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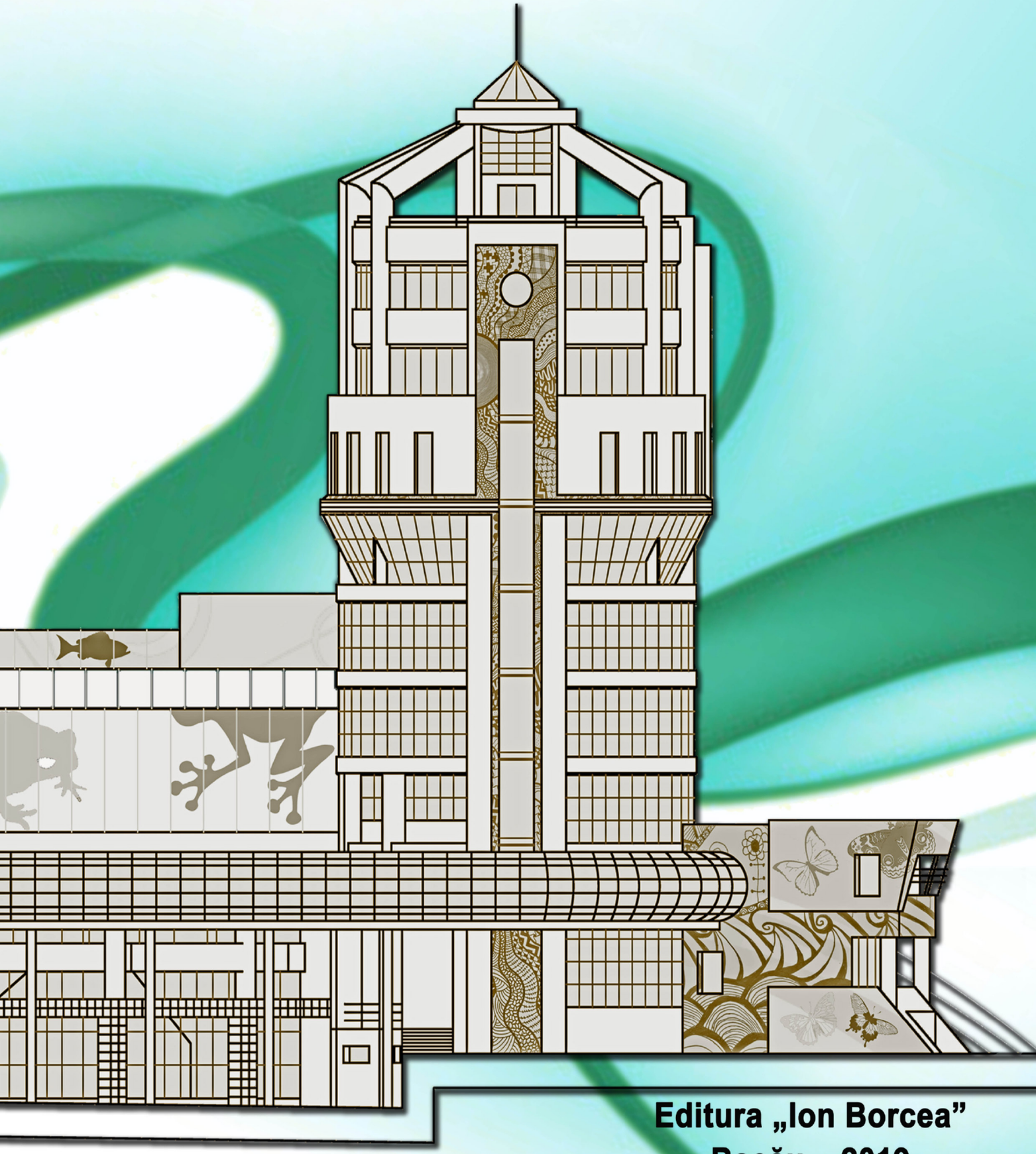

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MODIFICATION OF HUMUS CONTENT IN THE CHERNOZEMS OF MOLDOVA UNDER AGRICULTURE IMPACT

