailov et al., 2010).

As for the trophic, one can mention that the fauna of beetles, found in the Botanical Garden of NMENH, was composed of four trophic groups: 55% are phytophagous species, followed by zoophagous with 24%, necrophagous with 12%, and only 9% refers to coprophagia (Fig. 1).

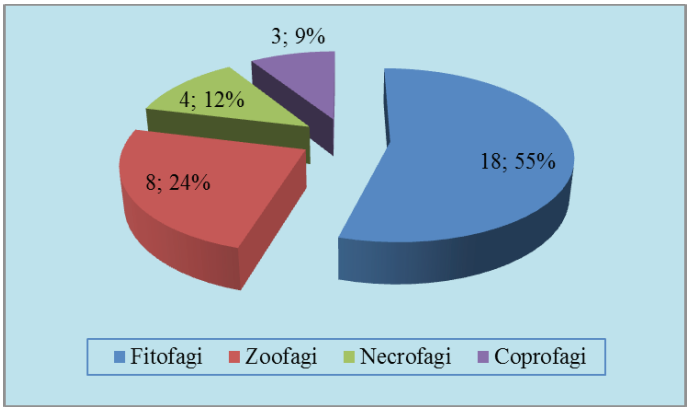

Fig. 1. The trophic spectrum of beetles found in the Botanical Garden of NMENH

According to the literature on geographic spread, it was found that beetles fauna identified in the Botanical Garden of NMENH belong to 10 zoogeographic areas: Trans-Palearctic, European, Eurasian Palearctic, Holarctic, Euro-Siberian, Euro-Caucasian, Euro-Mediterranean, Mediterranean and West-Palearctic species (Fig. 2).

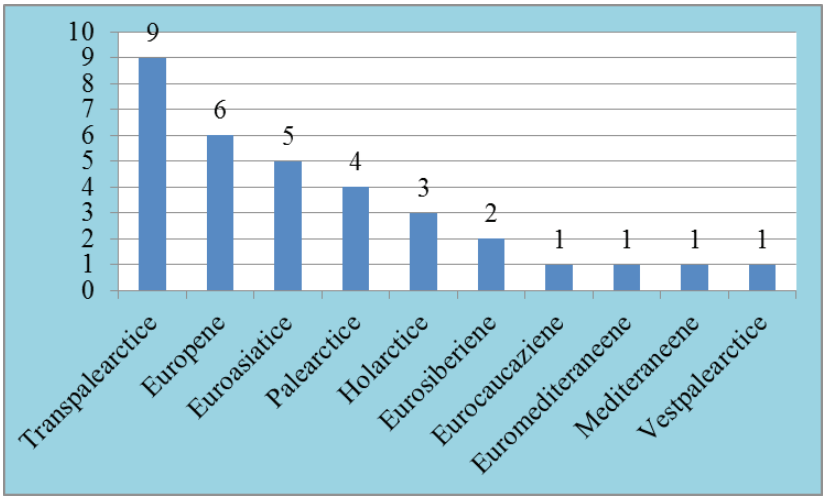

Fig. 2. The geographical spread of the beetles found in the Botanical Garden of NMENH

Conclusions

The fauna of beetles found in the Botanical Garden of the National Museum of Ethnography and Natural History includes 33 species belonging to 24 genera and 8 families. The largest turned out to be the Carabidae family with 10 species, followed by Scarabaeidae and Chrisomelidae families with 5 species each, Silphidae and Coccinellidae with 4 species each, the Cerambycidae and Tenebrionidae families were represented by 2 species each, and the family Meloidae – only by a single species. The *Oryctes nasicornis* species is a vulnerable one included in the third edition of the Red Book of Moldova. The most abundant identified species are *Onthophagus verticicornis* and *Onthophagus fracticornis.* This is due to the fact that in some Barber traps mice were caught, which upon decomposition, have attracted these species. This is due to the fact that in some Barber traps mice got attracted to the decomposition of these species. More than half of all collected species were phytophagous ones, followed by zoophagous species. After the area of spreading, most species were transpalearctical, followed by European and Eurasian. Certainly the beetle fauna populating the Botanical Garden of the National Museum of Ethnography and Natural History is larger and further research will help to broaden this list.

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THE HARPALINI (COLEOPTERA: CARABIDAE) OF JAMAICA BAY WILDLIFE REFUGE (NEW YORK, USA)

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THE HARPALINI (COLEOPTERA: CARABIDAE) OF JAMAICA BAY WILDLIFE REFUGE (NEW YORK, USA)

Abstract: The present paper presents the first comprehensive study of the the Harpalini (Coleoptera: Carabidae) of Jamaica Bay Wildlife Refuge (JBWR) (Gateway National Recreation Area). From this refuge were recorded 17 species, belonging to genera *Amphasia* Newman (1 species), *Anisodactylus* Dejean (2 species), *Stenolophus* Dejean (4 species), *Acupalpus* Latreille (1 species), *Selenophorus* Dejean (4 species), *Harpalus* Latreille (5 species), 16 of which are native species, and one adventive species *Harpalus rubripes* (Duftschmid), introduced from Palaearctic. Were obtained original data about the biology and reproduction period of the *Anisodactylus harrisi* LeConte, *Stenolophus ochropezus* (Say), *Stenolophus comma* (Fabricius).
Keywords: Carabidae, Harpalini, taxonomy, biology, ecology.

Introduction

The Ground Beetles (Carabidae), with very attractive beetles, is one of the largest family of the order Coleoptera, with about 40,000 species presently known worldwide (Kryzhanovskij, 1983; Kryzhanovskij et al., 1995; Downie and Arnett Jr., 1996; Arnett Jr. and Thomas, 2000). Most species are black, but some are iridescent. Many of species are large in size, but the variation, even within a single species, is great. Both adults and larvae of ground-beetles are, with rare exceptions, predators. In general, these beetles are terrestrial and they are very abundant in moist areas. They hunt at night and hide under rocks, logs, and other ground cover during the day. The ground beetles are consumers at the highest level of the food pyramid of the small soil animals. Therefore they are important for the flow of energy and nutrients. The Carabidae Family was selected to analyze above

problems since it is one of the most effective bio-indicator taxa belonging to the soil fauna. Previous research carried out in different areas from Europe suggested that the main individual biomass (MIS) of ground beetles could be used as a suitable measure to assess the environment stage. Many ground beetles are stenoecious and their mobility enables them to respond quickly to environmental modifications. Species like this are important bioindicators with a high indicator value (Thiele, 1977; Sharova, 1981). Small species are able to fly and move quickly so that they are often pioneers of instable habitats. Such sites are lowland floodplains, which are flooded from time to time. Species that cannot fly, mostly large beetles, are permanent residents. Carabid beetles is the group of insects which is successfully monitored in some European countries by researchers and by voluntary organizations. In the JBWR the insects has been poorly investigated till now, so, generally there is little information and literature on arthropods of this area, about all insects, ground beetles (Carabidae) inclusive. In JBWR were collected 100 carabids species, 17% of wich (of the total catch) constituted species of the tribe Harpalini (Neculiseanu, 2011, 2013a, 2013b, 2013c, 2016). From 17 species of this tribe recorded in JBWR, 16 are native species, which are well known in the North America and one species is adventive – Harpalus *rubripes* (Duftschmid) introduced from Palaearctic (Downie and Arnett Jr., 1996). This adventive species is known in North America from Connecticut, New Hampshire, Rhode Island, and by author were first recorded for New York. In this work we were presented the Harpalini fauna and describe in detail the biology of some species: oviposition periods, fecundity, the development period from eggs to adults, adult longevity, duration of each immature stage (egg-, larval-, pupal- stages) etc. Behavior observation and ecological data as feeding, cannibalism, predation were also describe for some species.

Material and methods

The studies were carried out in the Jamaica Bay Wildlife Refuge (JBWR) which is located in Queens, within the limits of New York City (Fig. 1). JBWR is one of the most important urban wildlife refuge in the United States, and is the largest bird sanctuary in the northeastern United States. Considered nationally and internationally area this refuge also is renowned as a prime birding spot where thousands of water, land and shorebirds stop during migration.

The Jamaica Bay Wildlife Refuge was initially “created” and managed by the New York City Department of Parks and Recreation. In 1951, the landscape of the Wildlife Refuge underwent a major change when then Park Commissioner Robert Moses ordered the creation of two large fresh water ponds, East Pond (100 acres) and West Pond (45 acres), which are still major features of the park today. In 1953 Park Department employee Herbert Johnson was transferred to the site and became the first refuge manager. To provide year-round food and shelter, under

his capable supervision and dedication, were planted trees, shrubs and grasses and thus, the barren landscape was transformed into a paradise for birds and other wildlife. In 1972, the city transferred ownership of the Wildlife Refuge to the National Park Service, and the site became part of Gateway National Recreation Area. Encompassing 9,155 acres (20 square miles), it is comprised of diverse habitats including open fields, shrub thickets and developing woodlands, wet meadows and salt marsh, several fresh and brackish water ponds and an open expance of bay and islands. The refuge was managed to provide a variety of habitats for a wide variety of marine and terrestrial plants and animals. The refuge is also productive for the now rare native flora and fauna of the coastal areas. More than 325 species of birds have been recorded here during the last 25 years. Some authors showed that Jamaica Bay Wildlife Refuge, the only wildlife refuge in the National Park System, is also home to an impressive array of native vertebrates. Many reptiles and amphibians call the park home. Mammals also prosper here, with evenings the best time to observe raccoons, opossums, and muskrats on their nightly

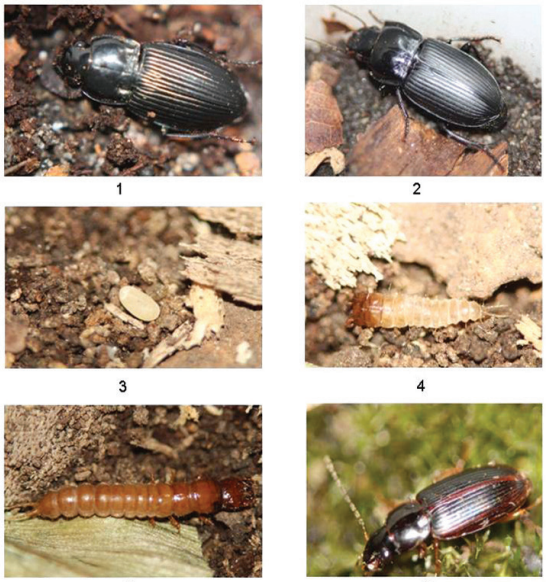
Fig. 1. The Jamaica Bay Wildlife Refuge (JBWR) (Gateway National Recreation Area)

forays (Cook & Pinnock, 1989). In spring, tree frogs such as Spring Peepers and Gray Tree Frogs, breed in shallow pools, while snakes such as the Black Racer, Garter Snake, and Brown Snake hunt the park woodlands. In refuge there is one of the largest populations of horseshoe crabs in the Northeast. A total of 81 fish species were recorded in Jamaica Bay. More than 60 species of butterflies (Lepidoptera, Insecta), belong to the families Papilionidae, Pieridae, Lycaenidae, Libytheidae, Nymphalidae, Satyridae, Danaidae, Hesperiidae, restricted to one or more habitat types have been observed by researchers in this refuge (Ingraham et al., 1989).The research was effectuated in variety types of habitats and in their microhabitats in the vegetative season of 2008–2009. During field work were used pitfall traps, consists of plastic jars (08 cm diameter by 10 cm deep) and some pitfall traps constructed by author, which were buried in the ground even with the soil surface and filled with a solution of white vinegar (100 ml. in each trap). These traps were installed in the spring, summer and autumn in wet and dry habitats and along the border of standing water. Beetles also were collected by sifter and by hand from a variety of habitats. Some adults and larvae come to bait, other were hand captured from mushrooms, margins of ponds, in leaf-litter, under stones and logs, under back, on and in the soil and sandy. Immature stages of some species were collected from the field, while their eggs were obtained in the laboratory from field collected adults. Some species taken at light. In order to study their behavior, life cycle and type of reproduction many species were grown in the laboratory (pair beetles). The adults and immature stages (larvae, pupae) collected in the field has been maintained in the containers and glasses with different diameter and deep with the soil from their habitats. The reproduction and life cycle for many species were studied at temperature 25±3°C under laboratory condition. Classification of the beetles is made after Lawrence and Newton (1995) and American Beetles (Arnett Jr. & Thomas (2000). The scientific works of Noonan (1991), Downie and Arnett Jr. (1996), Bousquet (2010) and Nomina Insecta Nearctica (1996) were used as the primary key to identify the majority of species. The following abbreviations are used in the text of this work: JBWR (Jamaica Bay Wildlife Refuge), LI (first instar), L2 (second instar), L3 (third instar). The Microscope MBS–9 (LOMO) was used for identification of species and separation by sex.

Results and discussions

In this study we identified the diversity and natural history of the beetles Harpalini (Coleoptera, Carabidae) of the Jamaica Bay Wildlife Refuge. In the research periods in JBWR were collected 17 species of the tribe Harpalini, which belong to 6 genera: *Amphasia*, *Anisodactylus*, *Stenolophus*, *Acupalpus*, *Selenophorus*, *Harpalus.* Captured beetles of the genus *Harpalus* were the most abundant, with a total of 5 species*: Harpalus pensylvanica* (DeGeer), *Harpalus reversus* Casey*, Harpalus rubripes* Duftschmid*, Harpalus rufipes* (DeGeer), *Harpalus solitaries* Dejean. The genus

Stenolophus include 4 species *Stenolophus comma* Fabricius, *Stenolophus conjuctus* (Say), *Stenolophus fuscatus* Dejean, *Stenolophus ochropezus* Say. *Genus Selenophorus* also include 4 species *Selenophorus ellipticus* Dejean, *Selenophorus granaries* Dejean, *Selenophorus opalinus* LeConte, *Selenophorus planipennis* LeConte. The genus *Anisodactylus* is represented by the species *Anisodactylus harrisi* LeConte and *Anisodactylus melanopus* Haldeman, the genus *Amphasia* by species *Amphasia interstitialis* (Say), and the genus *Acupalpus* by species *Acupalpus partiarius* (Say). Were obtained original data about the natural history of Harpalini and were describe the biology of some species: mating, oviposition periods, fecundity of female, the development period from eggs to adults, adult longevity, duration of each immature stage (egg-, larval-, pupal- stages), duration of the entire life cycle, voltinism etc. aspects of feeding and behavior of the adults and of instars larvae L1-L3.



1. *Anisodactylus melanopus* (13-14 mm) has the following distinctive sign: body black, clypeus with 2 setigerous puntures on each side, antennomere 1 rufous, palpi infuscated, hind angles of pronotum angulate, elytra shiny, iridescent, elongated hind tarsi. The adults were collected in pitfall traps, and under stones. **2. *Anisodactylus harrisi*** (10-13 mm) Distinguishing characters: black, antennomere 1 pale, pronotum with strong lateral derpression much widened at base. This is univoltine, spring-summer breeder species, overwinteres as adult. Development from egg to adult generally takes 30 to 39 ds. Female lay the eggs in the soil, separately **3.** Eggs are oval, their length is 2.0-2.2 mm; the width is 1.0-1.2 mm. Duration of egg stage is 4 to 7 ds. The total fecundity of female is 50 to 55 eggs. **4.** The first larvae L1 observed in Mid of May, their length is 4.7-5.2 mm. **5.** The length of third instar before pupation is 15.5-15.7 mm. The larval stage lasted 20 to 24 ds. The larval stage duration can last to 45 to 50 ds if was not feeding the last instars and some larvae were unable to pupate. Cannibalism frequently occurred for first instars. The pupal stage lasted 6 to 8 ds. It was taken near water under fallen trees. **6. *Stenolophus ochropezus*** (5.0-7.0 mm) Beetles of this species have two series of pronotum: pronotum entirely rufous or dark pronotum; beetle can be recognized by almost truncate front angles of pronotum, strongly iridescent elytra with sides rufotestaceous, paler epipleural and testaceous legs. This is a monovoltine, spring-summer breeder species. Winter is spent in the adult stage and development is usually complete in one year. Overwintered adults emerge from hibernation in early April. Copulation observed in May month at night. Duration of copulation 10 to 15 min. Eggs is laid singly in the soil on different deeph. The duration of the egg stage is 4 to 6 ds.

Fig. 1.

1

2

3

4

5

6

S. ochropezus (continued) Larvae of this species are usually active predators like the adults. Both larvae and adults eat other insects. **1.** This photo shows the first instar L1; body is cylindrical, head and thorax light brown, abdomen segments vary in color. The length of this instar on 2-3 ds is 3.0-3.3 mm, width of head capsule is 0.5-0.6 mm. **2.-3.** The second instar L2 makes galleries in the soil; its head and thorax have much darker color than L1. Abdomen varies in color from a milky white to a dirty brown. The length of L2 on 8-9 ds is 5.6-6.4 mm, width of head capsule 0,9-1.0 mm. **4.** This pictures shows the L3 near its gallery. The length of L3 on 13-14 ds is 9.0-9.4 mm; width of head capsule is 1.1-1.3 mm **5.** L3 before pupation has head and thorax dark brownish-rufous, tergal sclerites of abdomen are dirty-brown. Cannibalism is observed for second and third instars. Usually the duration of the total larval stage constitutes 14 to17 ds, but if larvae in captivity have not sufficiently feeding this stage can be longer from a few ds to two weeks. **6.** Pupation usually occurs in a cavity in the earth. The color of emerging pupa is white. The pupal stage lasted 5 to 7 ds. The length of pupa - 4.4-4.7 mm its width 1.4-1.7 mm.

Fig. 2.

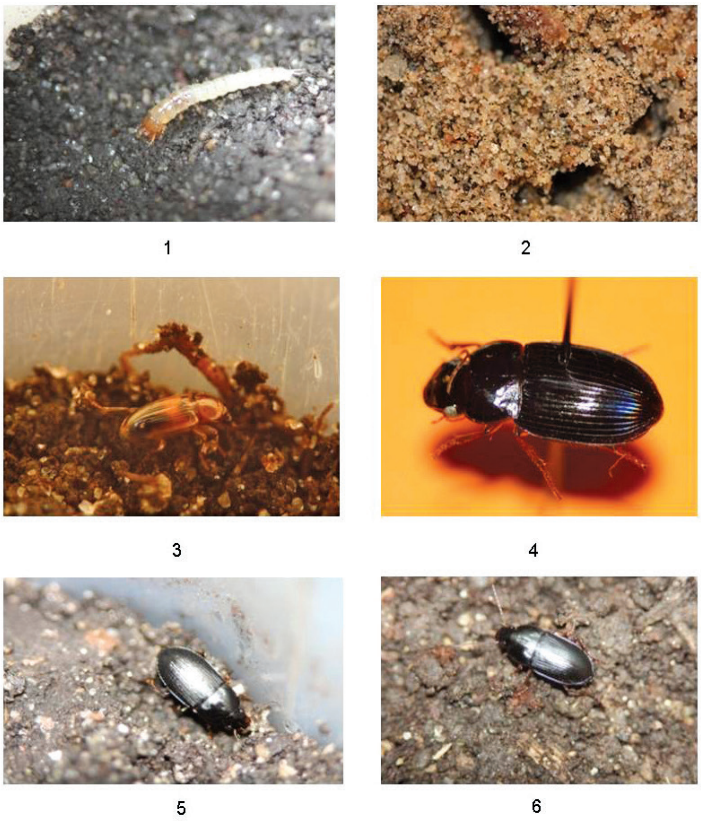
1 2

3 4

5 6

S. ochropezus* (continued) 1.** New adults usually emerged from June to August. Color of body was generally white to yellowish, head and pronotum yellow to brown. The adults and larvae live along the edge of bodies of water, under stones, bark, logs, and other debris laying on the ground. Both adults and larvae are predators, feeding on insects and other arthropods. The old beetles sometimes attac other species of ground beetles. **2.** This photo represent an attak of ***S. ochropezus on ***Bembidion contractum*** Say. Old overwintered adults usually die in the August - September. This native to North America species is known from North, Northeastern, Eastern, and Western North America. We collected them along the edge of water and by pitfall traps; some specimens come to light. **3.** The species ***Stenolophus fuscatus*** (4.8-5.2 mm) was taken at light in early August. Distinguishing characters of adult: pronotum rufotestaceous with dark central cloud; elytra darker at apex, hind tarsomere 1 without carina. **4.** This photo shows the species ***Stenolophus conjunctus*** (3.2-4.3 mm). Characteristic signs: pronotum paler than head, rufous; elytra with interval 1, sides and epipleura more or less paler; antennomeres 3-11 infuscated. Adults and larvae prefer open, dry habitats with sparse vegetation. Species overwintering as adult, beetles hibernate in a variety of habitats. Adults were collected by pitfall traps in dry habitats toward the end of May. **5.** This ***Stenolophus*** belongs to species ***S. comma*** (5.3-7.7 mm) and can be recognized by presence on each pale rufotestaceous elytra with oblong piceous spot on intervals 2-5. Found in dense reed under debris near water, come to light. Female lay eggs in the soil. **6.** Egg are cylindrical, white, with a length of 1.4-1.5 mm and width 0.5-0.6 mm.