TAMARA LEAH, NICOLAI LEAH*

ABSTRACT

The current state characteristic of the humus content in the chernozems of the Republic of Moldova is presented. Over a period of more than 140 years, the humus content in the arable layer of the chernozems, as a result of their use in agriculture, decreased by 2.47% or 43.2% from the content of the virgin (natural) chernozem, the rate of humus reduction of was 0.019% annually. Maintaining the annual reduction rate of humus content presents a significant ecological and economic danger for Republic of Moldova. The state quality of the investigated chernozems regarding the content of organic matter is satisfactory. The factors limiting the productivity of chernozems (and other soils) are: low humus and nutrient content, strong compaction and destruction of the arable and post-arable layer. The quality of the chernozem (and the soil resources in general) must be maintained by administering the organic-mineral fertilizers at optimum doses, incorporating plant residues and secondary production in soils, respecting crop rotation with the introduction of alfalfa into the soil, increasing the proportion of leguminous crops up to 20-25%.

Key words: agriculture, chernozem, degradation, fertilizer, humus.

Introduction

The content of organic matter in soils is a genetic and classification feature characteristic of each known types of soils. The change in the content of humus in soils occurs extremely slowly, being the result not of temporary circumstances, but of a complex and lengthy previous history of the soil-forming process and the interaction of the soil with the environment.

For each soil type, a certain stable humus content in the upper soil horizons and a stable type of distribution of its reserves along the profile have been established. At the same time, each type of soil is characterized by a certain qualitative composition of humus (4).

The humus content in the soil of each pedo-climatic region is a certain constant value, it varies within a certain limit and the increase in its amount is associated with a long cultivation period with the use of sufficiently high doses of organic fertilizers, the expansion of leguminous crops, and the reduction in the area of clean fallow. I.V. Tyurin pointed out that "under certain constant conditions regarding the intake and decomposition, the accumulation of organic matter in soils has a limit above which accumulation is impossible", quoted by Иванов et al. (13**).** The intensity of humus accumulation is largely determined by the properties of the soil itself.

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At present, everyone has a firm opinion about decrease in the content of humus in soils. Indeed, the loss of humus from arable soils is possible for various reasons (7):

- Increased mineralization of organic matter due to intensive machining, liming, predominant use of mineral fertilizers, consumption of organic matter in crop formation, which does not allow to compensate for the natural decrease in humus;
- Inadequate intake of organic residues due to low yields and lack of organic fertilizers. In a normally formed farming system, more than 50% of plant nutrients should be returned to the soil as part of organic matter (litter, stubble, root residues, organic fertilizers, etc.).
- Loss of humus during erosion and deflation. These losses will be even more significant from soils of light particle size distribution. “Not only that, and the humus that fell into the sandy soil has relatively few chances to remain there; firstly, there is nothing to connect humus with, secondly, due to the porosity of the sands it will most likely burn in the air and give the final products of decay”, noted Dokuchaev (6).

The research purpose - the comparative study of the humus content in the fallow (natural) chernozems and in the arable chernozems used in agriculture for a long time.

Material and method

The paper presents an analysis of the publications that reflect the problems regarding the humus content in the chernozems of the Republic of

Moldova, as well as the impact of the anthropogenic factors on the organic matter in soils. The humus content was determined by the I.V.Tyurin classical method.

Results and discussions

In the Republic of Moldova, chernozems of two facies groups are distributed approximately equally:

a) south-western or Danube - Pontic;

b) central or Eastern European.

Those and others are divided into several subtypes, forming genetical and geographical pairs:

1) for the south - surface carbonatic and high-carbonatic (carbonatic and ordinary);

2) for the north - typical and leached.

The remaining subtypes are less characteristic and occupy small areas. Existing genetic relationships between chernozems, on the one hand, forest and hydromorphic soils, on the other hand, are interesting, but not yet studied and explored enough. The total area of all chernozems is about 80% of the Moldova's territory and 86% of the territory of the plateaus. The moderately and highly eroded chernozems account about 20% of the area (1).

The plateaus and peripheral parts of the highlands of northern Moldova are covered with chernozems, which are divided into two subtypes - typical and leached, the first of which prevail at absolute heights of 160-210 m and the second - at 190-250 m. The parent rocks are eluvial - deluvial loamy - clays and clayey - loams, silty and moderately silty, rich in aluminium, iron, alkaline elements and metals. The climate of the northern regions is cooler and wetter than in the south of Moldova. The chernozems under consideration formed under the meadow-steppe vegetation characteristic for forest-steppe (1).

Chernozem typical. In this subtype, the progressive aspects of the chernozem soil formation process manifested themselves in the most striking in a harmonious form. Typical chernozems extend in a continuous strip from the eastern borders of Moldova to the Prut River and passes over to Romania. In the neighboring regions of Ukraine, they are known as powerful chernozems; they are humus-coloured up to 1.0-1.5 m (4).

Typical chernozems occupy an area of about 165 thousand ha and are characteristic of the northern forest-steppe part of Moldova, but are also found in the central part. They are formed most often on eluvial - diluvial rocks of a clayey-loamy composition with an average content of physical clay from 54 to 64% and silt from 30 to 38%; loess features are rather weak. Geomorphologically, these soils are confined to plain or slightly hilly watershed plateaus, ancient river terraces. The axis of the altitude zone is 200 m in the north with fluctuations of 180-200 m, in the areas of the center - 190 m with oscillations of 160-200 m (1).

The typical clayey-loamy chernozem from north-eastern of Moldova (com. Napadova, Floresti district). The investigated soil is characterized by the weakly acid reaction in the Ah horizon (pH = 6.5-6.7) and weakly alkaline in the underlying carbonatic horizons (pH=7.7-8.1). These pH values can be appreciated as optimal for growing and developing of crop plants. The distribution of carbonates on the investigated soil profile is typical for chernozem. Depth of occurrence of carbonates, depending on the soil moisture regime, can be within 50-70 cm from the soil's surface. The content of carbonates varies within 5-7% in the horizon Bh2, 13-20% in the BC and C (9, 10).

Typical Chernozems from Napadova are of interest because they were first studied by V.V. Dokuchaev in 1877 (6) and then by the scientists in pedology prof. I.A. Krupenicov (4), acad. A. Ursu (12). In 2010 in the framework of monitoring research was carried out by IPAPS N. Dimo scientists (14). Comparison of the humus content in the typical chernozem (fallow) in 1877 with the typical chernozems (arable) studied after Dokuchaev gives the possibility to assess the degree of soil degradation as a result of the long exploitation in agriculture (Table 1).

Table 1 - Morphological indices and humus content of the typical chernozem in the research years

Indices		1877 - steppe [6]	1960 - arable [4]		2003 - arable [12]	2010 - arable [10]
		-	p.42	p.43	-	p.22
The thickness of the genetic horizons, cm	A	0-61	0-43	0-44	0-50	0-48
	B	62-91	44-101	45-92	51-98	49-95
	C	92	102	93	99	96
	Effervescence		92	65	70	70
Humus content, %	cm	steppe	arable	arable	arable	arable
	0-20	5.718%	3.75	3.60	3.36	3.25
	30-40	-	3.65	3.30	3.15	2.97

	50-70	-	2.34	2.73	1.94	2.38
	70-90	-	1.59	1.57	1.68	1.35
	90-110	-	-	-	-	0.86

From 1877 to 1960 - the beginning of the intensive farming period, the humus content in arable 0-20 cm of chernozem typical decreased as a result of ploughing from 5.72% to 3.75%, i.e., by 1.97% or 0.024% annually. During the period of intensive agriculture from 1960 to 2010 - the initial period of the agrarian reform, the humus content in the arable 0-20 cm layer over the 50 years decreased from 3.75% to 3.25%, i.e., by 0.50% or 0.010% annually (Figure 1). Currently, due to the non-use of organic fertilizers and the lack of leguminous perennial and annual grasses in the crop rotation, the process of dehumification of chernozems is only intensifying (1, 7).