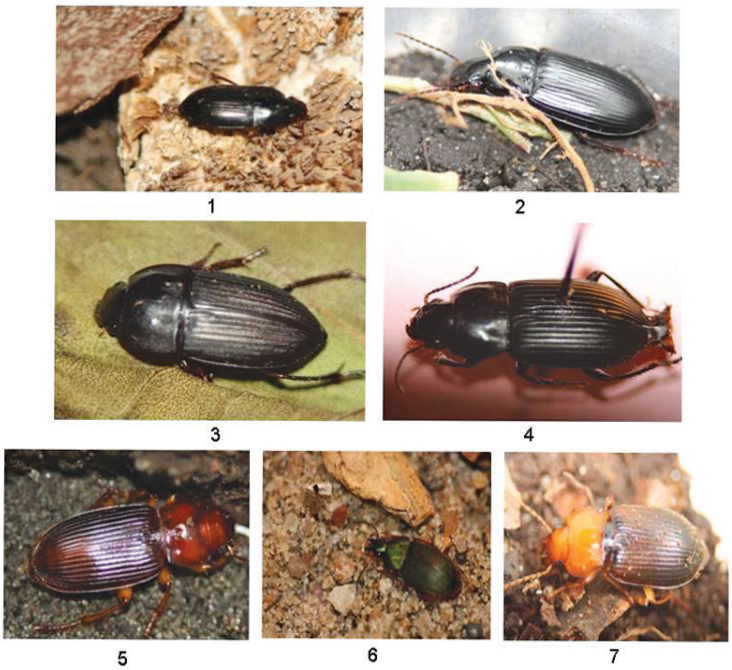
Fig. 3.



1 2 3 4 5 6

S. comma (continued) **1.** The first instar L1 obtained in laboratory in the early of August; their length on 1-2 ds was 2.8-3.0 mm; width of head capsule 0.6-0.7 mm. **2.** This photo shows a gallery in the sand made by beetles kept in captivity, where they hide at day-time and from where get to hunt at night. Species in the genus ***Acupalpus*** are the smallest members of the tribe **Harpalini** and they differ from ***Stenolophus*** by no divided into two separate groups of punctures on intervals 8. This genus contains 12 species found in the northeast North America. **3.** A single species of this genus - ***Acupalpus partiarius*** (3.0-4.0 mm) was taken in leaf- litter in the east pond of Refuge. The large North American genus ***Selenophorus*** includes seven species in northeastern North America. The following four species occur in the JBWR. **4.** ***Selenophorus opalinus*** (9.0-11.0 mm) was found under debris in dry habitat in the second half of May. Distinguishing characters of adult: black body, paler venter, margins of pronotum and elytral epipleurae pale, appendages rufotestaceous. **5.** ***Selenophorus planipennis*** (4.3-5.7 mm) have the following distinctive signs: body slightly bronze, elytra with truncate apex and scutellar stria rudimentary, tarsal pubescence scarce. Adults was captured in leaf litter in the early September. **6.** The species ***S. ellipticus*** (5.3-6.5 mm) taken in dry woodlands at sunset in early July. The color of beetle is dull black, appendages rufotestaceous, palpi infuscated, pronotum with front angles protruded. These beetles are fully winged and do fly. Adults prefers dry, sandy soil.

Fig. 4.



1. Species ***S. granarius*** (5.2-5.7 mm) differ from preceding species by following characteristics: redish color of mandibles, large punctures of interval 2, palpi and antennomeres infuscated, and pronotum with frontal angles less protruded. Adults were captured on the margins of water in wet leaves in dense reedy place. Genus ***Harpalus*** is one of the largest in this family. Four species of this genus were found in JBWR. **2.** The species ***Harpalus reversus*** (10.5-13.0 mm) was found in leaf-litter. Has the following distinguishing characters: dark piceous body, translucent margins of pronotum, rufous palpi and antennae, antennomeres 2-3 and maxillary palpomere 4 darker. **3.** Non-native species (with Palearctic distribution) ***H. rubripes*** (8.5-12.5 mm) was collected mostly in spring. It is a mixophagous, overwintering as larva and adult, prefer open habitats, but can be found also in the forest glade. Species occur in America in Connecticut, New Hampshire and Rhode Island. This species is here firstly recorded for New York. **4.** This species, ***H. solitaris*** (9.0-10.4 mm) was captured in dry habitat on sand. **5.** This photo shows the new adult of species ***H. pensylvanica*** (10-15 mm). Distinctive signs of old adults: body oblong, robust, dark piceous to black, punctuation variable; ventral surface paler, sides of pronotum somewhat translucent, appendage rufotestaceous. Taken in open dry habitat, under stones. In America only two species of ***Ophonus*** are known, both are introduced from Europe. **6.** This ***Ophonus*** was found in the spring by pitfall traps. Genus ***Amphasia*** in the Northeast contains two species. The adults of these species have labial palpomere 2 plurisetose, simple apical spur of anterior tibiae, elytra with striae impunctate and intervals all densely, finely punctuate. **7.** Only A***mphasia interstitialis*** (8.5-10.2 mm) was found in woods, in leaf-litter in Mid October. Distinguishing characters of this species: body testaceous, except for elytra, meso- and metasternum which are black, all appendages pale.

Fig. 5.

Conclusions

The results of research detected 17 carabid species of the tribe Harpalini, belonging to genera *Amphasia* Newman (1 species), *Anisodactylus* Dejean (2 species), *Stenolophus* Dejean (4 species), *Acupalpus* Latreille (1 species), *Selenophorus* Dejean (4 species), *Harpalus* Latreille (5 species), 16 of which are native species, and one non-native (adventive) species (*Harpalus rubripes* (Duftschmid), introduced from Palaearctic. This paleatctic species in North America is known from Connecticut, New Hampshire and Rhode Island. Our data demonstrate the distribution of this species also in New York. This summer-autumn breeding species, is mixophagous, overwinter as larva and adult.

Were obtained original data about the biology and reproduction period of the *Anisodactylus harrissi* LeConte, *Stenolophus ochropezus* (Say), *Stenolophus comma* (Fabricius). Two of these species *Anisodactylus harrissi*, *Stenolophus ochropezus* are monovoltine, spring-summer breeders species, overwintered as adults (with spring-summer reproduction type), and *Stenolophus comma* is summer-autumn breeder species, overwintered as larva. Adults and larvae of these species are active predators. Cannibalistic behavior is common among larvae of species *Anisodactylus harrisi* (observed only for first unstars) and of species *Stenolophus ochropezus* (observed for second and third instars) and suggested that this phenomenon is an important factor in the regulation of the population size of both species. Cannibalism was not observed for larvae of *Stenolophus comma.*

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POECILOCAMPA POPULI (L. 1758) SPECIES – RECONFIRMATION OF SPREADING IN THE REPUBLIC OF MOLDOVA

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***POECILOCAMPA POPULI* (L. 1758) SPECIES – RECONFIRMATION OF SPREADING IN THE REPUBLIC OF MOLDOVA**

Abstract: The paper presents observations and research on species *Poecilocampa populi* (L. 1758), made in the years 2013 and 2015 in the alleys of Chisinau and orchards in central Moldova. In the context of knowledge of local biodiversity and enrich national entomological scientific heritage in this area was determined that in conditions our country species develops a single generation, overwinter in the egg stage; larvae is defoliating polyphagous on forestry and fruit plants; pupate in the soil; the first time was recorded in 1929 (*Pirus sativa*, in Bularda, Calarasi), then 2013 (*Tilia platyphyllos*, in Kishinev) and 2015 (*Juglans regia*, in Văratec Aneni-November).
Keywords: *Poecilocampa populi* (L. 1758), Republic of Moldova.

Introduction

The *Poecilocampa populi* (L. 1758) species was observed in 2013 and 2016 in the larval stage on lime and walnut in the center of Moldova. The species is rare in Moldova, such enrichment entomological national heritage, the paper presents the most important aspects about spreading, plants-hosts, morphology and bio-ecology them.

Material and methods

The taxonomical identity was made according the papers signed by authors from soviet period (Ruscinsky, 1927; Miller et al., 1929; Sovkovsky, 1969) and from present period (Gerasimov, 1952; Nekrutenko, 1974).

Results

It is well known that *P. populi* (L. 1758) species belong to the family Lasiocampidae, which in general are called false silk spinner worms, but it should not be confused with *Bombyx mori* L. 1758 of fam. Bombycidae, popularly called – silkworm, generally known like true silk spinner worms (Sovkovsky, 1969).

The popular name of *P. populi* (L. 1758) species is not almost known in Moldova, and as proof, we mention that it does not have a popular name in Romanian. In order to give a suitable popular name we have been analysed the information from other countries. In Russian and Ukrainian, the butterfly is called "topolevyi kokonopread" which means "poplar cocoon silkworm" (Sovkovsky, 1969; https://de.wikipedia.org/wiki/Kleine_Pappelglucke). In German language, this butterfly species is called "poplar clucking hen" while Lasiocampidae family – "the clucking" (Nekrutenko, 1974). Finally, in English this species is named December moth.

In the result of those analysed above we decided to give for this moth species the name – december poecilocampa moth – inspired by hers biological peculiarities – adults fly during late autumn (October-November) and early winter (December).

In the "Animal Kingdom. Insects" book from Soviet period is mentioned that in Moldova are found 12 moths species from family Lasiocampidae. Most widespread from these snout mothsspecies being *Malacosoma neustria* L. 1758 – being in specialty literature frequently named as an usual pest of fruit trees, *Gastropacha quercifolia* L. 1758 – morphologically very nice; *Trichiura crataegi* L. 1758 and *Lasiocampa quercus* L. 1758 about the eight remained lasiocampide not being offered any date.

For the first time the *P. populi* (L. 1758) was recorded on the territory of the country by Alexander Rushcinsky during the interwar period. Alexander Rushcinsky was a collaborator and entomologist at the Department of Applied Zoology and Fish farming, of the Agricultural Sciences Faculty from Kishinev, "Mihăileană" University from Iasi, Romania. Thus, he mentioned in his registry that caterpillar of December moth were observed for the first time under leaves of *Pirus* on 30.V.1929 in Bularda village, Orhei district, in our days Călăraşi district. The second registration being fixed on 19.X.1929, unfortunately it was not specified larvae or pupae.

Exactly this is the most precious national information, showing that over 80 years ago, this species was spreading on these landscapes (Plugaru, 1983). From this author can also find out that the species "was found in the Old Bucovina Kingdom, and Podolia Gubernia, then on the east in Poltava Gubernia, Saratov and Viatca".

Earth spread. The *P. populi* (L. 1758) occurs from Northern Spain through Europe and Asia to Japan. According to Ukrainian literature then *P. populi* (L. 1758) is considered an species with Palaearctic being spread throughout European Russia, including Siberia, the Far East and in Ukraine (Sovkovsky, 1969).

In other sources, it is mentioned that December moth is a migratory species and fly from northern Iberian Peninsula and the Pyrenees to the east, central and northern Europe, to Asia and up to Japan where the climate is moderate (Nekrutenko, 1974). Suitable to the information from the database Wildlife Europaea *P. populi* (L. 1758) spreads in 41 countries, also mentioning that is absents in 18 countries (predominantly island areas) and in 10 countries including Moldova there no information (Miller et al., 1929). In this context, it is possible that this moth species can has a distribution in the countries listed with "no data" where and our republic is appearing. For all that, this small species has not yet been discovered, although climatic conditions and variety of host-plants can ensure a normal development of December moth.

Butterfly habitats are the low altitudes up to those mountainous, but prefers moist deciduous forests and rare on the edges of forest roads and paths, including shrub vegetation from hills, parks, boulevards also in the gardens.

Morphological description. Adult: the male length 35 mm and female 44 mm, with 30–45 mm wingspan while the length of anterior wings is between 12–18 mm (Fig. 1).

The color of forewingsis from grey-blue to dark black and with a discretely purple luster, thinly scaled; base reddish brown; postmedian and subcostal fasciae yellowish white; costa reddish brown; cilia reddish brown, broken by patches of yellowish white. In the middle of wing is a transverse slightly valuable line, colored in whitish or pale yellow that is ending as a point-stain on the coastal border.

Fig. 1. *Poecilocampa populi* species – male in repos lateral and dorsal view (www.lepinet.fr – visited at 25.05.2016)

Hindwing grey, thinly scaled; oblique median line indistinct, yellowish white; cilia as forewing. Wings has no frenulum – the coupling device of posterior wings to the previous ones.

Head and collar reddish brown. The collar has yellow obviously short soft hair (in profile) and dorsal aspect is like "bow tie". The thorax blackish brown; abdomen dark brown.

The sexual polymorphism is pronounced: (i) the female is bigger in size and has threadlike antennae or shortly bipectinate; (ii) the male is smaller with

strongly bipectinate and long antennae which not exceeding the mid of the forewings length (Ruscinsky, 1927; Sovkovsky, 1969).

The egg. The shape's egg is oval, flattened laterally with large, shallow, lateral depression; pale grey or whitish, and mottled with darker grey, glossy and the chorion is glabrous and glossy. The eggs are deposited on the host plants shoots and overwinter in this stage (Fig. 2).

The larvae. The body dimensions of larvae reach up to 50 mm, this being flattened. Head pale grey with black maculation; the head and body are covered with secondary setae. Body is pale grey, lightly suffused dorsal with reddish brown, densely spotted with dark grey or black. The spiracles are brown and peritreme black. Prothoracic and anal plates strongly marked with reddish brown. The thoracic legs are reddish brown and abdominal prolegs grey.

Fig. 2. The eggs of *Poecilocampa populi* (L. 1758) (www.lepinet.fr)

According coloring, the larvae body present two forms (the feature that complicated species determination): The dark coloured feature – in general is grey-black, with pairs of rhomboid spots very visible on the backside. Conventionally we called this feature "Moldavian caterpillar" (Fig. 3a-c); The light coloured feature – the caterpillar has agrey-brown colour, with small yellow spots and thick arranged in two rows on the dorsal sides. We called this form conventional "Dutch caterpillar" (Fig. 4).

a

b

c

Figure 3. "The Moldavian caterpillar" – photo by I.Scorpan (determinate by A.Timuș)

In addition, in specialty literature is mentioned that the body colour is formed and vary depending on the wood of host plant on which the caterpillar feeds. Thanks to that, the caterpillar becomes almost invisible and so it masks or protects it from predators – this process being called mimicry.

a b

Figure 4. "The Moldavian caterpillar": a) "the dark colored feature" (orig.); b) "the light colored feature" (www.lepinet.fr)

Both forms after head have an excavation whose chitin having a reddish colour better visible during feedings process, when position of the head gets orthognathic position.

The pupa has an obtect form, with about 25 mm long and the color is reddish brown; being encapsulated within a dense, tough and small cocoon, having a dark greyish brown colour, similar to the earth.

Nutritional regime. In imago stage, this species not feeds because the proboscis is not well developed only caterpillars are defoliators. After the larval stage, this species is considered a polyphagous defoliator. The caterpillars do not selects the host plants, so they feed on many deciduous woods and shrubs: the poplar, especially common aspen (*Populus tremula*), willow (*Salix caprea*), common

hazel (*Corylus avellana*), silver birch (*Betula pendula*), the common alder (*Alnus glutinosa*), the European beech or common beech (*Fagus sylvatica*), the pedunculate oak (*Quercus robur*), blackthorn (*Prunus spinosa*), large-leaved linden (*Tilia platyphyllos*), Norway maple (*Acer platanoides*), ash (*Fraxinus excelsios*), elms (*Ulmus* spp.), European Mountain-Ash (*Sorbus aucupana*), apple (*Malus domestica*), European plum (*Prunus domestica*). At these hosts plants we want to add another two that were not mentioned abovecommon pear (*Pyrus sativa*) – from Rushcinsky (1929) and common walnut (*Juglans regia*) – from own researches.

Discussion

The species of *P. populi* (L. 1758) inhabits mainly woodland in open forests with much softwood. In addition, this species can be met in grove rich sites of all kinds, occasionally in scrubland, hedgerows and gardens, even in villages.

In condition of our republic, *P. populi* (L. 1758) species develops one generation per year and overwinter in the egg stage on host plant branches (Fig. 5). The moth flies from August (in mountain areas) and October to December (in years with warmer autumn's months). The adults are nocturnal and are attracted to lighted sources in early November, but males can sometimes be detected by day to.

Months and decades																					
IV			V			VI			VII			VIII			IX			X			Overwinter
–	=	≡	–	=	≡	–	=	≡	–	=	≡	–	=	≡	–	=	≡	–	=	≡	
(*)	(*)																				
		–	–	–	–	–	–	–	–												
		the buds and leaf																			
								o	o	o	o										
								pupe in cocoon below ground													
												+	+	+	+	+	+	+	+	+	+
											estival and autumn diapause								(*)	(*)	(*)
Legend: (*) = eggs in diapause; – = larvae; o = pupe; + = imago.																					

Fig. 5. The biological calendar of *P. populi* (L. 1758) species (orig.)

Owing to long and dense scales also to pubescence, the butterflies are protected from the cold, so they can fly at temperatures of 0°C, sometimes during the first snowfall. Cool late autumn conditions are not binding for the flight and the development of the species, this been frequently an exception in development.

The female prolificacy is between 120–170 eggs laid singly or in small groups on the bark and offshoots of host plant.

Caterpillar are usually found between late April to July, and the latest hatching was observed in May. By day period, the caterpillar is camouflaged on the

wood or in its cracks. The feeding process occurs only at night period being intensive and fast.

At full development in June – September, the caterpillar migrate into the soil where occurs the *pupation process* in a cocoon below ground amongst litter or beneath loose bark. After pupae developing, the adults could fly but they remain in the cocoon until the temperatures fall. After mating and oviposition, the females die soon.

Conclusions

According to literature and our researches result that *P. populi* (L. 1758) is a butterfly that spreads permanently in Moldova, but its populations are small, therefore, in the teaching process the entomological descriptions was avoided. The large diversity of host plants is not a guarantee for to develop big populations for to exceed of acceptable limits. The main factors in population density regulating of this insect species are:

Ecological – (the temperature and humidity), which are not established in any country, probably for the same reason – the reduced number of individuals and staggered development of this species;

Physiological – low prolificacy, the eggs are laid without any protection (pubescent aspect, adhesion, hidden under bark or other shelters,) etc.;

Biological – diverse *entomophagous predators* and *parasitoids* species of various stages of development, which also are not introduced in the entomological research;

Migration – the impact concerning individuals involved in the process is entirely unexplored and analysed, from the same reasons named by us "the complicated species".

Thus, any information about diverse was not discussed issues in this paper and obtained from other observations will complete the historical development of *P. populi* L. 1758 species in the country and worldwide.

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RECONFIRMATION OF *STEGOBIUM PANICEUM* (L. 1758) SPECIES IN REPUBLIC OF MOLDOVA

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RECONFIRMATION OF *STEGOBIUM PANICEUM* (L. 1758) SPECIES IN REPUBLIC OF MOLDOVA

Abstract: The drugstore beetle, *Stegobium paniceum* (L. 1758), discussed in the paper, is part of those which forced the entomologists to study, supposing without enthusiasm, but as a responsibility and a professional necessity, because it is a harmful organism of the most important food product – the bread. The drugstore beetle *S. paniceum* (L. 1758) (Col., Anobiidae), probably it is spread in republic and to cause damage to various products of vegetale origin from deposits of over hundred years. With the same probability it is spread and the entomophagous *L.distinguendus* Foerster 1841 (Hym., Pteromalidae), but the moment of exactly penetration or with aproximation, in this moment it is not possible to specify. However, these species in 2016 were reconfirmed as present in republic and the fitted specimens they were stored in museum of Entomology Laboratory of Institute of Zoology, ASM.
Keywords: *Stegobium paniceum*, entomofauna of Republic of Moldova.

Introduction

In the class Insecta, there is a great diversity of species with attractive aspect as some butterflies, rove beetles, bugs, dragonflies, wasps, bumblebees, flies etc.; therefore, they are studied persistently and can be found in various scientific sources of entomological field.We also mention that there is another variety of insects, which morphologically are not attractive but repulsive, because cause damages to plants and create social discomfort. They are studied only as a necessity and with less passion.

The drugstore beetle, *Stegobium paniceum* (L. 1758), discussed in the paper, is part of those which forced the entomologists to study, supposing without

enthusiasm, but as a responsibility and a professional necessity, because it is a harmful organism of the most important food product – the bread.

However, the species have some interesting aspects, namely: (i) it is the only beetle with Latin naming of genus *Stegobium*, which comes from the ancient Greek "stegos", translated as "roof", plus "bium" or "bios", translated as "life"; the *Paniceum* species comes from the Latin "panis", translated as "bread"; (ii) it is an alien, invasive species of cryptogenic origin, which indicates that is new to the territory of the Republic of Moldova; (iii) it is part of the group of pests in stored products of vegetable origin with a significant impact.

Due to these considerations, we proposed to study it multilaterally, and the most important aspects are exposed below.

Results and discussion

I. The research of the species in the Republic of Moldova

Recent registration. From the noble intention, called "reutilization of entomological needles" from the insectarium of Plant Protection Department, SAUM obtained two entomological news.

During the process of needles removal from the damaged insects, the students observed an insect with very small dimensions – 1,6–2,5 mm, rust-coloured, barely visible, but moving with high-speed among the entomological remains.

In its statement, we were sure that is the museum beetle, *Anthrenus museorum* (L. 1761) (Col., Dermestidae), because it was found thereafter, spreading frequently in various, closed niches (deposits, museums, barns etc.).

After identification, the first finding was rejected since it was determined to be a species from the same niches, namely *S. paniceum* (L. 1758) (Fig. 1).

During the specimen collection, concomitantly, another insect has been found among the entomological remains, similar to a *Trichogramma*, which has been shown to be a wasp, namely *Lariophagus distinguendus* Foerster 1841 (Fig. 2).

These species constitute entomological news for us because the *S. paniceum* (L. 1758) has the status of invasive, alien species, a new research project in the Republic of Moldova in which authors of paper collaborates.

Historical records. The first indication of the drugstore beetle, *S.paniceum* (L. 1758), appears in the country in Miller and Zubovski's research (Миллер & Зубовский, 1917), with the synonym, *Sitodrepa panicea* L.

The authors mention that the species has been encountered in Chisinau, only that the other information is not presented for this beetle, with all that the other 8 species of the fam. Anobiidae from the same work are accompanied by: site of collection, date, month and year. From the paper, it can be found that the species included in the historical list were collected from 1899, but the paper was published only in 1917.

a b c d

imago viewed: a) dorsal; b) lateral larvae viewed: c) dorsal, b) ventral

Fig. 1. The drugstore beetle *Stegobium paniceum* (L. 1758) collected specimens from insectarium of Plant Protection Department, SAUM 12.V.2016 (photo by Irina Mihailov)

In this context, the period of penetration of the drugstore beetle, *S. paniceum* (L. 1758), can be determined approximately on the current territory of the Republic of Moldova. Subsequently, the rove beetles checklist of fam. Anobiidae is completed with the species, *Anobium pertinax* L., a specimen found by entomologist, Ienişţea (Ienişţea, 1933), at 1130 m altitude in Retezat Mountains.

Treatment of species in specialized, autochthon literature. In the paper, "World of Animals. The insect" (Остафичук, 1983), it is mentioned that there are 16 species of Anobiidae in the country. The bioecology is presented only for *Anobium punctatum*, and the species *S. paniceum* (L. 1758) are exposed in general and such as: "live on the planet, harm the flour and the farinaceous products, the cereals, including the rice and the groats, the tobacco, the dried fruits and vegetables, the books, etc.".

In Busuioc's monograph and manual (Busuioc, 2003, 2006), the pest is very well described (the spread, the description of the development stages, the biology and the ecology, the diet and the pesticide mode of action), only that "the collections of insects" are not specified as a source of nutrients for the species, although in other papers that aspect is mentioned.

II. The researches of species on Planet

By analyzing the various sources to find several aspects of the species, three interesting details have been noted: (i) the insect is accompanied by seven synonyms of the genus (Table 1) and 27 synonyms of the species (Table 2); (ii) the author, Linnaeus, is indicated in brackets (L. 1758), which confirms that unclarities are present; (iii) the *Stegobium* genus is attributed to Motschoulsky with the

reference year, 1860, or after 77 years when the insect has been published for the first time with the same genre, *Stegobium ferrugineum*, by a German entomologist, Johann Friedrich Wilhelm Herbs, in 1783. In this context, we have decided to decode those aspects as far as possible and to derive more information about the species from a variety of sources (Fauna Europea, 2016).

By arranging the entomologists in chronological order, who created the genus names, it has been noted that the authors of the genus *Anobium*, is a Danish entomologist, Fabricius, with the reference year, 1775, and an entomologist in the French source (Franch entomofauna. 2016), Olivier, with the reference year, 1790. That information is exposed as an entomological curiosity.

In order to continue with the curiosities from the entomological domain, we mention that the researchers of the drugstore beetle, *S. paniceum* (L. 1758), have been from different types of guilds and professional repute, for example:

– Gmelin has been a German doctor, botanist and chemist, but the description of insects was a professional responsibility to which he had to present appropriate responses, and thus the heritage of the entomological world was filled with useful information;

– Gyllenhaal has been a responsible, Swedish officer and a passionate entomologist, but known in history from his last results of his research, accumulated in various military companies;

– Fabricius, Linnaeus's student, has been considered the most famous Danish entomologist of XVIII century, describing over 10 thousand of animals, overlooking the insects, and has established the modern, systematic basis of the insects classification;

Table 1. Authors, who have created the genera and species names for anobiid drugstore beetle, *Stegobium paniceum* (L. 1758)

Author				Year mention of insect	Genus
Surname		Life	The origin		
Authors of genus					
1.	Linnaeus	1707–1778	Swedish	1758	*Dermestes*
2.	Fabricius	1745–1808	Danish	1775	*Anobium*
3.	Olivier	1756–1814	French	1790	
4.	Latreille	1762–1833	French	1796	*Cis*
5.	Linnaeus	1707–1778	Swedish	1767	*Ptinus*
6.	Thomson	1824–1899	Swedish	1863	*Sitodrepa*
7.	Motschoulsky	1810–1871	Russian	1860	*Stegobium*
8.	Mulsant & Rey	1797–1880 1817–1895	French French	1863	*Artobium*
Authors of species based on these genera					
1.	Herbst	1743–1807	German	1783	*Anobium, Stegobium*
2.	Thunberg	1743–1828	Swedish	1784	*Ptinus, Stegobium*
3.	Gmelin	1748–1804	German	1790	*Ptinus, Stegobium*

	Author			Year mention of insect	Genus
	Surname	**Life**	**The origin**		
4.	Marsham	?–1819	English	1802	*Ptinus, Stegobium*
5.	Gyllenhal	1752–1840	Swedish	1808	*Stegobium*
6.	Say	1787–1834	American	1825	*Anobium, Stegobium*
7.	Villa & Villa	?-?	Italian	1833	*Anobium, Stegobium*
8.	Melsheimer	1749–1814	American	1845	*Anobium, Stegobium*
9.	Kuster	1807–1876	German	1849	*Anobium, Stegobium*
10.	Steinheil	?-?	Australian	1873	*Cis*

– Fleming (the Scottish author of the name of Anobiidae family) has been a minister and a naturalist, but his paper is basically dedicated to the insects, "Insecta: In: Supplement to the fourth, fifth and sixth editions of the Encyclopaedia Britannica, with preliminary dissertations on the history of the sciences" (1821);

– the German,Kuster,has published multiple papers between 1844–1912 years, and the most famous being "Beetles of Europe, described from nature";

– Latreille, a French zoologist and specialist in arthropods, being named as "prince of entomology" throughout his life for his works dedicated to the insects;

– Melsheimer was an American entomologist, considered as "Father of American Entomology", because he described more than 1363 species of beetles and published "A Catalogue of Insects of Pennsylvania" (1806); he was succeded by Thomas Say, known from the autochthonous literature as the author of the species, *Leptinotarsa decemlineata* Say 1824, but in his country, he was among the first who organized the "Academy of Natural Sciences" in Philadelphia and published his classical paper entitled, "American entomology, or, Descriptions of the insects of North America";

– Motschulsky was not only a Russian officer and a resercher of The Chief of Army Staff, but also an entomologist, who collected and studied various insects when traveling across Europe, Africa and North America; he also created genera and species names, considering that they are missing or do not fit;

– Mulsant has been a French entomologist and ornithologist, a great owner of vineyards in the south of France, and also a writer and being from other honorable services, who has become famous with his paper "Natural History of the Coleoptera of France" (1840). He also included in his research the name of his employee, Claudius Ray, who continued Mulsant's work after his death.

– Olivier, has been a French, human doctor, but he studied the insects passionately and has published "Encyclopedie methodique" in 10 volumes with 389 original drawings, and "Entomology ou Histoire naturelle des insects…" in 6 volumes with 363 original drawings;

– the Swedish,Thomson, has been a member of the Swedish crew, who surrounded the planet with "Fregate Eugenie" for the first time and described the

various hymenoptera, especially from *Vespula* genus, and more than 300 beetles and diptera, which resulted in books and scientific articles.

– the Swedish,Thunberg, Linnaeus's student, after his undertaken, scientific expeditions, he has been called "the father of South African botany" and the "Japanese Linnaeus", providing valuable information available today.

Table 2. The analysis of synonyms of genres for drugstore beetle S.paniceum (L. 1758)

Nr.	Genus	Species	Author of genus/ of species
1.	*Dermestes*		Linnaeus 1767
		1. paniceus	Linnaeus 1767
2.	*Ptinus*		Linnaeus 1767
		2. testaceus	Thunberg 1784
		3. upsaliensis	Gmelin 1790
		4. tenuicorne	Marsham 1802
		4. rubellum	Marsham 1802
3.	*Anobium*		Olivier 1790, Fabricius 1792 (Fauna Europea, 2016)
		6. ferrugineum	Herbst 1783
		7. minutum	Fabricius 1792
		8. tenuestriatum	Say 1825
		9. ireos	Villa & Villa 1833
		10. nanum	Kuster 1849
		11. obesum	Melsheimer 1845
		12.villosum	Melsheimer 1806
4.	*Cis*		Latreille 1796
		13. bonariensis	Steinheil 1873
		14. striatopunctatum	Steinheil 1873
5.	*Stegobium*		Motschoulsky 1860
		15.paniceum	(Linnaeus 1767)
		16. ferrugineum	Herbst 1783
		17. testaceum	Thunberg 1784
		18. upsaliense	Gmelin 1790
		19. minutum	Fabricius 1792
		20. rubellum	Marsham 1802
		21. tenuicorne	Marsham 1802
		22. pusillum	Gyllenhal 1808
		23. tenuestriatum	Say 1825
		24. ireos	Villa & Villa 1833
		25. obesum	Melsheimer 1845
		26. nanum	Kuster 1849
6.	*Sitodrepa*		Thomson 1863
		27. panicea	Thomson 1863
7.	*Artobium*		Mulsant& Rey 1863

From these short sequences of people's lives, who have completed the entomological science with various species of insects and aspects of their lives, it may also be noted that the anobiid, *S. paniceum* (L. 1758), has been the subject of the research for some historical personalities. Certainly, it is not the morphological aspect of this insect urged them to the scientific process, but because it was and continues to be a considerable household pest, or they were compelled, by virtue of their functions and their statutes, to offer counseling and consultation to those interested.

From the biography of each entomologist presented in the paper, it can be determined that all of them have undertaken expeditions and trips to various corners of the planet. Unintentionally, they could have been those who contributed to the migration of the species from one country or continent to another because the bread, the cereals, the packages, the luggages, etc. have been indispensable for any mode of transport. However, we consider that the migration of this insect most likely started much earlier, especially, through the trade from Asian countries to Europe with cereals, spices, domestic animals, horse riding, traction, etc., including the natural silk, before the expeditions of Christopher Columbus. In this context, we emphasize that the year of 1492 – the first expedition of Columbus in America – is the reference year for the research and establishment of the invasive, alien species from Europe.

III. The origin and spread of drugstore beetle *S.paniceum* (L. 1758)

About the origin and spread of the insect on the planet more conceptions are exposed, some controversial, such as:

(i) it has a palearctic origin, but in the same context is emphasized "except China", an unlikely fact, where in Japan and the Philippines is very widespread, and the climatic conditions are favorable for the development in China;

(ii) meanwhile, it has become a cosmopolitan because it is present in all ecozones of the Earth;

(i) in England, it is indicated that is spreading from the Bronze Age (evidence does not exist);

(iv) in Egypt and France, it is spread from ancient times (evidence not mentioned);

(v) based on synonyms, the invasion of the insect in other European countries is assumed approximately, or increasing the populations up to the production of the major damages, and the insect got into the entomologists viewfinder when an increasing of the populations has been noted up to the production of the major damages, and namely in: Sweden 1758 (Linnaeus); Germany 1783 (Herbst); 1790 France (Olivier); Denmark 1792 (Fabricius); England 1802 (Marsham); Italy 1833 (Villa & Villa); Russia 1860 (Motschoulsky) (Fauna Europea, 2016);

(vi) it is recognized that in North America and Oceania it has been introduced and naturalized (information from French), but the penetration period can be

specified from the authors of the synonyms: USA 1825 (Say) and Australia 1873 (Steinheil) (Fauna Europea, 2016);

(vii) according to the new concepts of organisms migration on Earth, the anobiid, drugstore bettle, is considered an invasive, alien insect in Europe, a status established by Poland 1792 (Glowacinski et al., 2011); Bulgary 1930 and Macedonia 2007 (Томов et al., 2009), the concept and the status being acquired by the Republic of Moldova; the penetration has been considered and detected at the beginning of XX century in the insects collection of Plant Protection Department, SAUM. detected and determined by Timuş in 12.V.2016, based on Miller and Zubovschi's list specification from 1914–1915 (Bacal et al., 2012).

From these sequences about the spread and evolution of the drugstore beetle on Earth, *S. paniceum* (L.1758), we conclude that the investigations of this insect are not finalized; therefore, the research will continue.

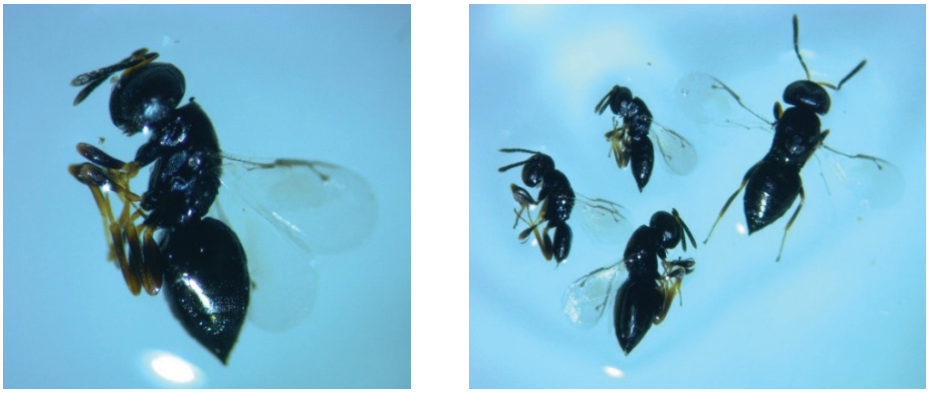
IV. Nutritional aspects of drugstore beetle *S.paniceum* (L. 1758)

After it reaches the adult stage, the anobiid does not feed, although, it is mentioned that produces razing and sawdust. In the larval stage, it is a "super» polyphagous and the main sources are the products of origin: (i) vegetable – the cereals (grain, flour, Bran), pastries (bread, pasta, cookies), legumes (broken grains), dried fruits and vegetables, herbal medications (tea, tobacco and other tobacco products), coffee beans and cocoa, confectionery products (chocolate), spices (pepper, cinnamon, coriander, etc.), botanical herbarium; (ii) products of animal origin-anatomical collections (skeletons), entomological and sericultural; (iii) industrial – cardboard, polyethylene, wood furniture, covering, mirror and painting frames, lead sheets.

V. Bioecologicalaspects of species *Lariophagus distinguendus* Foerster 1841

The wasp adults have been obtained automatically at the time of specimen collection of *S. paniceum* (L. 1758) from the insects collection of Plant Protection Department, SAUM in May 12, 2016 (Fig. 2). The entomophagous is described as well in Perju's work (Perju et al., 1989), resulting in that it is a frequent and an effective wasp in its limitation and to other pests. More details about larviphagous wasp are outlined below.

The wasp, *L. distinguendus* Foerster 1841, is polyphagous and attacks several pests of deposits: (i) species from the order Coleoptera – *Sitophilus granarius*, *S. zea-mais* (Wasp specimens from these species have been obtained in Romania (Perju et al., 1989), *S. oryzae*, *Rhyzoperta dominica, Gnatocerus cornutus*, *Stegobium paniceum, Ptinus fur* (Busuioc, 2003, 2006), *Lasioderma serricorne*, *Bruchus brachialis* (Perju et al., 1989) and from the order Lepidoptera – *Sitotroga cerealiera*.



a b

Fig. 2. The species *Lariophagus distinguendus* Foerster 1841: a) adult, lateral view; b) another specimens in different positions b) (photo by Irina Mihailov)

The wasp is a larviphagous ectoparasite, which detects the infested grain by the beetle larvae, by crossing it and depositing only one egg on its body. After hatching, the intimate sticks to the tegument and extracts the content of the larvae-victim. The parasitized larvae shrinks and dries out.

The majority of the victim beetles are referred to as invasive, alien species, and the origin of the entomophagous is not indicated in any source, being considered, as well, comopolitan. In this context, it is interesting to find out if the wasp, evolutionarily, has "accompanied the victims", or has continued the nutrition activity on the new species occurring in its habitat.

In the "Fauna Europaea", the entomophagous larviphagous is shown as present in 12 countries, including Romania and Ukraine, but for the Republic of Moldova qualifying as "absent" (Bacal et al., 2012). Thereby, we consider it as a new species for the country, although, it is specified in the academic, didactic literature (Busuioc, 2003, 2006).

The species, *L. distinguendus* Foerster 1841, represent an interest for the protection of stored vegetable products against the harmful beetles through biological methods, using the *Trihogramma* model.

Conclusions

The drugstore beetle *S. paniceum* (L. 1758) (Col., Anobiidae), probably it is spread in republic and to cause damage to various products of vegetale origin from deposits of over hundred years. With the same probability it is spread and the entomophagous *L. distinguendus* Foerster 1841 (Hym., Pteromalidae), but the moment of exactly penetration or with aproximation, in this moment it is not possible to specify. However, these species in 2016 were reconfirmed as present in

republic and the fitted specimens they were stored in museum of Entomology Laboratory of Institute of Zoology, ASM. Thereby, the information from autohtone literature about *S. paniceum* (L. 1758), it was filled with: (i)source of nutrition – corpses of insects from collection of Plant Protection Department; (ii) ecological area of spread – Chişinău city, Petricani neighborhood, SAUM campus; (iii) historical figures who researched the beetle in various countries in Europe, America, Asia and Australia; (iv) confirmation of spread to larviphagous entomophagous *L. distinguendus* Foerster 1841 in Republic of Moldova; (v) the entomological investigations complement to the national entomological patrimony heritage with data and with new aspects about 2 species from the same habitation niche: polyphagous detritophagus *S. paniceum* (L. 1758) and larviphagous entomophagous *L. distinguendus* Foerster 1841.

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* *Lariophagus distinguendus* (Forster 1841) http://www.faunaeur.org/distribution_table.php (accesat 22.VII. 2016)
* *Stegobium* Motschulsky 1860 http://www.faunaeur.org/distribution_table.php (accesat 22.VII. 2016)
* *Stegobium paniceum* (Linnaeus 1758). http://www.faunaeur.org/distribution_table.php (accesat 22.VII.2016)

THE EVALUATION OF THE STRENGTHS OF SOME DIURNAL RAPTOR BIRDS (*ACCIPITER BREVIPES, BUTEO RUFINUS, CIRCAETUS GALLICUS, HIERAAETUS PENNATUS* AND *FALCO CHERRUG*) BREEDING IN ROSPA0073 MĂCIN-NICULIŢEL (IN 2013)

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THE EVALUATION OF THE STRENGTHS OF SOME DIURNAL RAPTOR BIRDS (*ACCIPITER BREVIPES*, *BUTEO RUFINUS*, *CIRCAETUS GALLICUS*, *HIERAAETUS PENNATUS* ŞI *FALCO CHERRUG*) BREEDING IN ROSPA0073 MĂCIN-NICULIŢEL (IN 2013)

Abstract: In this paper the breeding situation, in 2013, of five species of diurnal birds of pray (*Accipiter brevipes*, *Buteo rufinus*, *Circaetus gallicus*, *Hieraaetus pennatus* şi *Falco cherrug*) from ROSPA0073 Măcin-Niculiţel is presented. Among them, *Falco cherrug* was the only species that was not observed. In comparison with the previously data, the strengths of the four species, *Accipiter brevipes*, *Buteo rufinus*, *Circaetus gallicus* and *Falco cherrug*, seem to be in a decreasing trend, while *Hieraaetus pennatus* seems to be the only stable species from this point of view. The strict applying of the full area management plan is necessary to increase the number of breeding pairs and, in this purpose, is important to teach the inhabitants the importance of the biodiversity.
Keywords: diurnal birds of prey, ROSPA0073 Măcin-Niculiţel, protection.

Introduction

In the last years, the area of ROSPA0073 Măcin-Niculiţel was the subject of some studies regarding the occurrence in the area of the diurnal raptor birds. Principally, they were centred on the Măcin Mountains National Park and were

focused on migration (Domahidi & Komáromi, 2004; Domahidi et al., 2004; Komáromi, 2005, Fulop et al., 2012, etc.) and less on the breeding population (Pap, 2006).

The purposes of this study were to estimate the current breeding populations of diurnal raptors (*Accipiter brevipes*, *Buteo rufinus*, *Circaetus gallicus*, *Hieraaetus pennatus* and *Falco cherrug*) in the area. The data were obtained in the project "Studii pentru elaborarea Planului De Management integrat al PNMM prin revizuirea şi integrarea prescripţiilor de management pentru siturile Natura 2000 (SPA-ul Macin-Niculitel şi SCI-UL Munţii Măcinului) ce includ PNMM" (Contract no. 286/POS/August 29, 2011 between RNP Romsilva Administraţia Parcului Naţional Munţii Măcinului RA and S.C. Multidimension Research and Development S.R.L. / S.C. Geosystems Romania S.R.L.).