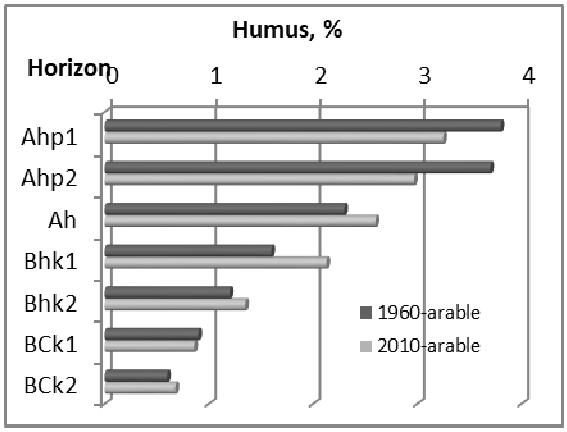

Fig. 1 - The humus content in the profile of arable typical chernozems, studied in 1960 and 2010.

The average statistical data of humus content in the humiferous layer of investigated soil in 2010 ranges from 3.25 ± 0.14% in the Ahp1 horizon to 1.35 ± 0.28% in the Bh2 horizon. The comparatively low humus content for typical chernozem in the Napadova commune is caused by the intensive use in agriculture and the sandy-dusty soil texture (9).

Comparison of the humus content in the typical loamy-clayey chernozem initially fallow near the commune of Napadova researched in 1877, 1960 and 2010 showed that the thickness of the humiferous horizon A was reduced in 133 years by 15 cm (from 61 cm - in 1877 to 46 cm - in 2010).

During the period of 1877-2010 the humus content in the arable layer of the typical chernozem as a result of its use in agriculture was reduced by 2.47% or 43,2% of the initial content of the soil (1877), the humus reduction rate was 0.019% annual (10).

During the period of 1960-2010, the humus content was reduced in these chernozems under the influence of intensive agriculture. The humus content in soil samples collected in 2003 and 2010 years is approximately the same, with some insignificant changes.

Comparison of the characteristics of the former fallow soil, studied in 1877, with the characteristics of the arable soil, studied on the same area in 1960, 2003, 2010 gives the possibility to appreciate the recent degradation of the typical chernozem as a result of long exploitation in agriculture. The characteristics of the typical chernozem are satisfactory. The limiting factors of the productivity of these chernozems are: strong compaction of the postarable layer, reduced humus content and nutrients. The change of the technological process of plant cultivation must be directed towards increasing the content of organic matter and nutrients in the soil and the implementation of a rational soil tillage system that would lead to the remediation of compacted postarable layer.

Typical loamy-clayey chernozem from northern of Moldova (Bălți Steppe). In the typical clay-loamy chernozem, the humus content was analyzed in the arable and fallow soils studied in 1960 by Krupenikov (4) and in the arable chernozems for monitoring researches of zonal soils in 2010. The humus content in the humiferous horizon (0-26 cm) of the typical arable chernozems constitutes 5.50% in 1960 and 4.03% in 2010. Their use in arable land has led to the decrease of humus in a period of 50 years - by 1.47% or 0.029% annually. Compared to the fallow chernozem the arable soils lost, respectively: 17.9% (until 1960) and 39.8% of the humus content of the natural soil. Up to a depth of 50 cm in the soil, an amount of 4.21% is maintained, which gradually decreases in the depth of the profile. In arable soils, humus content is maintained at only 3% at this depth (Figure 2).

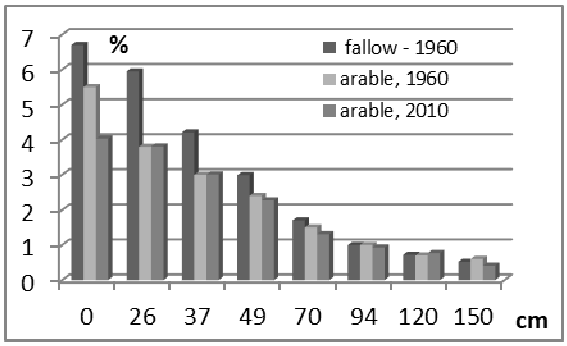

Fig. 2 - Humus content in the typical chernozems loamy-clayey from the warm semi-humid zone of northern Moldova (Bălţi Steppe)

Chernozem leached occupy somewhat higher heights than typical chernozems, are formed on the same parent rocks, and are close to them in terms of humus content and its vertical distribution. The main external difference between the two subtypes of chernozems is that the leached effervescence from 10% - HCl 20-30 cm deeper and, therefore, there is a small humus-free and carbon-free layer in the profile. In addition, sometimes they have a weakly expressed of illuvial horizon, enriched with silty (4).