Materials and methods

ROSPA0073 Măcin-Niculiţel is situated in Dobrudja, in the north-western part of Tulcea County. Its area (67,361 ha) includes the Măcin Mountains and the Niculiţel Hills. The Măcin Mountains is formed of two major parallel crests heavily eroded (Pricopan-Megina, in North-West, and Măcin, in the middle part and in South-East), that are separated by the Greci Depression. Ţuţuianu Peak (467 m) represents the maximum height, the lowest being the Jijila Pond (0 m), from the North-Western limit. The forms of relief are favourable for the thermals which are used by numerous species of birds (birds of prey, pelicans, storks, cranes, etc.) that transit the area or breed here.

The Danube flows close to the Western, Northern and North-Eastern boundaries. Other running waters are the Jijila, the Greci, the Taiţa, the Isaccea, and the Luncaviţa. They have small debits and they originate from the area (Fig. 1).

The climate is excessive temperate-continental. The summers are very dry and the winters are very cold. The temperatures fluctuate between –15^{0}C in January and 35^{0}C in July, with 10–11^{0}C – the annual average. The precipitations are up to 400 mm/year. The relatively constant winds are intense and blow predominantly from the North and the North-East.

The vegetation is specific to steppe (*Agropyron repens*, *Stipa pennata*, *Chrysopogon gryllus*, *Festuca* sp., *Andropogon* sp., *Thymus* sp., *Artemisia* sp., *Potentilla* sp., *Verbascum* sp., *Ononis spinosa*, etc.) and silvo-steppe (*Cotinus coggygria*, *Crataegus monogyna*, *Prunus spinosa*, *Quercus pedunculiflora*, *Quercus pubescens*, *Fagus sylvatica* – the last, in Valea Fagilor Reserve, etc.).

There are numerous species of animals, including protected ones: *Lycaena dispar*, *Callimorpha quadripunctaria*, *Lucanus cervus*, *Osmoderma eremita*, *Cerambyx cerdo*, *Morimus funereus*, *Euphydryas maturna*, *Bombina bombina*, *Bufo bufo*, *Rana dalmatina*, *Testudo graeca*, *Elaphe quatuorlineata*, *Rhinolophus ferrumequinum*, *Spermophilus citellus*, *Mesocricetus newtoni*, *Mustela eversmannii*,

Vormela peregusna, *Felis silvestris*, etc. Almost 200 species of birds were observed in the last decades in area, 56 of them being of communitarian interest: *Ciconia ciconia*, *Accipiter brevipes*, *Aquila pomarina*, *Buteo rufinus*, *Circus pygargus*, *Falco peregrinus*, *Falco cherrug*, *Burhinus oedicnemus*, *Coracias garrulus*, *Dendrocopos leucotos*, *Picus canus*, *Lullula arborea*, *Anthus campestris*, *Sylvia nisoria*, *Oenanthe pleschanka*, *Ficedula albicollis*, *Lanius minor*, *Emberiza hortulana*, etc. (cf. infonatura 2000).

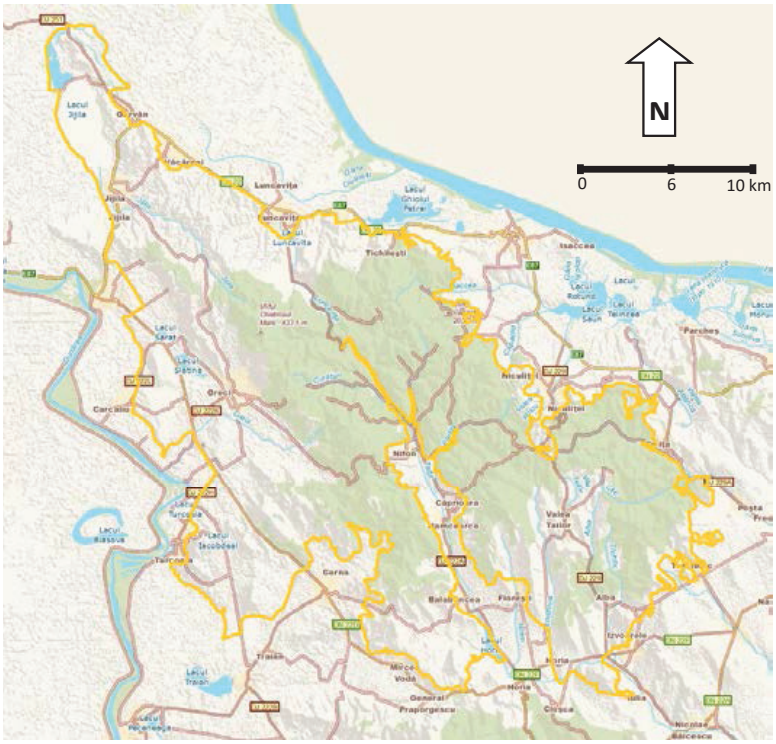

Fig. 1. The map of ROSPA0073 Măcin-Niculițel
(bordered by orange line, cf. infonatura 2000)

Regarding the birds of pray, the Levant Sparrowhawk (*Accipiter brevipes*) breeds in relatively small and rare forests, from the dry regions. Its nest is installed in trees. In Romania, it is a summer visitor, between April and September, and comprises probably few tens of pairs. The Long-legged Buzzard (*Buteo rufinus*) breeds in arid steppe and rocky mountains. For nest, it uses rocks, trees or even electrical pylons. In Romania, it is a summer visitor and a migrant bird; it is seen between March and October. Its strength is of few dozens (5–20 pairs, in Dobrogea, mainly in the Măcin Mountain). The Short-toed Eagle (*Circaetus gallicus*) breeds preponderantly in open, dry areas with mountains and scattered woods and also in depressions. Nests in trees. In Romania,

it is summer visitor, between March and October and comprises 80–100 pairs. The Booted Eagle (*Hieraaetus pennatus*) breeds in forests that alternate with open areas, in low mountains or plain areas. Nests in trees or, rarely, on cliffs. In Romania, it is a summer visitor between March and October and comprises 30–80 pairs. The Saker Falkon (*Falco cherrug*) breeds in wooded steppe and in the rocks areas from the plains. The eggs are laid on cliff-ledge or in old stick-nest built in trees; more recently the eggs are laid in old or artificial nests built on high voltage pylons. In Romania, it is partial migrant. The strength is 2–6 pairs (Bruun et al., 1999; Munteanu et al., 2002; Munteanu, 2005; Svensson et al., 2009; http://sakerlife2.mme.hu/ro/).

The populations of the species were evaluated through the method of the observations from the fixed points. Also, the occasional observations made concomitantly with the surveillance of the other birds' species were noted. Only a small part of the electrical pylons were verified. The observations were performed in the period April – July, 2013, mainly between 9:00 and 19:00, when the meteorological conditions were favourable.

Results and discussions

During April-July, 2013, among the five species we identified in ROSPA0073 Măcin-Niculiţel four breeding species: *Accipiter brevipes*, *Buteo rufinus*, *Circaetus gallicus*, and *Hieraaetus pennatus*.

We found 6 breeding pairs of *Accipiter brevipes* (Fig. 2), which confirm partially the previous results, when 15 pairs were mentioned as breeding in 2007 in the Măcin Mountains National Park and its vicinity; 10–12 pairs were estimated in the Park (Pap, 2007). We estimated for the entire special protection area 8–12 pairs, or even a little more. Other previous evaluations: 20–30 pairs (cf. http://biodiversitate.mmediu.ro; http://cndd.ro).

In the case of *Buteo rufinus*, we found 12 pairs (Fig. 3). 11 of them confirm previously known locations (there are 22 of them) and 1 is new (near Tichileşti – Revărsarea). 20–25 breeding pairs were estimated in 2007 in the Park (Pap, 2007). We presumed to be 15–18 pairs in the entire monitored quarter. Other recent evaluations: 20–26 pairs (http://biodiversitate.mmediu.ro) and 30–60 pairs (http://cndd.ro). Also, 1 pair was mentioned in the area of the Valea Fagilor Quarry (http://www.anpm.ro/).

Only 2 of the 6 pairs previously known (Pap, 2007) of *Circaetus gallicus* were identified by us (Fig. 4) and we estimated the breeding population of the area at 2–4 pairs. Other evaluations: 5–7 pairs in the Măcin Mountains National Park or 10–14 pairs (http://biodiversitate.mmediu.ro) and 10–16 pairs (http://cndd.ro) for the ROSPA0073 Măcin-Niculiţel.

Hieraaetus pennatus is better represented in the area. 9 pairs were previously known, and 6–8 were estimated in the Park (Pap, 2007). We found 5 of them and,

in addition, 3 (Fig. 5). For the whole area, we estimated 10–12 pairs. Other evaluations: 10–14 pairs (http://biodiversitate.mmediu.ro; http://cndd.ro).

Falco cherrug was the only species absent in the observations. In 2007, 3 nests were known in Măcin Mountains (Fig. 6), but no one was used at that time (Pap, 2007). We estimated 0–2 breeding pairs in the area. Other evaluations: 2–3 pairs, in the Măcin Mountains National Park (Pap, 2007), 2–6 pairs, some of them breeding in artificial nests (Gache, 2009), 3–5 pairs (cf. http://biodiversitate.mmediu.ro) and 6 pairs (cf. http://cndd.ro). In 2008, only one pair from the North Dobrudja managed to produce 2 chicks (Doroşencu et al., 2013). No pairs were found recently (2011 and 2012) in the Măcin Mountains in the previously used nests and 3 pairs were found in 2012, in Dobrudja, nesting on the electrical pylons (cf. http://sakerlife2.mme.hu/ro/).

Conclusions

– In April – July, 2013, in ROSPA0073 Măcin-Niculiţel, 4 species of diurnal birds of prey (*Accipiter brevipes*, *Buteo rufinus*, *Circaetus gallicus*, and *Hieraaetus pennatus*) were identified and a species (*Falco cherrug*) of the five monitored in this study have not been found.

– 6 breeding pairs of *Accipiter brevipes* were found and 8–12 (16) pairs were estimated.

– 12 breeding pairs of *Buteo rufinus* were found and 15–18 pairs were estimated.

– 2 breeding pairs of *Circaetus gallicus* were found and 2–4 pairs were estimated.

– 8 breeding pairs of *Hieraaetus pennatus* were found and 10–12 pairs were estimated.

– 0 breeding pairs of *Falco cherrug* were found and 0–2 pairs were estimated.

If our data did not underestimate the real figures and, vice versa, if the older information is not overestimated, it results a decreasing trend of the breeding population from the area for *Accipiter brevipes*, *Buteo rufinus* and *Circaetus gallicus*. The number of pairs of *Hieraaetus pennatus* seems to be stable. The lack of observations for *Falco cherrug* suggests the possibility of a temporary disappearance of the species from the area. The human pressure is responsible for this state of facts. Some actions must be taken in order to stop the population decline of these species and to improve their environment of life: the shooting control, the interdiction of the people access in the nesting areas during the breeding time, the reducing of the quarry working, the limitation of the wind farm expanding, the encouragement of the traditional activities with low impact for the milieu, the practice of the ecological agriculture in the protected area and in its vicinity, the banning of the deforestation, the maintaining of the bushy areas and natural grasslands, teaching the inhabitants the respect for nature, the setting of artificial nests, the insulations of the wires against the electrocution, the strict applying of the full area management plan, etc.

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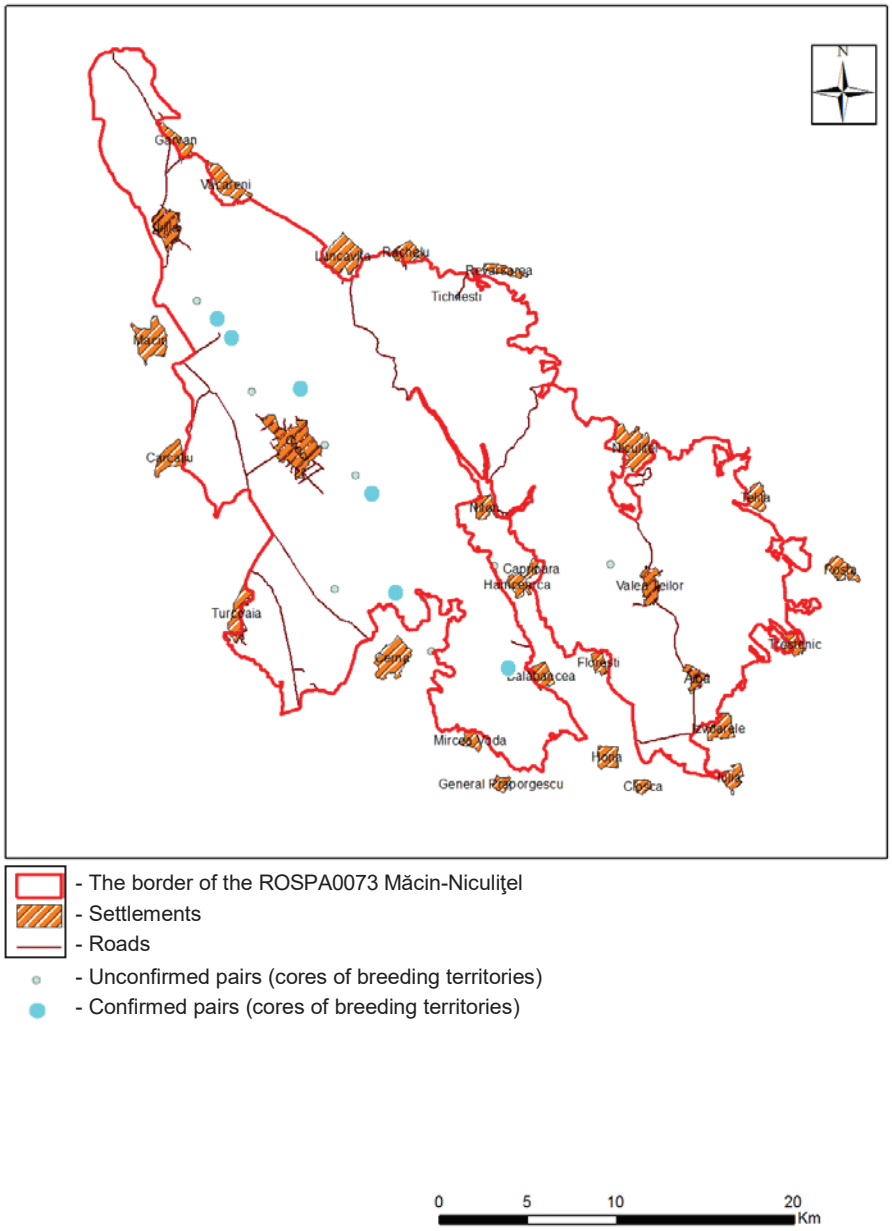


Fig. 2. The distribution map for *Accipiter brevipes*

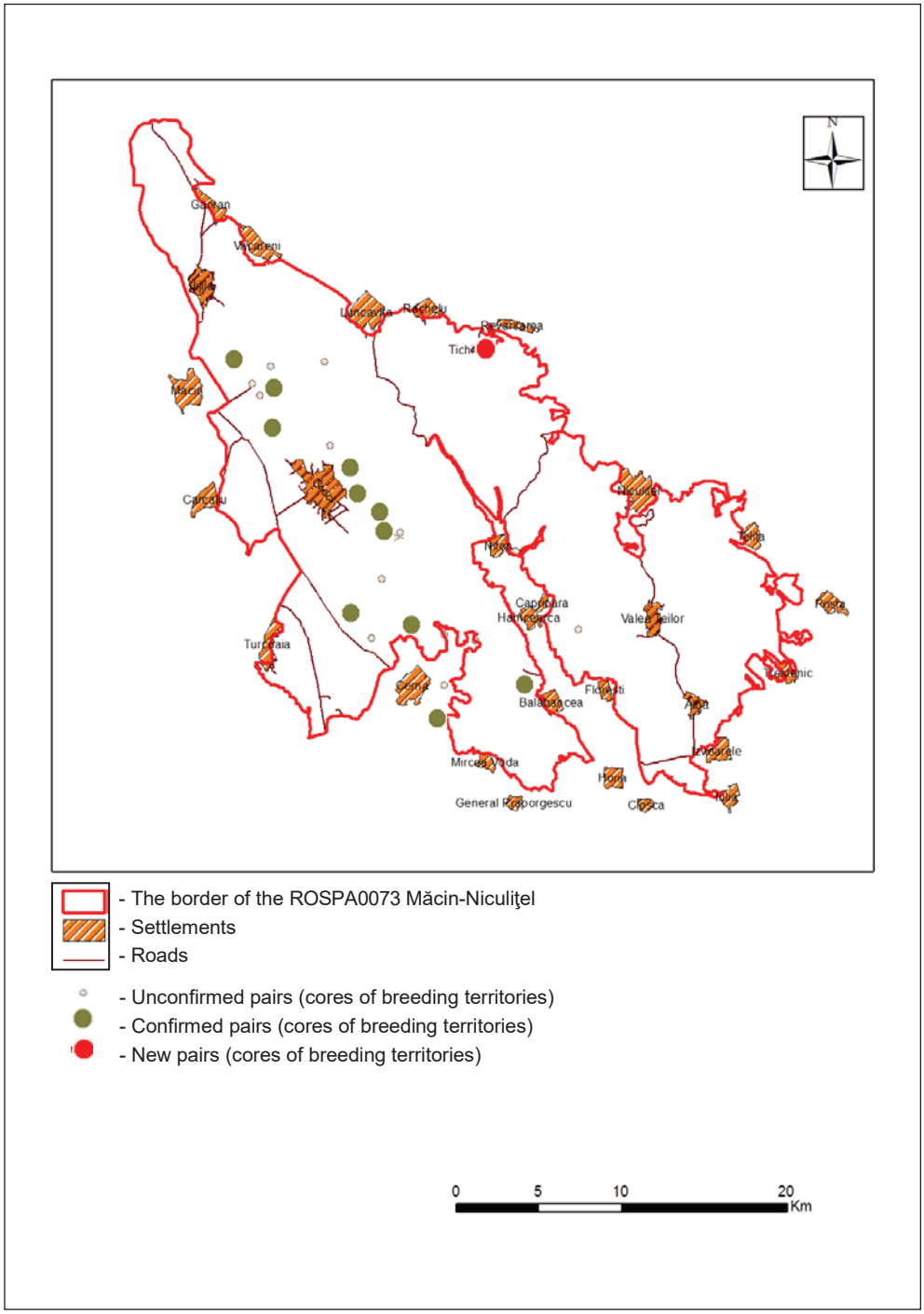
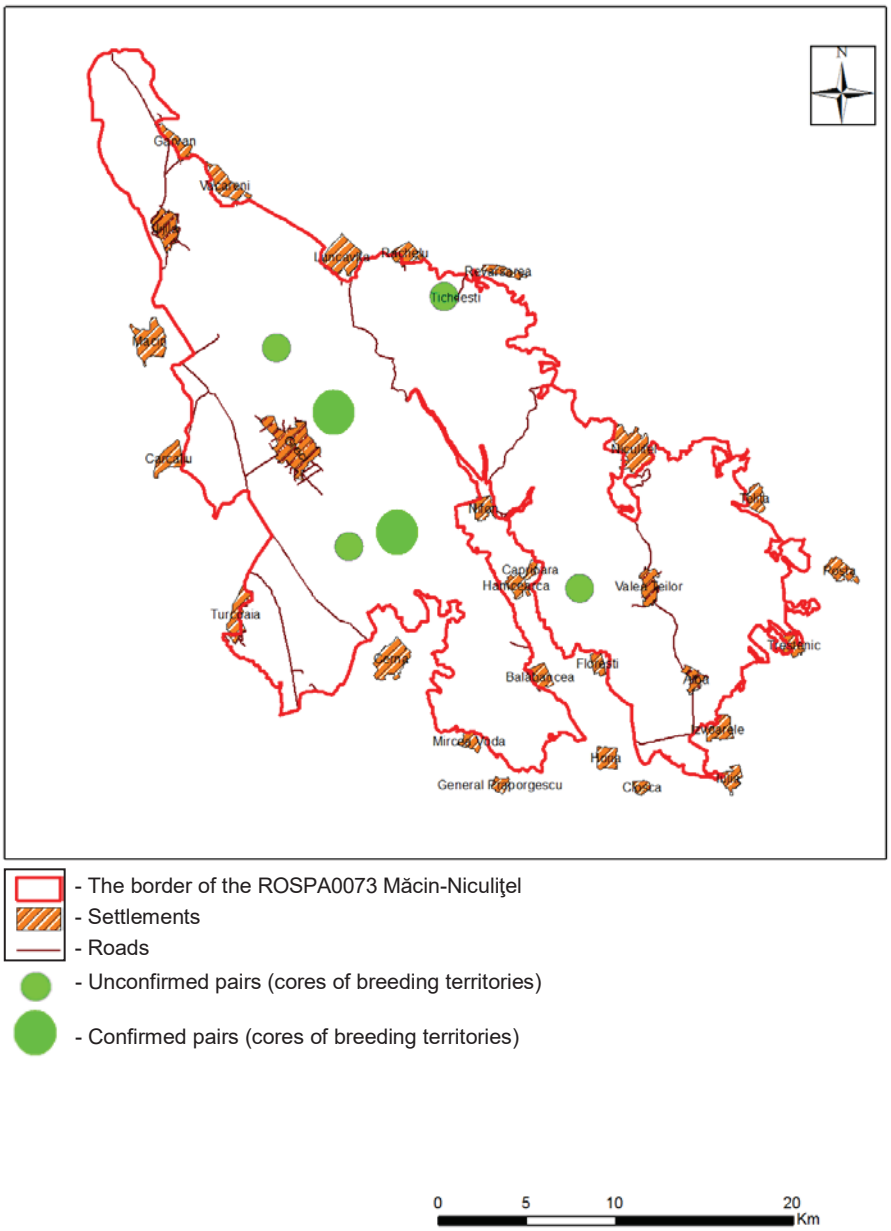


Fig. 3. The distribution map for *Buteo rufinus*



- The border of the ROSPA0073 Măcin-Niculiţel
- Settlements
- Roads
- Unconfirmed pairs (cores of breeding territories)
- Confirmed pairs (cores of breeding territories)

Fig. 4. The distribution map for *Circaetus gallicus*

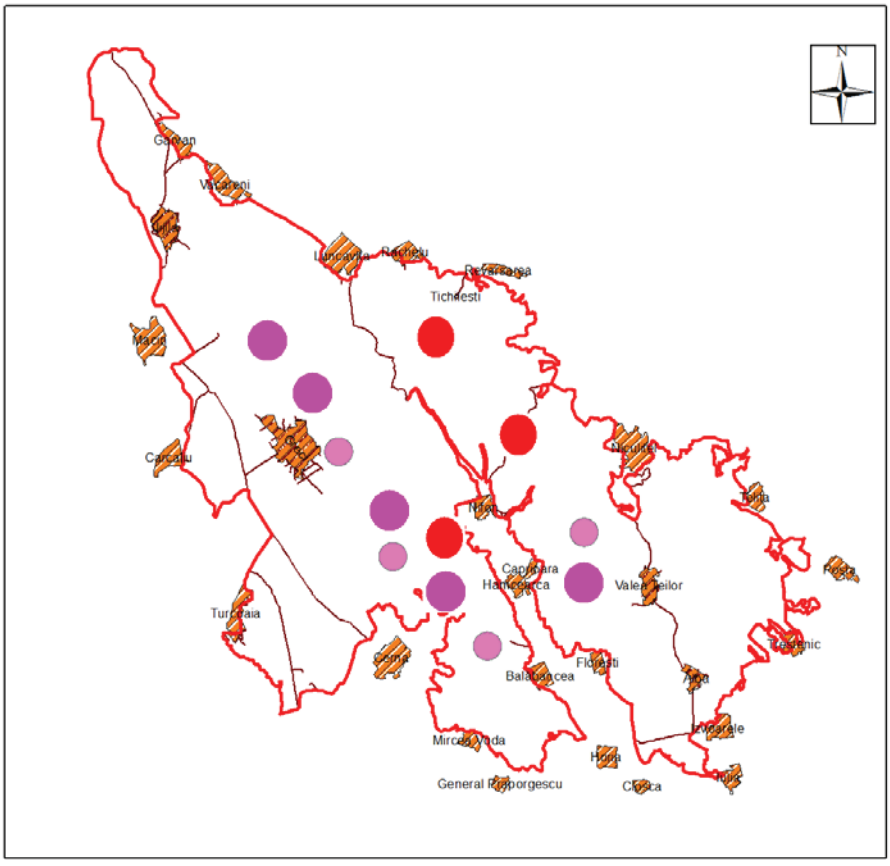


Fig. 5. The distribution map for *Hieraaetus pennatus*

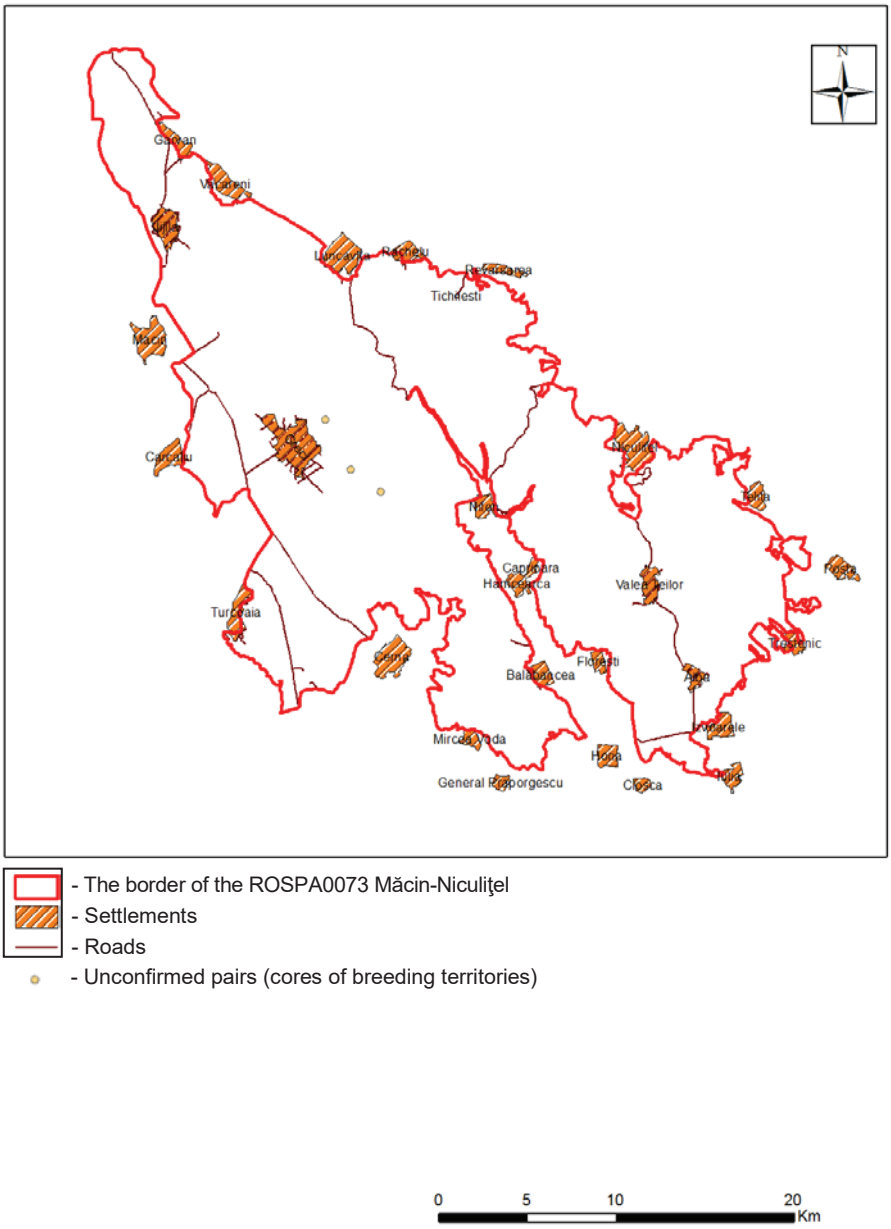


Fig. 6. The distribution map for *Falco cherrug*

DIVERSITY AND STATUS OF TERRESTRIAL VERTEBRATE FAUNA IN LOWER COURSE OF ICHEL RIVER BAZIN, REPUBLIC OF MOLDOVA

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DIVERSITY AND STATUS OF TERRESTRIAL VERTEBRATE FAUNA IN LOWER COURSE OF ICHEL RIVER BAZIN, REPUBLIC OF MOLDOVA

Abstract: The studies were performed in 2012–2016 in various types of ecosystems from the lower course of Ichel river basin. *In the studied ecosystems* 138 species of terrestrial vertebrates were registered: 39 species of mammals, 82 species of birds, 8 reptile and 9 amphibian species. The highest diversity was registered in forest and wet biotopes. Among the registered species 22 are included in the Red Book of R. Moldova, 29 – in Red Book of Vertebrates of Romania, 68 in Annex II and 46 in Annex III of Bern Convention, 22 species in Appendix II of Bonn Convention and 7 species – in IUCN Red List with vulnerability status.
Keywords: Ichel river, terrestrial vertebrates, diversity, conservation status.

Introduction

The Ichel river is an affluent of Nistru river of the Republic of Moldova. It springs at south-east of Sineşti village, Ungheni district and flows to south–east where it flushes in Nistru river near Coşerniţa village of Criuleni district. The Ichel river has a length of 101 km and passes through Călăraşi, Străşeni Criuleni districts and Chişinău city area. The river basin includes natural areas (woods, meadows, steppe sectors, slopes with rocky sites, gorges) and anthropized ones (shelter belts, agrocoenoses, localities, stone mines, roads).

The building of dams and use of river waters for irrigation and aquaculture purposes, especially in the middle and lower course of the river, disturbed the natural course of Ichel river and has affected the natural components of river

basin. Nevertheless, the terrestrial vertebrate fauna of natural area Cricova-Goian from lower Ichel basin is rather rich and there were indicated 97 species of terrestrial vertebrates (Cârlig, Cârlig, 2015). Only several studies can be mentioned, where data on some terrestrial vertebrate species are presented in the study area (Doroshenko, 1975; Cârlig, Cârlig, 2013, 2015; Nistreanu et al., 2013, 2014; Dibolskaia, 2016). Also, data on species occurrence in the lower Ichel basin can be found in the Atlas of Breeding birds of the Republic of Moldova (Munteanu et al., 2010) and in the Atlas of vertebrate species (Munteanu et al., 2013). This study is focused on diversity, biotopic distribution and conservation status of vertebrate fauna species from lower course of Ichel river basin.

Material and methods

The studies were performed in 2012–2016 in various types of ecosystems from the lower course of Ichel river basin, including the natural area Cricova-Goian of Ichel river basin. The mammals were recorded by direct observations, using traps (small mammals), counts on the route, after the traces and trophic activity (carnivorous mammals and artiodactyls), catch with nets and use of ultrasound detector (bats). The birds, reptiles and amphibians were identified and counted after direct observations on routes ranging from 2 to 10 km depending on type of biotope. The ecosystem classification was performed as follow: forest ecosystems – remains of natural forests, shelter belts, tree plantations, forest edge; pasture – pasture, steppe, grassland sectors, rocky ecosystems – slopes with rocky sites, gorges, stone mines; wet ecosystems – riparian, wet meadows, shrub vegetation situated on the river bank; agrocenoses – cereal crops, orchards, vineyards, fallow ground; localities – parks, gardens, agrocenoses within locality limits.

In studies the following equipment was used: binoculars, telescope, laser rangefinder, night vision monocular, GPS E-Trex–10, digital camera Nikon, Panasonic, ultrasonic detector D–230, snap traps, live traps.

To emphasize the position of certain species in a biotope the ecological significance was calculated (W_A) using the formula $W_a = F_a \cdot A_a/100$, where F_a is frequency of the species and A_a – abundance index. The species with the significance lower than 1% in the studied biocenoses are considered accidental; 1.1–5% – accessorial; 5.1–10% – dominant and W > 10% – eudominant in a studied biocoenosis.

The conservation status of terrestrial vertebrates was assessed according to Red Book of the Republic of Moldova, 3rd edition (2015), Red Book of Vertebrates from Romania (2005), Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979), Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 1979), IUCN European Red List. The following criteria of rarity are used in all mentioned sources: LC – Least concern, NT – Near threatened, VU – Vulnerable, EN – Endangered, CR – Critically endangered.

Results

In the studied ecosystems of lower Ichel river basin 138 species of terrestrial vertebrates were registered: 39 species of mammals, 82 species of birds, 8 reptile and 9 amphibian species (Table 1).

Table 1. Diversity of terrestrial vertebrate species in the studied biotopes from natural area Cricova-Goian of Ichel river

No	Species	Ecosystems					
		Forest	Pasture	Rocky sites	Wet	Agrocenoses	Localities
MAMMALIA							
	Insectivora						
1.	*Erinaceus concolor*	+	+	+	+	+	+
2.	*Talpa europaea*	+	+	+	+	+	+
3.	*Sorex araneus*	+	-	-	+	+	+
4.	*Sorex minutus*	+	-	-	+	-	-
5.	*Crocidura leucodon*	+	+	-	+	+	+
6.	*Crocidura suaveolens*	+	+	-	+	+	+
	Chiroptera						
7.	*Rhinolophus hipposideros*	+	-	+	-	-	-
8.	*Myotis bechsteini*	-	-	+	-	-	-
9.	*Myotis daubentoni*	+	-	+	+	-	+
10.	*Myotis dasycneme*	+	-	+	+	-	-
11.	*Myotis mystacinus*	+	-	+	+	-	-
12.	*Nyctalus noctula*	-	+	-	+	+	+
13.	*Pipistrellus pipistrellus*	-	-	+	+	+	+
14.	*Plecotus auritus*	+	-	+	+	-	-
15.	*Plecotus austriacus*	+	-	+	+	+	+
16.	*Eptesicus serotinus*	+	+	+	+	+	+
	Rodentia						
17.	*Sciurus vulgaris*	+	-	-	-	-	+
18.	*Muscardinus avellanarius*	+	-	-	-	-	-
19.	*Nannospalax leucodon*	-	+	+	-	+	+
20.	*Ondatra zibethicus*	-	-	-	+	-	-
21.	*Arvicola terrestris*	-	-	-	+	-	-
22.	*Cricetus cricetus*	-	+	-	-	-	-
23.	*Rattus norvegicus*	-	-	-	-	+	+
24.	*Mus musculus*	-	-	-	+	+	+
25.	*Mus spicilegus*	-	+	-	+	+	+
26.	*Micromys minutus*	-	-	-	+	-	-
27.	*Apodemus sylvaticus*	+	-	+	+	+	+
28.	*Apodemus uralensis*	-	+	+	+	+	+
29.	*Apodemus flavicollis*	+	-	-	-	+	+

No	Species	Ecosystems					
		Forest	Pasture	Rocky sites	Wet	Agrocenoses	Localities
30.	*Apodemus agrarius*	+	+	-	+	+	+
31.	*Microtus arvalis*	-	+	-	+	-	+
32.	*M. rossiaemeridionalis*	+	-	-	+	-	+
33.	*Clethrionomys glareolus*	+	-	-	-	-	-
	Lagomorpha						
34.	*Lepus europaeus*	+	-	-	-	+	-
	Carnivora						
35.	*Vulpes vulpes*	+	+	+	+	+	+
36.	*Mustela putorius*	+	+	+	-	+	+
37.	*Mustela nivalis*	+	-	+	-	+	+
38.	*Martes foina*	+	-	+	-	-	-
39.	*Lutra lutra*	-	-	-	+	-	-
	AVES						
	Ciconiformes						
40.	*Ixobrychus minutus*	-	-	-	+	-	-
41.	*Ciconia ciconia*	-	-	-	+	-	+
42.	*Ardea cinerea*	-	-	-	+	-	-
	Anseriformes						
43.	*Anas platyrhynchos*	-	-	-	+	-	-
	Falconiformes						
44.	*Circus aeruginosus*	-	-	-	+	-	-
45.	*Buteo buteo*	+	+	+	-	+	-
46.	*Falco tinnunculus*	+	-	-	-	+	-
	Galliformes						
47.	*Perdix perdix*	-	+	-	-	+	-
48.	*Coturnix coturnix*	-	+	-	-	+	-
49.	*Phasianus colchicus*	+	+	-	-	+	-
	Caradriiformes						
50.	*Charadrius dubius*	-	-	-	+	-	-
51.	*Scolopax rusticola*	+	-	-	-	-	-
	Columbiformes						
52.	*Columba livia*	-	-	-	+	+	+
53.	*Columba palumbus*	+	-	-	-	-	+
54.	*Streptopelia decaocto*	-	-	-	-	+	+
55.	*Streptopelia turtur*	+	-	-	-	-	+
	Cuculiformes						
56.	*Cuculus canorus*	+	-	-	-	-	+
	Strigiformes						
57.	*Otus scops*	+	-	-	-	-	-
58.	*Athene noctua*	-	-	-	+	+	+
59.	*Asio otus*	+	+	+	+	+	+

No	Species	Ecosystems					
		Forest	Pasture	Rocky sites	Wet	Agroce-noses	Locali-ties
	Apodiformes						
60.	*Apus apus*	-	-	+	-	-	-
	Coraciiformes						
61.	*Alcedo athis*	-	-	-	+	-	-
62.	*Merops apiaster*	-	-	+	+	-	-
63.	*Upupa epops*	+	-	+	-	-	-
	Piciformes						
64.	*Jynx torquilla*	+	-	-	-	-	-
65.	*Picus canus*	+	-	-	-	-	-
66.	*Dendrocopos major*	+	-	-	-	+	+
67.	*Dendrocopos minor*	+	-	-	-	-	+
68.	*Dendrocopos syriacus*	+	-	-	-	+	+
	Passeriformes						
69.	*Galerida cristata*	-	+	-	-	+	+
70.	*Lululla arborea*	+	-	-	-	-	-
71.	*Alauda arvensis*	-	+	-	-	+	-
72.	*Anthus campestris*	-	+	-	-	-	-
73.	*Anthus trivialis*	+	-	-	-	+	+
74.	*Hirundo rustica*	-	-	-	+	+	+
75.	*Delichon urbica*	-	-	-	+	+	+
76.	*Riparia riparia*	-	-	+	+	-	-
77.	*Motacilla alba*	-	-	+	+	+	+
78.	*Motacilla flava*	+	-	-	+	-	-
79.	*Troglodytes troglodytes*	+	-	-	-	-	-
80.	*Erithacus rubecula*	+	-	-	+	-	+
81.	*Luscinia luscinia*	+	-	-	+	-	+
82.	*Phoenecurus ochruros*	-	-	+	-	-	+
83.	*Ph. phoenecurus*	+	-	+	-	-	-
84.	*Saxicola rubetra*	-	+	-	-	-	-
85.	*Saxicola torquata*	-	+	-	-	+	-
86.	*Oenanthe oenanthe*	-	-	-	-	-	-
87.	*Turdus merula*	+	-	-	-	-	+
88.	*Turdus pilaris*	-	-	-	-	+	-
89.	*Turdus philomelos*	+	-	-	-	-	+
90.	*Turdus merula*	+	-	-	-	-	+
91.	*Acrocephalus arundinaceus*	-	-	-	+	-	-
92.	*Hippolais icterina*	+	-	-	-	-	-
93.	*Sylvia communis*	+	-	-	-	+	-
94.	*Sylvia borin*	+	-	-	+	+	+
95.	*Sylvia atricapilla*	+	-	-	-	+	+
96.	*Phylloscopus collybita*	+	-	-	+	-	+

No	Species	Ecosystems					
		Forest	Pasture	Rocky sites	Wet	Agrocenoses	Localities
97.	*Phylloscopus sibilatrix*	+	-	-	-	-	-
98.	*Muscicapa striata*	+	-	-	-	-	+
99.	*Parus major*	+	-	+	+	+	+
100.	*Parus caeruleus*	+	-	-	+	-	+
101.	*Sitta europaea*	+	-	-	-	-	+
102.	*Certhia familiaris*	+	-	-	-	-	-
103.	*Oriolus oriolus*	+	-	-	-	-	-
104.	*Lanius collurio*	+	+	-	+	+	-
105.	*Corvus corax*	+	-	+	+	+	-
106.	*Corvus frugilegus*	-	-	-	-	-	+
107.	*Corvus corone cornix*	-	-	-	-	+	+
108.	*Corvus monedula*	-	-	-	-	+	+
109.	*Pica pica*	+	+	+	+	+	+
110.	*Garrulus glandarius*	+	-	-	+	-	+
111.	*Sturnus vulgaris*	+	+	+	+	+	+
112.	*Passer domesticus*	-	-	+	+	+	+
113.	*Passer montanus*	+	+	+	+	+	+
114.	*Fringilla coelebs*	+	-	-	+	+	+
115.	*Serinus serinus*	+	-	-	-	-	-
116.	*Carduelis chloris*	+	-	-	+	-	+
117.	*Carduelis carduelis*	+	+	-	+	+	+
118.	*Carduelis cannabina*	-	+	-	-	+	+
119.	*Coccothraustes coccothraustes*	+	-	-	-	+	-
120.	*Emberiza citrinella*	+	+	-	+	-	-
121.	*Miliaria calandra*	-	-	-	-	+	-
REPTILIA							
	Testudines						
122.	*Emys orbicularis*	-	-	-	+	-	-
	Squamata						
123.	*Anguis fragilis*	+	-	-	+	-	-
124.	*Lacerta viridis*	+	-	+	+	+	+
125.	*Lacerta agilis*	-	+	+	+	+	+
126.	*Natrix natrix*	-	-	+	+	-	+
127.	*Natrix tesselata*	+	-	-	+	-	-
128.	*Coluber caspius*	-	-	+	-	-	-
129.	*Coronella austriaca*	+	-	+	-	-	-
AMPHIBIA							
	Urodela						
130.	*Triturus cristatus*	-	-	-	+	-	-
	Anura						
131.	*Bufo bufo*	+	-	-	+	-	-

No	Species	Ecosystems					
		Forest	**Pasture**	**Rocky sites**	**Wet**	**Agrocenoses**	**Localities**
132.	*Bufo viridis*	-	-	-	+	-	-
133.	*Bombina bombina*	+	-	-	+	-	-
134.	*Rana dalmatina*	+	-	-	+	-	-
135.	*Pelophylax ridibundus*	-	-	-	+	-	+
136.	*Pelophylax lessonae*	+	-	-	+	-	-
137.	*Hyla arborea*	-	-	-	+	-	-
138.	*Pelobates fuscus*	-	-	-	+	-	-
Total species		**82**	**31**	**38**	**75**	**59**	**69**

The common and eurytopic mammals species, such as eastern hedgehog, mole, serotine bat, mole-rat, wood mouse, fox are frequent and widespread in the studied territory, with a frequency of 47%–76% and a dominant or eudominant ecological significance (W_a = 8–36%). The hygrophilous species, such as water vole, muskrat, otter were recorded only in wet biotopes with accessorial or dominant significance (W_a = 3.2–8.8%) in studied ecosystems

Among birds the most common and widespread in various type of habitats were the long-eared owl, the magpie, the common starling and both sparrow species that were observed in all studied ecosystems with a frequency of 58%–80% and dominant or eudominant ecological significance (W_a = 6–54%) during the whole year. The aquatic birds and waders were registered in wet biotopes near water basins. The nesting bird species were registered in spring-summer period, the migratory birds were registered during spring and autumn migrations.