Leached chernozems occupy an area of about 315 thousand ha. Often meet together with typical on the same parent rocks and relief elements. In the north, the axis of their altitude zone is 210 m (180-240 m), which is only 10 m higher than typical (1).

In order to determine the changes in the humus content of the chernozem leached under the influence of mineral fertilizers, soil profiles were placed on the variants of the long-term experience with mineral fertilizers of the experimental stationary from Ivancea commune, Orhei district (used in 1964-1995). In 1996-2005, due to lack of fertilizers, soil fertilization on fertilizer variants was not performed. The research was limited to studying the post-action of soil fertilization for 30 years. Since 2006 the application of mineral fertilizers has started again (11).

The leached chernozem is characterized by the type profile: *Ahp1 - Ahp2 - Ah - Bhw1- Bhw2 - BCk1 - BCk2 - Ck*. The thickness of the humiferous profile - 90 cm. Effervescence from the depth of 90 cm. It is characterized by clayey-loamy texture and high fine clay content (35-36%), which favors the compaction of the degraded soils. The high clay content in horizons A and B is due to the more intensive process of "in situ" alteration of the mineral part of the soil in these horizons (8).

The humus content in the investigated chernozem profile decreases from 3.3% in the arable horizon to 1.5% in the Bhw2 horizon (71-90 cm). The total amount of nitrogen in the humiferous horizon Ah is in the range 0.192 - 0.151%. The values of the ratio C : N vary within the limits 10.1-9.2. Carbonates occur on the BCk1 horizon (90 - 120 cm) with increasing values from 12.9% on the BCk1 horizon to 18.8% on the Ck horizon (11).

According to the average statistical data (Table 2), the humus content in the 0-30 cm layer is 3.3% for the control variant and 3.4% for the fertilized variants.

The study of the modification in the humus content of the leached chernozem under influence of different doses of fertilizers in long-term field stationary showed that they did not increase the humus content in the fertilized variants.

Table 2 - Humus content in the chernozem leached under the influence of different fertilizer doses

Variant	Humus, %	Variant	Humus, %
Control	3,3	$N_{120}PK$	3,5
	3,3		3,3
	3,2		3,6
	3,3		3,4
	3,2		3,4
Average	*3,3±0,1*	*Average*	*3,4±0,1*
$N_{60}PK$	3,2	$N_{300}PK$	3,5
	3,6		3,4
	3,4		3,5
	3,4		3,2
	3,5		3,4
Average	*3,4±0,2*	*Average*	*3,4±0,1*

The humus reserves in the arable layer of the leached chernozem (control - unfertilized variant) constitute 154 t/ha, and in the 0-100 cm layer - 319 t/ha (Table 3).

Table 3 - Humus content of the chernozem leached on the control variant (unfertilized)

Genetic horizons	Depth, cm	Humus	
		%	t/ha
Ahp1	0-22	3,3	95,1
Ahp2	22-36	2,9	59,3
Ah	36-51	2,4	55,1
Bhw1	51-71	1,7	52,4
Bhw2	71-90	1,5	43,6
BCk1	90-120	0,9	41,0
BCk2	120-160	0,5	15,2
Ck	>160	0,4	11,3

The average statistical parameters of the humus content in the fertilized variants show that the

application of mineral fertilizers after a period of 10 years without fertilizer exploitation of the leached chernozem (1996-2005), did not lead to essential changes, the humus content was established at the level of 3.3-3.4% in the arable layer 0-22 cm.

As a result of the agricultural exploitation, the leached chernozem is affected by the dehumidification of the arable and subarable layer due to the insufficient flow of organic matter in the soil, the compaction of the arable and subarable layer as a result of the soil tillage. The influence of the application of mineral fertilizers $N_{60}PK$, $N_{120}PK$, $N_{300}PK$ after a period of 30 years of exploitation of the soil without fertilizers did not lead to a significant change in the humus content.

Chernozems carbonatic and ordinary. On the plateaus of the south of Moldova, the soil cover is represented by micellar - carbonatic chernozems, which are divided into:

1) surface-carbonatic (or simply carbonatic), characteristic of low altitude levels usually from 40 to 140 m (limiting fluctuations 10-180 m);

2) high-carbonatic (ordinary), occupying a high-altitude belt of 100-200 m with limit marks of 80-240 m (4).