The most common reptile species were the green and sand lizards, the first one is absent in steppe sectors, the second one is absent inside forest ecosystems, it can be met only at ecotone of woods. All amphibian species were registered in wet biotopes, in riparian and paludous ecosystems, some species were recorded in forest ecosystems and only one species – marsh from was observed in localities (Table 1).

The forest ecosystems that include woods, shelter belts, ecotone zone are suitable for the many species of terrestrial vertebrates, which use these biotopes for nesting, for feeding of for shelter. The wet biotopes are favorable for most of species, for hygrophilous mammal species, for water birds and waders, for the majority of reptile species and for all amphibian species. The rocky ecosystems provide shelter and favorable conditions for bat species (reproduction, hibernation), for carnivorous species (shelter, reproduction), for several bird species (shelter, reproduction, feeding), for some rare snake species. In agricultural ecosystems many insectivore, rodent, carnivorous mammal species and prey bird species occur, due to abundant trophic resources. Many passerine birds find favorable trophic and nesting conditions in agrocenoses as well. As to reptiles

and amphibians they are accidental in agricultural ecosystems. The open type biotopes – pastures and steppe sectors have the lowest number of species. Only eurytopic species or those adapted to specific conditions can be observed here. The fauna of localities is rather rich – 69 species, of which several are synanthropic, several are eurytopic and many other periodically, depending on season, find favorable trophic, breeding or shelter conditions.

The conservation status of the species was assessed in comparative aspect, according to the red lists of R. Moldova, Romania, Europe and several European conventions (Table 2).

Among the registered vertebrate species in the Red Book of the Republic of Moldova are listed 11 mammal species: *C. leucodon* (VU), *Rh. hipposideros* (EN), *M. bechsteinii* (CR), *M. dasycneme* (EN), *M. daubentonii* (VU), *M. mystacinus* (VU), *P. auritus* (EN), *P. austriacus* (VU), *C. cricetus* (VU), *M. minutus* (VU), *L. lutra* (VU); one bird species – *C. ciconia* (VU); 4 reptile species: *E. orbicularis* (EN), *C. caspius* (EN), *C. austriaca* (EN), *Z. longissimus* (EN) and 6 amphibian species: *T. cristatus* (VU), *P. fuscus* (CR), *B. bufo* (VU), *B. bombina* (VU), *H. arborea* (VU), *R. dalmatina* (VU). It must be mentioned the presence of *E. quatorlineata* in this area in the past century. Unfortunately, the species could not be found in the last 30 years in the lower basin of Ichel river.

Table 2. Rarity status of terrestrial vertebrate species in lower Ichel river

No	Class	No of species					
		RBRM	RBVR	Bern Convention		Bonn Convention	IUCN
				Annex II	Annex III		
1.	Mammals	11	14	11	10	10	4
2.	Birds	1	5	45	30	12	2
3.	Reptiles	4	5	7	1	-	1
4.	Amphibians	6	6	5	4	-	-
Total species		**22**	**30**	**68**	**46**	**22**	**7**

In the red Book of Vertebrates from Romania there are listed 14 mammal species: *C. leucodon* (VU), *C. suaveolens* (VU), *Rh. hipposideros* (VU), *M. dasycneme* (CR), *M. daubentonii* (CR), *M. mystacinus* (EN), *M. bechsteinii* (EN), *P. auritus* (VU), *P. austriacus* (EN), *E. serotinus* (VU), *M. avellanarius* (VU), *C. cricetus* (VU), *M. minutus* (VU), *L. lutra* (VU); 5 bird species: *C. ciconia* (VU), *S. turtur* (VU), *U. epops* (VU), *J. torquilla* (EN) *C. corax* (EN); 5 reptile species: *E. orbicularis* (VU), *C. caspius* (VU), *C. austriaca* (VU), *Z. longissimus* (VU), *N. tesselata* (NT) and 6 amphibian species: *T. cristatus* (VU), *B. bombina* (NT), *P. fuscus* (CR), *B. bufo* (NT), *H. arborea* (VU), *R. dalmatina* (VU).

In Bern Convention at Annex II (strictly protected fauna species) the following species are listed: all species of chiropterans (except *P. pipistrellus*), *C. cricetus*, *L. lutra* from mammals; *I. minutus*, *C. ciconia*, all species of Falconiformes and

Strigiformes, *Ch. dubius*, *A. athis*, *M. apiaster*, *U. epops*, all species of Piciformes, Hirundinidae, Motacillidae, Laniidae, *T. troglodytes*, *E. rubecula*, *L. luscinia*, *O. oenante*, *Ph. ochruros*, *Ph. phoenicurus*, *S. rubetra*, *S. torquata*, all species of Silvinae, Muscicapinae, Paridae, Sittidae, Certhiidae, *E. citrinella*, *C. cannabina*, *C. carduelis*, *C. chloris C. coccothraustes*, *S. serinus*, *O. oriolus* among birds; *E. orbicularis, L. agilis, L. viridis, C. caspius, C. austriaca, E. longissima, N. tesselata* among reptiles and *T. cristatus, P. fuscus, B. viridis, H. arborea, R. dalmatina* among amphibians. In Annex III (protected fauna species) there are listed all Soricidae species, *P. pipistrellus, S. vulgaris*, all Gliridae species, *M. foina, M. nivalis, M. putorius* among mammals; all species of birds not included in Annex II with the exception of *C. palumbus, C. corone, C. frugilegus, C. monedula, G. glandarius, P. domesticus, S. vulgaris, P. pica*; all species of reptiles and amphibians not included in Annex II.

None of the registered species is included in Appendix I of Bonn Convention. In App. II there are included 10 mammal species (all bat species) and 12 bird species (*I. minutus*, *C. ciconia*, *A. plathirhynchos, C. coturnix, S. turtur*, *M. apiaster*, all Chardriidae, Scolopacidae, Accipitridae, Falconidae and Muscicapidae species).

In IUCN Red list only 7 species are of concern for conservation: *Rh. hipposideros* (NT), *M. bechsteinii* (VU), *M. dasycneme* (NT), *L. lutra* (NT), *S. turtur* (VU), *A. athis* (VU) and *E. orbicularis* (NT). The rest of species are of Least Concern.

Conclusions

During the study 138 species of terrestrial vertebrates were registered: 39 species of mammals, 82 species of birds, 8 reptile and 9 amphibian species. The highest diversity was registered in forest and wet biotopes. Among the registered species 22 are included in the Red Book of R. Moldova, 29 – in Red Book of Vertebrates of Romania, 68 in Annex II and 46 in Annex III of Bern Convention, 22 species in Appendix II of Bonn Convention and 7 species – in IUCN Red List with vulnerability status. Despite of strong anthropic disturbances the ecosystems from lower basin of Ichel river provide favorable conditions for a high number of terrestrial vertebrate species.

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BIOMONITORING ATMOSPHERIC POLLUTION IN FOREST ECOSYSTEM "RACOVĂȚII DE SUD"

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BIOMONITORING ATMOSPHERIC POLLUTION IN FOREST ECOSYSTEM "RACOVĂȚII DE SUD"

Abstract: Applying the method biomonitoring passive, lichenindication, taking into account the abundance and toxitolerance indicator species for the content of SO_2 atmosphere, it was assessed ambient air quality in forest ecosystem "Racovăţii de Sud" according to the Scale Gradation Evaluation of Air Quality (GECA) proposed by Begu et Brega (2009) for Republic of Moldova. Thus, the air quality from studied area is assessed as low polluted with SO_2 (SO_2 = 0.05 to 0, 1mg/m^3 air), which show significant effects of pollution sources in the area, including cross-border ones.
Keywords: SO_2 pollution, lichen indication, forest ecosystem.

Introduction

During last decades the anthropogenic factors of air pollution began to surpass the natural ones, thus acquiring a global character. Emissions into the atmosphere, in addition to negative environmental impacts, show negative effects on human health, too, are potential to alter the properties of the atmosphere itself, which may lead to adverse climate and ecological consequences (Begu et Brega, 2009). Damages that air pollution cause to plants, animals and humans are often obvious and can be easily recognized, but the most frequently they act on unnoticed and their impact can occur after a long period of time (FAO – UNESCO, 1989). The significant impacts on forest ecosystems have the atmospheric pollutants (sulfur compounds, nitrogen, ozone and heavy metals). According to studies conducted within ICP Forest Programme (EMEP/CCC-Report, 2013, Fischer et al, 2010) transported at distances sulfur compounds, which are deemed to directly or indirectly influence the health of forest ecosystems are: SO_2, SO_3, SO_4^{2-} (Begu et Brega, 2009).

Research in this area have identified that many of the toxic effects of air pollutants are difficult to identify and cataloged, because most of them act synergistically with other biotic and abiotic stressors (ICP Forest, 1997). Effects of sulfur are manifested by dabbing the alkali nutritive cations, and acidification, and eutrophication substrate. At the same time, due to soil acidification is favored and accelerated the mobility of heavy metals accumulated in the soil as result of atmospheric deposition (Brummer et Herms, 1983).

For monitoring atmospheric pollution of forest ecosystems, some states have wide implemented the method of ecobioindication. This method is based on the study of species and communities of organisms susceptible to changing environmental conditions, or having cumulative features, particularly of chemical pollutants. Most popular bio-indicators of air quality are lichens (lichen indication), successfully used in ecological monitoring in many countries of the world (Begu, 2011). Lichens are extremely sensitive to environmental stress conditions, especially to air pollution, eutrophication and climate change. Under the Directive on air quality of the Geneva Convention (1979), lichens have been proposed for the definition / revision of critical levels and loads of pollutants for different types of sensitive ecosystems (Nimis et al., 2002). The main advantage of the lichen indication is the possibility of early detecting the environmental changes and level of pollution, for a wide range of pollutants, especially SO_2, before other components of ecosystems would be affected (Begu, 2011).

In our study, applying the passive biological monitoring through the method of lichen indication, allowed us to perform an evaluation of air quality in regard with SO_2 pollution.

Materials and methods

As subject for study served the forest ecosystem "Racovăţii de Sud" from the Forestry Soroca, Soroca State Forestry Enterprise in the Cereşnovăţ River basin (Fig. 1).

To achieve the aim of this study were conducted field and laboratory research in the period 2011–2015.

Was determined the coverage range of the substrate by lichens – based on the scale of abundance-dominance of Braun – Blanquet (1965), with approximate visual assessment of the percentage of strain coverage for each species (Ivan et Doniţă, 1975).

Determination of the systematic appertaining was carried out under laboratory conditions, starting with visual analysis, then using the magnifying glass МБС–10 and of the microscope Mikmed–5, using special determinators.

Applying the method of lichen indication, which takes into account the abundance and toxicity tolerance of indicator species to SO_2, was measured the air quality of the forest ecosystem "Racovăţii de Sud" according to Scale of Gradation of Evaluation of Air Quality proposed by Begu et Brega (2009) for Republic of Moldova.

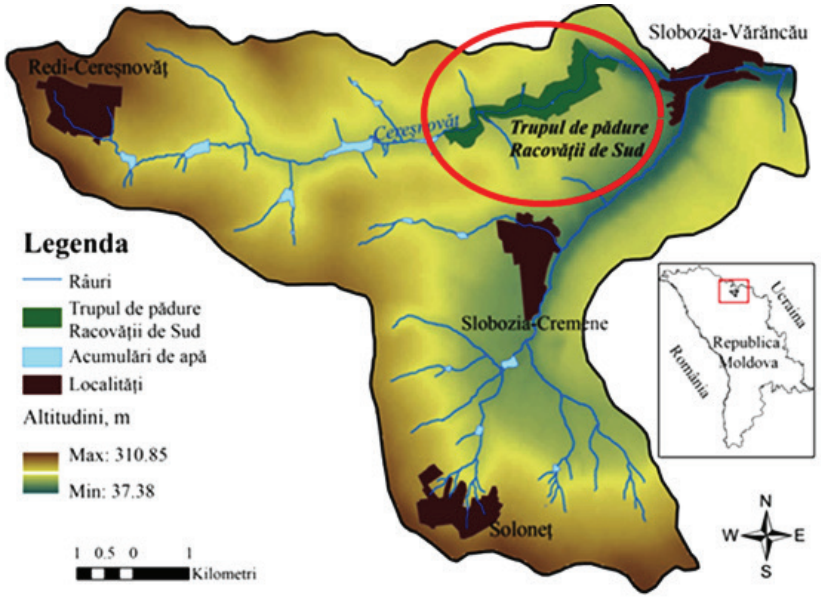

Fig. 1. Cereşnovăţ River basin

Results and discussions

Within the studied forest ecosystem "Racovăţii de Sud", lichen biodiversity represented 12 species with different degree of toxicity tolerance to SO_2, which are recommended as species for bio indication for Republic of Moldova (Begu et Brega, 2009; Begu, 2011). The species of lichens recorded by us that are dominants within respective ecosystem, according to the scale of toxicity tolerance proposed by Begu (2011), belong to the level II and III of toxicity tolerance, indicate, depending on abundance, a weak pollution of air with SO_2 (Table 1).

Table 1 Specific diversity, toxicity tolerance and abundance (%) of registered lichens in forest ecosystem "Racovăţii de Sud"

The level of toxicity tolerance to SO_2	**Air quality**	**Registered lichens species**	**The abundance of lichens species (%)**
I	**Clean air**	*Ramalina fraxinea*	2
II	**Low pollution**	*Cladonia fimbriata*	1
		Evernia prunastri	26
		Parmelia caperata	7
		Parmelia sulcata	15
III	**Moderate pollution**	*Hypogymnia physodes*	10
		Parmelia acetabulum	7
		Parmelia olivacea	5
		Physcia stellaris	5

The level of toxicity tolerance to SO_2	Air quality	Registered lichens species	The abundance of lichens species (%)
IV	**High pollution**	*Candelariella vitellina*	7
V	Very high pollution	Xanthoria parietina	8
		Lepraria aeruginosa	5

Thus, air quality in regard with SO_2 content is appreciated as low polluted with SO_2 (SO_2 = 0.05-0,1 mg / m^3 air) (Table 2). The quality of air – low polluted with SO_2, shows insignificant effects of pollution sources in the area, including cross-border ones. The dominance of species of lichens with degree of toxicity tolerance II (*Evernia prunastri*, *Cladonia fimbriata*, *Parmelia capers*, *Parmelia sulcata*), confirm low polluted air with SO_2, that are determined by the location of trans boundary sources of pollution disadvantaged by the dominance of wind direction in studied area.

Table 2 The air quality in the forest ecosystem "Racovăţii de Sud", according to (GECA), based on abundance of lichens species and level of toxicity tolerance (Begu et Brega, 2009)

Air quality	Content SO_2 in air, mg/m^3	Abundance of species with different degree of toxicity tolerance,% of substrate surface
Clean	<0,05	I > 10 or I < 10 and II > 75
Low polluted	0,05–0,1	I – 0–10 or II – 50–75
Moderate polluted	0,1–0,2	II – 10–50 or III > 50
Polluted	0,2–0,3	III – 10–50 or IV > 50
High polluted	0,3–0,5	IV – 10–50 or V – 1–100
Critical pollution	>0,5	Total absence of lichens
Racovăţii de Sud	0,05–0,1	I – 0–10

The result obtained in the present study – low polluted air with SO_2, show an improvement of air quality compared to the results of previous studies (2009) made over 63 forest ecosystems of RM, according to which in this area was certified moderately polluted air with SO_2 (Fig. 2). These results show a downward trend in emissions of pollution sources in the area, including cross-border ones.

The quality of air in the forest ecosystem "Racovăţii de Sud" of course is influenced by multiple biotic and abiotic factors (altitude, exhibition, rose wind, rainfall, etc.) and their interrelationship, but obviously it can be influences by atmospheric deposition of S-SO_4^{2-}, which in this area were heavy deposits for 2012.

Low polluted air with SO_2 can affect in long-term perspective the structural stability and function of forest ecosystem studied. These processes are manifested by the effects of acidification and eutrophication resulting from sulfur and nitrogen oxide emissions from economic sector. Degradable effects caused by sulfur compounds can be hardest felt by oak species as a result of low toxicity tolerance to sulfur, after sulfur content in leaves (*Quercus petraea* – 2.0 g/kg for

Quercus robur – 15 g / kg), according to Bolea et Chira (2008). Thus, in order to avoid and relieve the risk of threat to valuable oak species within the forest ecosystem "Racovăţii de Sud" (secular ones), as well as to other vulnerable species of flora and fauna, are required steps to protect and preserve the given ecosystem.

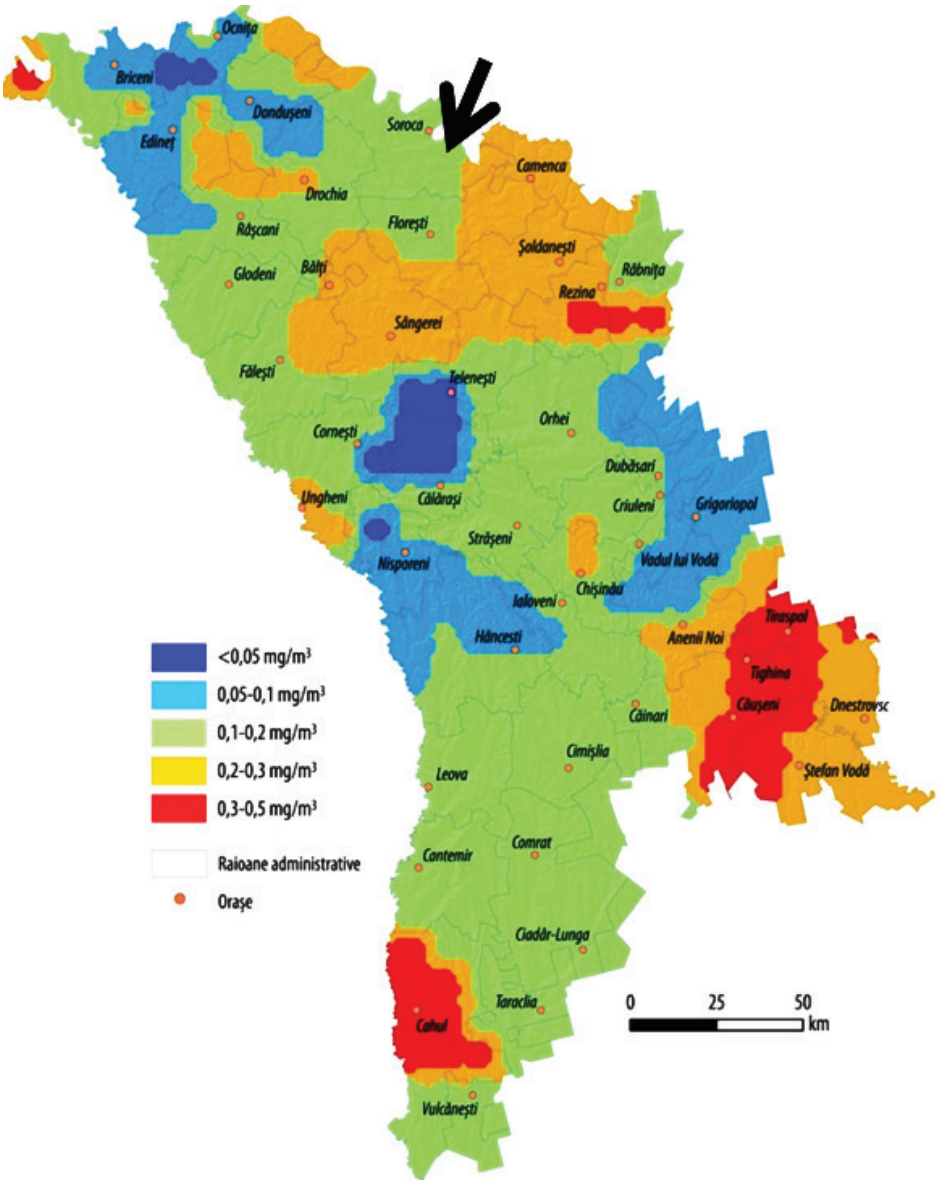

Fig. 2. The spatial distribution of SO_2 pollution on the territory of Moldova, established using lichen indication, Begu et Brega (2009)

Conclusions

Based on lichen indication, in the forest ecosystem "Racovăţii de Sud" the air quality is assessed as low polluted with SO_2 (SO_2 = 0.05 to 0,1mg / m^3 air), which shows significant effects of pollution sources in the area, including cross-border ones. In long-term perspective the structural stability and sustainable functionality of the forest ecosystem studied may be affected by the intensity of the economic processes that contribute to the emission of SO_2 into the atmosphere with adverse effects on the strengthening of oak species, which have a low toxicity tolerance to SO_2.

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*****2013:** *EMEP/CCC-Report 4, Heavy metals and POP measurements*, *2011. Norwegian Institute for Air Research PO Box 100, NO–2027*. 136 p., Kjeller, Norway.

*****1988:** *FAO – UNESCO, Soil map of the world, revised legend – Report 60 FAO – UNESCO –* Rome, 1988, Published by ISRIC, Wageningen.

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THE ENVIRONMENT ISSUE IN THE HIGHER EDUCATION SYSTEM: STATE UNIVERSITY OF MOLDOVA AND "ION CREANGA" STATE PEDAGOGICAL UNIVERSITY – CASE STUDY

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THE ENVIRONMENT ISSUE IN THE HIGHER EDUCATION SYSTEM: STATE UNIVERSITY OF MOLDOVA AND "ION CREANGA" STATE PEDAGOGICAL UNIVERSITY – CASE STUDY

Abstract: In this article it is analysed the focus on environmental issues in the State University of Moldova (SUM) and "Ion Creanga" State Pedagogical University ("I. Creanga" SPU). According to archives, the study of environmental issues evolved significantly in the higher education systems around ,80s. SUM and SPU established special departments and laboratories focused on environmental issues which consequently determined them to be taught as part of the standard list of subjects studied in these universities. SUM fully dedicated to the training process of specialists in ecology, scientific research and spreading knowledge and practices about environmental protection. PSU contributed by streamlining the educational methods and preparing the young generation through developing the ecology related subjects. There were, as well, developed various teaching methods to prepare stuff for schools and preschools, to teach and spread knowledge about environmental issues.
Keywords: environmental protection, ecological disciplines, environmental policies, State University of Moldova, State Pedagogical University.

After the Second World War most Western countries involved in the conflict have started a policy of rapid economic revival. In the USSR, a process of forced retrieval based on extensive development and resource mobilization was initiated, which caused significant environmental damages. The tense relations between the capitalist and the socialist system, the danger of a nuclear cataclysm prompted the civil society to assess the gravity of the situation. According to the scientists, the environmental protection is a priority for the socioeconomic development, or a possible nuclear conflict will create an irreparably

damaged ecosystem. In the late '60 of the XXth century, all industrialized countries have adopted laws and administrative measures relating to the protection of the ecosystem[1]. In the summer of 1972, the United Nations General Assembly in Stockholm established the World Environment (Ecology) Day on June 5, and identified the most important world economic policies of the United Nations Environment Program (UNEP). Along with the thaw of the East and West relations, the issue of nature protection and rational use of resources was included in the peace programs concerning the international collaboration approved by the XXIVth, XXVth, XXVIth congresses of the Communist Party of Soviet Union. On 16 May 1978 the Presidium of the Supreme Soviet of the USSR ratified the Convention on prohibiting the use of military means or other methods of negative influence on the environment[2].

The environmental issue, the growth of awareness and responsibility of the population regarding the environmental protection has generated the need to organize the ecological education. According to specialists in ecology, the knowledge of the biosphere can contribute directly to the improvement of the global, regional and local ecological situation[3]. The first organizations that have integrated into the educational process through ecological education, thematic curriculum development, specialists' training, conducting relevant research etc. were higher educational institutions. In 1979–1980, 8 universities where students were hearing the course "the protection of nature" were working in Moldovan Soviet Socialist Republic. With this aim, methodical works, course supports have been developed and at the Moldova Film Studio documentary films have been realized[4]. In 1970–1980, "M. Lomonosov" Moscow State University organized pedagogical internships of training professionals for teaching environmental disciplines[5]. The courses had as resort the UNESCO program "Human and Biosphere"[6]. Such activities were organized also by the State Department for Environmental Protection of Moldovan SSR[7], the Institute of Teachers Retraining[8]. The ecological knowledge was disseminated by the "Znanie" (knowledge) Society, which organized lessons, seminars,

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1 Coteaţă I. *Unul e pământul*. În: *Viaţa satului*, 1982, 5 iunie, p. 4.

2 *Ibidem*

3 Bumbu I. *Ecologia şi protecţia naturii în învăţământul preuniversitar. Aspecte metodice la tema "Omul şi biosfera"*. În: *Făclia*, 1994, 17 iunie.

4 Moldova-Film made the films: "The forest is not just trees", "Traces of ancient life" etc.

5 *The Archive of State University of Moldova* (forward *ASUM*), F. 1, inv. 8, d. 1902 (Personal file, no. D–7, Dediu Ion Ilici), f. 130.

6 In the UN operated multiple bodies designed to ensure the protection of nature. The International Biological Program has been called the "Man and Biosphere" and constituted a serious basis for the research of natural ecosystems. Since 1989 in the USSR is implementing the UNESCO program, which had introduced the principle of ecological education.

7 *ASUM*, F. 1, inv. 8, d. 1754 (The personal file of the doctor in geographic sciences, the reader Mâtcu Matvei)

8 *ASUM*, F. 1, inv. 8, d. 1902 (Personal file, no. D–7, Dediu Ion Ilici), f. 78.

attended both by teachers and students, as well as inspectors-environmentalists, officials[9].

Environmental issues at State University of Moldova. Since 1973, at the "V. Lenin" State University in Chisinau, two fields of study have been established within the Faculty of Biology and Soil Science: "Ecology and environmental protection" and "Entomology and the biological protection of plants" on the initiative of a working group from the Department of Zoology and Botany, guided by the dean Ion Dediu[10]. By establishing these important specializations it was aimed to ensure the national economy with highly skilled ecologists, to coordinate the issues of environmental education in institutions of higher education, to contribute to the personnel retraining, etc. The titular teachers were performing documentation trips in the territory, but also at the internships organized within the "M. Lomonosov" Moscow State University for the "Environmental protection" discipline. As a result of the internship, Ion Dediu included within the Faculty of Biology and Soil Science innovative, interactive teaching methods of the discipline "Ecology and environmental protection"[11].

In the 1980 the issue of the environmental protection was addressed more intensively at union level. The ecological topics were researched in approximately 200 scientific institutions within USSR, have been reflected in the Communist Party's and state programs[12]. For example, a series of ecological activities were set in the draft of the CC of the CPSU for the XXVIth congress "Fundamental directions of economic and social development of the USSR for 1981–1985 and the period up to 1990". In the chapter "Nature protection" it was noticed on the state leadership qualification and control enhancement in nature protection and the environment, wider mobilization of society in nature protection activities[13]. The scientists from MSSR were participating in 14 international projects: "Ecology and rational use of the main ecosystems", "Ecological aspects of urban systems", "The mutual action between the transformed environment and the genetic and demographic adaptive structures of the population", "The research of the impurities from the environment and their influence on the biosphere" etc. The Ministry of Education

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9 The Archive of Social-Political Organizations of the Republic of Moldova (forward *ASPO RM*), F. 586, inv. 126, d. 13, f. 126.

10 Ion Dediu (born on June 24, 1934 in Rediu Mare village, Soroca county). In 1976, he was elected as chairman of the Inter-University Council for coordination on the issue of "Protection and rational use of natural resources". He is the founder of the national ecological school, the school of acoustic ecotoxicology and school of politic ecology. Professor (1981), associate (1992). Doctoral supervisor of circa 30 doctors in biological sciences etc. Author of about 400 scientific papers, including 20 monographs. Decorated with the Order of the Republic (2010) etc. În: *Membrii Academiei de Ştiinţe a Moldovei. Dicţionar (1961–2006)*. Chişinău: Ştiinţa, 2006, p. 184–185; Dediu I. *Enciclopedie de ecologie*. Chişinău: Ştiinţa, 2010, p. 835.

11 ASUM, Fond 1, inv. 8, d. 1902 (Personal file, no D–7, Dediu Ion Ilici), f. 79. In 1987 he was at the third placement of this type.

12 ASPO, F. 586, inv. 126, d. 6, f. 47.

13 Dediu I., Nirca E. Locul ecologiei în şcoala medie. În: Învăţătorul sovietic, 1981, nr. 10, p. 33.

of the USSR in the letter of July 1980 "On the organization of the teachers' conferences in August of 1980" invited the biology teachers to examine the current issues of ecology, nature protection measures, the physics teachers familiarize the students with some notions concerning nature protection and the geography teachers with issues of ecological education.

Consequently, the environmental protection issues become the state's work program, together with economic, social aspects and had been included in the educational programs[14]. In 1984, by the Order of the Ministry of Higher Education (MHE) of the MSSR no. 119 of April 27,1984, Ion Dediu was appointed the chairman of the Standing Committee of the MHE, whose aim was to study the situation of ecological training and education in MSSR, to accelerate the personnel training in ecology, to include the ecological disciplines in education. During the Commission's activity the ecological issue in the higher institutions of the country has been thoroughly studied, concrete measures to address these issues had been developed and submitted to the ministry[15]. In 1985, the chairman of the Standing Committee of MHE Ion Dediu took part in the works of the first union ecological school concerning the issue of water ecological chemistry.

In answer to the suggestions of the mentioned committee, on July 31, 1987, at the session of the Supreme Soviet of the MSSR, a long-term complex program on the issue of environmental protection and rational use of the MSSR's resources had been approved, lasting until 2005[16]. The mentioned program was the basis of the republican scientific conference "Peculiarities of the ecological training and education of the population and nature protection knowledge propaganda in MSSR." On the strength of the CC of the CPSU and the USSR Council of Ministers Decision no. 102 of April 12, 1988 "Regarding the radical reorganization of the situation of environmental protection in the country" the educational institutions were to introduce special courses on the subjects of environmental protection and the rational use of resources within the middle and higher education[17]. A particular attention was given to the disciplines through the prism of which the groundwork of the ecological education was established – biology, geography, chemistry[18]. Later, the resolutions of the Council of Ministers (Executive) and the CC Secretariat of CPM followed. As a result, by the order of August 1, 1988, of

[14] Ropot V. *Cu gândul la viitor*. // *Moldova socialistă*, 20 ianuarie, p. 2

[15] *ASUM, F.1, inv. 8, d. 1902 (Personal file, no. D–7, Dediu Ion Ilici), f. 76.*

[16] *Dediu I. Puti perestroichi ecologhicescogo obrazovania i vospitania v vuzah Moldavii.* În: *Actualinîe voprosî soverşenstvovania podgotovchi ucitilei biologhii v svete trebovanii perestroichi narodnogo obrazovania.* Chişinev: Timpul, 1989, str. 32.

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the Minister of Education of MSSR, D. Zidu, was adopted the decision to create the Interuniversity Department of Ecology and Environment Protection within the "V. Lenin" MSU. The founder and the first head of the department was the Professor, Habilitated Doctor I. Dediu, who has spurred a number of directions of activity, being resumed with the following: the department's contribution in personnel training based on the specializations: a. Ecology and environmental protection; b. Entomology and the protection of plants; the development of special courses based on the mentioned specializations; teaching the course "Fundamentals of rational exploitation of natural resources"; the management of scientific-methodological training activity and environmental education in higher institutions; the education and retraining of the personnel for the discipline of ecology, including through doctorate; scientific research on environmental protection and rational exploitation of resources; participation in the development of a map of nature monuments of MSSR; the development and introduction of new methods in promoting ecological activities among the citizens of the republic; active participation in the work of the Republican Committee, according the UNESCO program "Man and Biosphere"; the research and the inclusion of the developments of Soviet and global ecological education in the study process; the contribution in promoting the knowledge on the ecology among teachers in intermediate, special, vocational schools etc. At the core of the department's strategy the principles of complexity, universality and continuity were put.

Under the impetus of the department, the University bought some special chemical devices; introduced new methods in the study process such as mathematical modeling of ecological systems, the computerization of the study process, interactive methods. The teachers had to facilitate the access to the ecological information, to prepare didactic material, to contribute to the enhancement of teachers' professional performance, to initiate experiments in the field. The process of teachers' qualification had to have a differentiated character, related to the teaching program from the general schools or those with special profile.

Known personalities in the country sat on department – I. Dediu, that also activated as a researcher of the Institute of Zoology (the Academy of Sciences of MSSR), member of the "Znanie" Society; I Bumbu, senior researcher of the Laboratory of Lower Plants of the Botanical Garden, head of the Laboratory of Ecology and Plant Physiology of the Botanical Garden, Chisinau, between 1983 and 1984; Roşcovan D., researcher of the Institute of Geology and Geography, scientific secretary of the Commission for Ecology and Nature Conservation under the Presidium of the Academy of Sciences of the MSSR; V. Mosanu, main specialist of the Committee for Nature Protection and Forestry in 1988–1990, specialist coordinator of the Department for Environment Protection and Natural Resources of the Republic of Moldova, 1990–1991, scientific researcher of the National Institute of Ecology, 1991; M. Mâtcu, researcher of the Institute of Geography of the Academy of Sciences of MSSR, an institution through which

it was contributed to the development of the scientific bases of environmental education of youth in high school, member of the "Znanie" Society. The scientific concerns of the teachers were channeled on studying the ecological systems, monitoring the impact of industrialization on the environment, developing methods of environmental protection, the rational use of the resources, environmental education of the population etc. There were developed and edited a number of encyclopaedic studies[19], instructive- educational works[20], on the use of aquatic resources in animal husbandry, agricultural and industrial sector[21], on the role of the micro-elements in the life of plants, animals and humans[22], on the biogeochemical zoning of the micro-elements in Moldova[23], as well as a series of articles in the collection of articles, the annals and the international scientific journals and in those of general culture[24]. In 1993, at SUM, the branch "Ecology and the Environment Protection" was created besides the Interuniversity Department of Ecology and Environmental Protection, that contributed to the personnel's training[25]. Given the fact that the environmental protection has become a current goal for society, the professional performance of the personnel was widely requested by the higher education institutions in the country. Thus, the Interuniversity Department of Ecology has ensured the teaching of environmental protection courses at several institutions, such as SUM, "Ion Creangă" PSU, the Academy of Economic Studies of Moldova (AESM)[26]. Some members of the department sat on the Republican branch of the "Science" Society (I. Dediu, Mâtcu M., D. Roşcovan) and were participating actively with propaganda lessons of ecology not only in

[19] Dediu I. *Ecologhiceschii enţiclopediceschii slovari*. Chişinev: MSE, 1989.

[20] Roşcovan D. *Educaţia ecologică a populaţiei din Republica Moldova*. Chişinău: USM, 1993; Idem. *Poluarea bazinelor acvatice din Republica Moldova cu ape reziduale de la complexele şi fermele zootehnice de tip industrial.* În: *Managment ecologic şi dezvoltarea durabilă*. Chişinău, 1996; AUPS "Ion Creangă", F. 1, inv. 5 PS, d. 664; SUM, Human Resources Department, Personal file, no.–20 (Dumitru Roşcovan); AUPS "Ion Creangă", F. 1, inv. 5 PS, d. 664; SUM, Human Resources Department, Personal file no.–20 (Dumitru Roşcovan); Mâtcu M. *Protecţia şi transformarea naturii.* În: Problemî ecologhicescogo obrazovania, vospitania naselenia i propagandî prirodoohranitelinîh znanii v Moldavii. Chişinău: Ştiinţa, 1988.

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[22] Bumbu I. *Microelementele în viaţa plantelor, animalelor şi a omului* (1970); *AUSM*, f. 1, inv. 8, d. 1912, p. 12 (Pesonal file, no. Б 40, Bumbu I.).

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[24] Dediu I.*Repartition et caracteristique ecologique de mysides de bassiens riviers Dniestr et Pruth.* În: *Revue Roumain de biologie. Serie de zoologi*, Bucureşti, 1966, t. 11, nr. 3; Mîtcu M. *Osobennosti razvitia urbanizaţii v raionah agropromîşlennogo tipa*. În: *Gheografia naselenia. Tezisî docladov Vsesoiuznogo Mejvedomstvennogo po gheografii naselenia.* Leningrad, 1984.

[25] *Istoria Universităţii de Stat din Moldova 1946–1996*. Chişinău: s.a., 1996, p. 202.

[26] In 1992, ASEM has asked SUM Rector, the Academician B. Melnic to send a teacher to teach the course "Ecology and rational use of natural resources". At AESM's endeavour, Matvei Mâtcu, Doctor in geography, Reader was delegated. In: ASUM, f. 1, inv. 8, d. 1754 (personal file nr. M –31), f. 97.

the country[27] but also abroad[28]. At the SUM, they organized and participated in the following conferences: the international conference "Nature protection – present and future – 1996"; the international conference "Combating desertification and drought in Moldova", 1998; the anniversary conference dedicated to the celebration of the 125th birth of Academician N. Dimo "Land and water resources", 1998; the conference "The development of scientific and didactic geography in Moldova", 1999; the international conference "Drought – prognosis and dilution of its consequences", 2000; the Republican conference "The biodiversity and vegetal ecology of Moldova", 2001; the scientific conference "Geography studies: achievements and prospects", dedicated to the 40th anniversary of the establishment of Moldovan Academy of Sciences, 2001.

Besides the didactic activity the members of the department, together with the scientists from the National Institute of Ecology and the State Department of the Republic of Moldova for the Environmental Protection and Natural Resources developed the ecological bills that have been examined and later adopted by the Parliament[29]. The department participated in drafting the Strategic Action Program of the Republic of Moldova in the environmental protection and rational use of natural resources and in developing a similar plan for the Prut river basin as an integrated part of the Danube basin. The department's activity was directed toward expanding the international collaborative relationships on the ecological issues, which comprises Romania, USA, Russia, Ukraine, France, Germany, Belarus, cooperation within the community of the Black Sea, including the Danube basin. A number of important measures in training and retraining of personnel were achieved.

In 1988, Professor, Habilitated Doctor Ion Dediu founded the Laboratory of Ecology and Nature Protection, which was reorganized in 1991 in the Laboratory of Geochemical Ecology and Toxicology. Over the years, the heads of the laboratory have been Dr. Leonid Rogoşevski (1988–1989), Dr. Eugen Tomnatic (1989–1991), and since 1991 – Dr. Dumitru Drumea.

In 1997, the Department of Ecology, Botany and Forestry under the leadership of Vasile Şalaru was created at SUM. The scientific concerns of the new department have expanded with the following topics – the study of the biological, ecological and biochemical principles of the algae, the ecology of edaphic algae (V. Salaru, N. Ciubuc), the algoflora of different types of water basins (V. Salaru, I. Ungureanu)[30], the industrial biotechnology of microalgae (V. Şalaru), ecological zoology, the rational use of biodiversity (V. Rusu)[31], forest ecology (Boaghe

[27] They attended the conferences "International cooperation in the field of environmental protection" (organized in 1985 in Tiraspol).

[28] *ASUM*, F. 1, inv. 8, d. 1902 (Personal file, no. D–7, Dediu Ion Ilici), f. 78.

[29] *Istoria Universităţii de Stat din Moldova 1946–1996.* Chişinău: s.a., 1996.

[30] *MSU, Human Resources Department*, Personal file– Ş–4 (Şalaru Vasile Maxim); USM, D/P Nr. U–2 (Ion Ungureanu).

[31] ASUM, Personal file, no. R–34 (Russu Vadim Andrei).

Dionisie), plant ecology, the adventitious plants of Moldova (Cuharscaia L.), algal biotechnology (T. Dudnicenco)[32].

The contribution and the scientific achievements of the teaching staff have been exhibited in a series of works concerning the analysis of the environmental situation of the urban territories[33], the assessment of the environmental situation through living organisms[34]; woody plants in the conditions of Chisinau[35], the municipality green spaces[36], ecological monitoring[37], natural reservations and the forest quality[38], factors influencing the population of the aquatic mermithidae[39]. In order to work assiduously in the field, the SO "Biofil" was organized besides the Department of Soil Sciences and Ecology (chairman V. Şalaru), in which Natalia Ciubuc took active part[40].

With the intention to exchange pedagogical-scientific experiences, the department's representatives attended specialized training courses organized by the Systemic Ecology Department of the University of Bucharest (1 to 30 June 2004, Vasile Şalaru), took part in national and international conferences. At the local and international meetings they debated current issues concerning the biosphere conservation, rational use of resources, ecological chemistry and chemical risk assessment: the international conference "Biodiversity conservation of the Dniester basin" (Chisinau, 1999); the second European congress of phycology (Montecantini Terme, Italy, 1999); the second international conference "Actual issues of contemporary algology" (May 1999, Kiev); the seventh international congress of phycology (Thessaloniki Hellas, 2001, 18 to 25 August); the scientific conference with international participation "Soil and future" (9 to 10 August 2001, Chisinau); the international scientific-practical conference "Soil – one of the main

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32 ASUM, Personal file– D–47 (Dudniceno Tatiana).

33 Şalaru, V., Dudnicenco, T, Ciubuc N. *Estimarea stării ecologice a teritoriilor urbane cu ajutorul algelor edafice în calitate de bioindicatori*. În: *Analele ştiinţifice ale USM*, seria "Ştiinţe chimico-biologice". Chişinău, 2004, p. 261–262.

34 Şalaru, V., Ciubuc, N., Dudnicenco, T. *Estimarea stării ecologice a teritoriilor urbane cu ajutorul algelor edafice în calitate de bioindicatori*. În: *Analele ştiinţifice ale USM*, Chişinău, 2004.

35 Boaghe D. *Rezistenţa plantelor lemnoase la substanţe noxe în condiţiile Chişinăului*. Chişinău, 1995.

36 Boaghe D. *Spaţiile verzi ale municipiului Chişinău: particularităţi biologice, management ecologic şi dezvoltare durabilă, teza de doctor în ştiinţe biologic*e. Chişinău, 1998.

37 Boaghe D. *Monitoring ecologic forestier*. Chişinău, 2004; Dudnicenco T., V. Aşevschi D., Roşcovan. *Ecologia şi protecţia mediului cu elemente de lucrări practice în laborator şi pe teren*. Chişinău: ULIM, 2007.

38 *Rezervaţia Naturală de Stat "Plaiul Fagului"*. Chişinău: Rădenii Vechi, 2003; *Cercetarea ecosistemelor forestiere din rezervaţia Plaiul Fagului*. Chişinău: Universul, 2009; Boaghe D., *Monitoring ecologic forestier*.Chişinău: (s. n.), 2004.

39 *Influenţa factorilor de mediu înconjurător asupra efectivului populaţiilor de mermitide acvatice*. În:*Conferinţa corpului didactico-ştiinţific "Bilanţul activităţii ştiinţifice a USM pe anii 1996/97",* 30 septembrie–5 octombrie 1998. Ştiinţe naturale. Chişinău, 1998, p. 189.

40 SUM, Human Resources Department. Personal file- Ş.- 22 (Şalaru Victor); SUM, Personal file no. 40 B (Ciubuc-Gogoman Natalia).

problems of the XXI century" devoted to the 50th anniversary of the N. Dimo Research Institute of Pedology and Agrochemistry (Chisinau, August 7, 2003); the botanists' scientific conference "Protection, reproduction and use of plants" (Chisinau, 1994); the national conference "Actual issues of genetics, biotechnology and improvement" (Chisinau, 1994); the scientific-practical conference "The European year of nature conservation in the Republic of Moldova: issues, achievements and prospects" (Chisinau, 1994); "Natural and technogen ecological disasters: causes of emergence, prevention and elimination of their consequences" (Lvov, Ukraine, 11 to 16 October 2005); the seventh edition of Republican scientific conference of young researchers "Ecological chemistry and chemical risk assessment" (Chisinau, 2003); the second international conference of ecological chemistry (Chisinau, 11 to 12 October 2002); the jubilee symposium "The natural reservation Codru – 25 years: achievements, issues, perspectives" (Lozova, 1996); the international conference "Pedoecological issues in the Bic river basin" (Chisinau, 2001); the third conference of zoologists from Moldova with international participation "Protection, recovery and rational use of the biodiversity of the animal world" (Chisinau, 1995); the XVth international symposium devoted to the entomofauna of Central Europe (Iasi, 1996)[41].

The ecological explosion led to the opening of other academic research units. On 1 September 1992, the Department of Industrial and Ecological chemistry was founded, whose purpose was to conduct research and train specialists in the fields of chemical technology and environmental protection[42]. At the core of this structure had been the idea of adjusting the issues of chemistry technological development to the demands of the ecology. The establishment initiative belonged to the correspondent member of Moldovan Science Academy, Professor Gh. Duca (actually the chairman of MSA)[43]. Gh. Duca, the founder of ecological chemistry in the Republic of Moldova, of the redox concept concerning the action of some peroxide substances on the ecological systems, developed the theory of biochemical reactors for the treatment of the drinking water and wastewater. The research results have found expression in over 500 public works in the country and abroad, including 36 monographs and textbooks[44]. Among the members of the department who have contributed to the education process

[41] Dudnicenco, T. *Human Resources Department*. Personal file– D–47 (Dudniceno Tatiana).

[42] Rusnac Gh., Cozma V. *Istoria Universităţii de Stat din Moldova 1946–1996*. Chişinău, s.a., 1996, p. 169.

[43] Gh. Duca (born February 29, 1952, Copaceni village, Singerei district), chemist (the field of study – physic and ecological chemistry). Habilitated Doctor in chemistry (1989), Professor (1992). Correspondent member (1992) and titular member (2000) of the Academy of Science of Moldova. Dean of the Faculty of Ecology of the Free International University of Moldova (1992–1995). Member of the Parliament and chairman of Culture, Science, Education and Mass Media Committee (1998–2001). Minister of Ecology, Construction and Territorial Development of the Republic of Moldova (2001–2004). Since February 5, 2004 – the chairman of the Academy of Sciences of Moldova.

[44] *Chimia, stresul şi tumoarea*. Chişinău: Universul, 1997 (în colaborare), *Каталитические реакции*

and the ecological investigations, we can nominate Dr. Reader Maria Gonta[45], Iulii Gorodeţchi[46], Dr. Reader Gheorghe Şişcovschi[47], Dr. Reader Victor Covaliov, Dr. Superior Reader Olga Covaliova, Assistant Reader Diana Juc[48], Assistant Reader Igor Mardari.

Among the courses that fall into ecology we mention: Ecological Chemistry (holders Gh. Duca, M. Gonta), The Basics of Ecology (D. Juc). The department's prodigious achievements and the interest towards the promoted disciplines have spurred the inclusion in 2000 of the specialization and specialty of "Environmental Protection" within the Faculty of Chemistry and Chemical Technology. For the specialization on environmental protection the following special courses were set: environmental engineering, hydrochemistry, chemical control of the environment, radioecology, the modelling of the pollution and self-purification processes of the environment, chemical risk assessment.

Another priority of the department constituted the research activity focused on the scientific topic "The chemistry and technology of the industrial processing and waste treatment." On the basis of the topic there were carried out anodic and cathodic researches, researches on metal protection toward corrosion, on waste treatment in the galvanic industry (Associate Professor V. Covaliov), on physicochemical mechanics of the disperse systems (Associate Professor Gh. Şişcovschi), on chemistry and oenological technology (Associate Professor Gonta M., Professor Gh. Duca, Reader I. Mardari), on ecological chemistry (Professor Gh. Duca, Associate Professor M. Gonta, Reader V. Covaliov, Superior Reader O. Covaliova). About 30 monographs and textbooks, tens of teaching materials for theoretical courses were published in the field of ecological chemistry and environmental protection. The academician Gh. Duca drafted the first handbook of Ecological Chemistry, published in Romanian, Russian and English language. The main monographs published by the academician Gh. Duca together with the department's team and that of Scientific Center of Applied and Ecological Chemistry includes over ten titles, including *The ecological audit (2000), Redox processes in the environment (2001), Modern technologies of combustion and attenuation of pollutant atmospheric emissions (2002), Processes of pollution and self-purification of the natural waters (2002), Environment engineering in energy (2003), The ecologically pure wine industry (2004), Hydrochemistry of the small rivers (2004), Chemical control of the environment (2007), The ecological chemistry of nitrates, nitrites and N-nitrosamines (2008) etc.* The complex activity in the research field has transformed the department into an important research center. The need to develop

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и охрана окружающей среды (Кишинев: Штиинца, 1983, în colaborare); *Экологически чистое винодельческое производство* (Кишинев: Академия наук Молдовы, 2004, în colaborare).

45 MSU, *Human Resources D*epartment, personal file no. 42, Gonţa Maria Vasile.

46 ASUM, f. 1, inv. 8, d. 1825 (Personal file of Gorodeţchi Iu., no. G–14).

47 ASUM, f. 1, inv. 8, d. 2049.

48 ASUM, f. 1, inv. 8, d. 2013.

the science was actively promoted among students. Since 1999, by the instrumentality of the department the scientific conference for students "Ecological chemistry and chemical risk assessment" was organized at the Faculty.

It is well known that the environment and resources is an international issue. Therefore, for the projects realization, the department has established collaborative relationships with the universities in Rome and Florence (Italy), Institute of Applied Sciences in Lyon (France), "Gh. Asachi" Technical University and "Al. I. Cuza" University in Iasi, The Oncology Institute, The meat factory, "Alfa" TV Factory in Chisinau. In the period of 1 to 4 October, 1995, the department initiated and organized the international symposium of ecological chemistry, which was attended by 160 scholars from 14 countries[49].The second international symposium in this field was organized in 2002 in Chisinau, which was attended by 260 scientists from 26 countries. The third international symposium on the ecological chemistry was organized in 2005 with the participation of 470 participants from 38 countries.

According to the Rector's decree and the decision of the Moldovan State University' s Senate (decision taken under the Government Decision no. 2317 from August 02, 1988), in September 1988, the Laboratory of Applied and Ecological Chemistry was founded within the Faculty of Chemistry. Professor Gh. Duca was appointed to direct the scientific activity of the laboratory. All the scientific directions initiated by the laboratory were focused on the idea of using chemistry not as a source of pollution, but in order to treat and protect the environment.

Ecological education at "Ion Creanga" PSU. In the late 80s in the XXth century, the "Ion Creanga" Pedagogical State Institute from Chisinau (now "Ion Creanga" Pedagogical State University ("Ion Creanga" PSU) carried forward the Decision of the CC of the CPSU and the USSR Council of Ministers no. 102 of April 12, 1988 "On the radical reorganization of the environmental situation in the country"[50]. A decisive role in the intensification of ecological education in the institution had C. Andon[51], doctor in biological sciences, scientific researcher at the Academy of Science of MSSR. On 29 June 1989, C. Andon was confirmed as head of the

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[49] *Istoria Universităţii de Stat din Moldova 1946–1996*. Chişinău: s.a., 1996, p. 172. Apud Simposyum on ecologycal chemistry (1–4 octombrie 1995). Chişinău, 1995.

[50] Dediu I. *Unele sugestii de instruire şi educaţie în domeniul ecologiei şi ocrotirii naturii*. În: *Актуальные вопросы совершенствования подготовки учителей биологии в свете требований перестройки народного образования,* Кишинев: Тимпул, 1989.

[51] Andon Constantin (born August 13, 1943 in Chirilovca village, Soroca county– 2004, Chisinau). Doctor in biology (1970), Reader (1991). Graduate of Tiraspol Pedagogical Institute (1965). Biology and chemistry teacher at the Pedagogical School in Lipcani. Between 1967–1970 he got doctoral studies at the Academy of Sciences of MSSR, Lower Researcher at the Botanical Garden of the Academy of Sciences of MSSR (1970–1972), Senior Researcher at the Institute of Selection in Voronezh (1972–1974), Lower Researcher at the Institute of Agronomy in Chisinau (1974–1977), Senior Researcher, head of laboratory, head of department, deputy director of the Botanical Garden of the Academy of Sciences of MSSR (1977–1987). Since 1987 Senior Reader, Associate Professor, head of the Department of Natural Sciences with particular methods of "I. Creanga"

Department of Natural Sciences and Mathematics[52], starting a series of ecological projects, being materialized into a serious ecological school.

Among the types of activity carried out by this professor and scientist was the mobilization of the department's members in developing and teaching ecological subjects. Since 1989, at the Faculty of Pedagogy of the Institute the following subjects have been introduced in the curriculum: "The fundamentals of the ecological training and the environmental protection" (course designed and taught by C. Andon, subsequently by E. Haheu), "Ecological education for preschool aged children" (C. Andon), "Ecological education of future teachers of primary classes and preschool educators" (Dr. in biology Leşenco A.), "The development of social-emotional behavior based on the representations about the living for older preschoolers (holder E. Haheu), "Natural sciences with ecological bases" (holders Dr. in biology V. Cecoi[53]), "Zoology with ecology bases", "Botany with ecology bases" (Dr. in biology E. Popov[54] and Dr. in biology S. Leşenco), "The ecological training" with emphasis on the ecological situation in the MSSR (S. Leşenco[55]), "Plants and animal protection in Moldova"[56], "Ecological education through mathematical activities" (Dr. in pedagogy Ursu L.)[57]. In order to diversify the teaching strategies, teachers organized trips in picturesque places (the Old Orhei, Trebujeni, Butuceni, Capriana Monastery), natural reservations (Codri, The park from Ivancea, The Taul park (Donduseni district)), museums (the zoological museum of SUM), organized naturalistic circles "Native land", in which they were prepared didactical materials for class hours (collections of shells, insectariums)[58]. The didactics of the nominated disciplines contributed to the teachers' specialization in teaching ecological courses, in developing new instructional and educational technologies focused on developing ecological skills, in mobilization of young researchers – post-graduates, students studying ecological topics.

Another type of activity targeted the accomplishment of investigations in the field of environmental training and education. This matched with the approval

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Pedagogical University. Author of over 120 scientific and methodical works. În: *Universitatea Pedagogică de Stat Ion Creangă din Chişinău (1940–2000)*. Chişinău: UPSC, 2000, p. 318.

52 In 1996 the structure was renamed as Department of Natural Sciences with particular methods. In 1999, according to Order no. 22 of April 03, 1999 and on the basis of the Faculty of Education reorganization, C. Andon is chosen by competition the head of the Preschool Pedagogy Department. He worked as head of department till October 22, 1999, returning to the post on February 07, 2000. *Ibidem*.

53 APSU (The Archive of Ion Creanga State Pedagogical University), F. I, inv. 2, d. 3350 (The minutes of the department meetings for the 1997/1998 academic year), p. 82.

54 APSU, F. 1, inv. 2, d. 2275, f. 3; Personal file of Eugenia Popov.

55 *Ibidem*, F. 1, inv. 2, d. 2275 (The minutes of the Natural Sciences and Mathematics Department), f. 2.

56 *Ibidem*, F. 1 (the report on department work for 1995–1996 academic year), inv. 2, d. 3059, p. 2.

57 *Ibidem*, F. 1, inv. 2, d. 3350, p. 49.

58 *Ibidem*, F. 1, inv. 2, d. 3350 (The minutes of the department meetings no 1–10 for the 1997/1998 academic year), p. 63.

of the research topic of Department of Natural Sciences and Mathematics in 1989: "The finalization of ecological education principles for students – future teachers of primary school and preschool educators." The mentioned topic was adjusted to the National Institute of Ecology theme: "The development of the scientific bases for greening public consciousness, training process, as well as the adjustment of ecological and law relations in the field of natural resource use." In 1994, at the Ministry of Education's behest[59], C. Andon organized the Scientific Laboratory "Eco-education", intended for further research in the field of environmental education with the topic: "The activation of the training and education in the process of nature sciences teaching in the higher education institution – primary school – the preschool settlement"[60]. The department members (C. Andon, V. Cecoi, E. Popova), post-graduates (L. Gordea, Haheu E., E. Buzinschi), students involved in the laboratory. In 1997, the laboratory has continued its activity following the confirmation of the Ministry of Education, Youth and Sport of the Republic of Moldova, according to which the ecological investigations are basic and foreground scientific researches[61]. As interpreted by Dr. in pedagogy L. Gordea, the laboratory has focused its work in two main areas: to cultivate the conscience and ecological culture of young generation through courses and accomplished researches and to provide pre-university and university education with curricular supports – study programs, teaching materials, methodological guides, etc. for the natural sciences, whose content should contribute to achieve the educational standards for the Pedagogy of Primary Education and Pedagogy of Preschool Education specialties[62]. In this context, it is worth to mention that the group of researchers conducted fundamental investigations, which contributed to the renewal of the didactic conception, the content restructuring of programs and disciplines, methodologies and educational means. The curricula of several disciplines as "Natural sciences with ecology bases", "Bases of ecological training and environmental protection", etc. have been adapted to the local context of the Republic of Moldova. From 2005, Dr. in pedagogy L. Ursu was appointed at the leadership of scientific laboratory. Being a specialist in teaching mathematic disciplines she expanded the greening goal of the training also over mathematic

[59] Now the Ministry of Education of the Republic of Moldova

[60] *Universitatea Pedagogică de Stat Ion Creangă din Chişinău (1940–2000).* Cişinău: UPSC, 2000, p. 318.

[61] In accordance with the Education Act of the Republic of Moldova (1995, art. 5 (2f), art. 56 (d)) the following goals have been envisaged: to cultivate a sense of responsibility towards the environment, to teach the environmental awareness; to engage teachers to educate a sensitive attitude towards the environment. This issue has been mentioned in other official documents such as: Education Concept in Moldova (1999), the Concept of the National Strategy for Sustainable Development of the Republic of Moldova (2000), the Concept of Environmental Policy of the Republic of Moldova (2001), The Concept of Employees Training of the Pre-university Education (2003) etc.

[62] Gordea L. Laboratorul Ecoeducaţie al Universităţii Pedagogice de Stat "Ion Creangă". În: Revista Didactica Pro, 2003, nr. 6 (22), p. 8.

strategies teaching[63]. During the laboratory's activity dozens of scientific articles, textbooks, university programs and methodical recommendations were published and are currently applied in the daily work practice of preschool and primary institutions. We should mention the textbooks and didactic works for teachers, students of higher institutions and those interested in the environment protection: "Natural sciences with ecology bases" (authors C. Andon, V. Ciocoi, E. Popov, Chisinau: Lumina Press, 1994), "The bases of ecological education and the environmental protection" (authors C. Andon, D. Roscovan, S. Leşenco, V. Aşevschi, Chisinau: MSU, 1996), "Native land. A chrestomathy of literary texts to familiarize preschool children with nature" (authors C. Andon, S. Mandric, Chisinau: Lumina Press, 1992), "The acquaintance of children with nature through nature nook, literary texts and paintings" (authors C. Andon, S. Leşenco, S. Cemortan, Chisinau [s: n], 1994), "The acquaintance of preschool children with nature through didactic games" (C. Andon, E. Haheu, Chisinau: Liceum Press, 1997), "A guide for teachers: environmental education at the homeroom classes: 1st–2nd grades" (L. Saranciuc-Gordea, Chisinau: Garamond-Studio Ltd., 2008), "Experiential activities in the primary science course" (S. Ginju, Chisinau: Goromond SRL, 2009), "How to accomplish the ecological education of pupils? Training for form masters: 1st–4th grades" (Gordea L., Chisinau: PSU, 2010), "Teachers training for achieving the ecological education for the primary stage of education" (Saranciuc- Gordea L., L. Bear, Chisinău: PSU, 2012, 160 p.), "Practical-investigatigative activities of the new curriculum" (S. Ganju, Carabet N., E. Haheu, Chisinau: PSU, 2013), "The training of environmental education competence of teaching staff for primary and preschool education" (L. Bear, L. Saranciuc-Gordea, Rusuleac T., S. Ginju, 2014) etc.

There were compiled analytical programs and methodical recommendations for the internal use of students and teachers from PSU: "Botany with elements of ecology", "Pedagogy and methodology of primary education", "Ecological education and environmental protection", etc. In these works were elucidated the mutual interrelations between the essential systems of life, the interdependence of biological systems and the natural environment, human influence on the environment, the laws of nature, the applicability of environmental training and education in educational institutions; there were analyzed sensitive topics as "The right of future generations to a healthy environment life." Since the 90s of the XXth century at the baccalaureate exams the pupils have taken an examination in biology, which also included topics involving the ecological issue. As a result, the members of the department published methodical works for pupils and high school students to prepare them for the graduation exams, baccalaureate and admission: "Biology – educational material for graduating students" (authors E. Popov, C. Andon, Chisinau, 1990). Today, the team members continue to develop the methodology of greening the educational process. To achieve

[63] Ursu l. Sinteze Ecoeducaţionale. Chişinău: UPSC, 2010, p. 153–170.

the desideratum they collaborate closely with specialists from the Institute of Educational Sciences, State University of Moldova, State University of Balti, Pedagogical University of Moscow, "Al. I. Cuza" University of Iasi etc.

Department and laboratory holders actively participated in national and international scientific conferences dedicated to the ecological issue, during which they presented the outcomes of scientific investigations: "Elements of nature protection in primary school" (S. Leşenco), "Some ecological aspects in training the future teachers for preschool establishments" (S. Leşenco), "Educational philosophy" (L. Saranciuc-Gordea), "Aspects of correlation between the ecological education and the education for changes and development in primary school" (L. Saranciuc-Gordea), "Theoretical highlights of the evolution and determination of environmental education concept" (L. Saranciuc-Gordea), "The perspectives of the experimental program in teaching the competence of ecological education of future teachers" (L. Saranciuc-Gordea, L. Ursu), Bioethics integration of the environmental education in the primary school curriculum (Liliana Saranciu-Gordea, Ludmila Ursu), "The prerogatives of pre-university and university education in the context of the society based on knowledge". The theses of the analyzed issues have been published in journals and conference materials, such as "Nature Protection: present and future" (1995–1998), Issues of social and human sciences and education update (2009–2016), Journal of Social and Human Sciences (2011–2015), The proceedings of the international scientific conference "Postmodern teaching: efficiency and functionality" (2013)[64] etc., to which all those interested in the issue of greening the education have access.

In conclusion, in the 80s of the XXth century the issue of environmental protection knew a substantial evolution within the higher educational system. Specialized departments, laboratories that led to the inclusion of the ecological disciplines in the curriculum have been created at the SUM and "Ion Creanga" PSU. SUM was fully integrated in the process of specialists in ecology training, in scientific research, in dissemination of environmental protection information and in promoting environmental policies. PSU has contributed to the improvement of environmental training and education of the young generation by developing the ecological pedagogy, numerous works, teaching methods with the aim of greening the training, preparing staff for preschool and school education.

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[64] Creanga APSU, F. 1, inv. 2, d. 3353; APSU, F. 1, inv. 2, d. 3350 (The minutes of the department meetings no 1–10 for the 1997/1998 academic year), p. 48.

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