Both subtypes of chernozems are formed on loess loams, less often on light clays. The climate in the south of Moldova is warm, rather dry, but with two maximums of atmospheric and soil moisture - winter-spring and summer. Vegetation in the past was a herbaceous and grassy degree with rich grass stand, a well-developed root system that penetrates deep into the soil.

Carbonatic and ordinary chernozems of the south of Moldova are described in the literature both as a whole and in certain regions (5).

Although these chernozems were analyzed together with southern or even chestnut soils, their dissimilarity was emphasized nevertheless in many important ways with the soils of the dry steppes of more south-eastern regions. In the north of Moldova and in Codri at low altitude levels, micellar-chernozems of both subtypes are also common.

Carbonate chernozems (low-humiferous) represent a link in the formation of chernozems under these conditions, although some of their properties are secondary characteristic (low humus content, high carbonate content) due to long-standing involvement in agricultural use.

By the amount of humus in them, three tiers are distinguished: uniform content (somewhat less than 3%), which coincides with horizon A; recession - up to 100-120 cm; almost humus less - deeper than 120 cm. Low-humiferous carbonatic chernozems, as a rule, occupy higher positions; they are more complex of profile structure, but at the same time they are quite similar to the previous ones. Formally, the humus content in the upper horizon, equal to 3%, serves as the boundary between these two varieties of chernozems.

The humus profile is divided into three tiers, the upper (up to 50 cm) is highly enriched in humus (4%), at a depth of 90-100 cm there is still 1.2% humus (1960 year), (2).

The most significant changes in humus content occurred in the humiferous horizon 0-40 cm (Figure 3). Fertilization of the carbonatic chernozem resulted in a non-essential increase of the humus content on the fertilized variants compared to the control variant (3.07%): $N_{120}P_{1,5}K_{60}$ - 3,17%, $N_{120}P_{2,5}K_{60}$ - 3,23, $N_{120}P_{3,5}K_{60}$ - 3,14%.

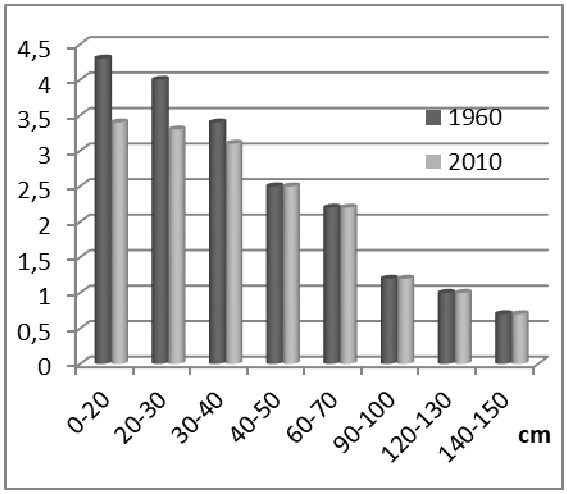

Fig. 3 - Content of humus in arable carbonatic chernozems, 1960 and 2010

The carbonatic chernozem from South-East of Moldova is characterized by satisfactory properties for growth and development of crop plants. As restrictive factors of quality status of these soils can be considered: dehumidification (over 50 years the humus content in these soils decreased by about 0.9-1.0% or 20-23% of the initial content); destruction and low resistance to secondary compaction. The systematic application of mineral fertilizers did not lead to essential changes in the humus content. The humus content in the fertilized variants compared to the control has changed non-essential.

In order to recover and conservation the properties of the carbonic chernozem, it is necessary that the share of legume crops and perennial herbs constitutes 25-30%; the crops rotation with a argued alteration of the tillage depth of soil and the lifting on the surface the compacted layers once in 3-4 years. For remediation the quality status of the

nutrients regimes its recommended to administrate organic fertilizers in optimum norms of 6-8 t/ha on average on soil and mineral fertilizers to obtain the discounted crops.

Chernozem ordinary. These chernozems prevail in the soil cover of the south of Moldova. They differ from carbonatic ones most noticeably in that they effervescence from 10% HCl not from the surface, but at a depth of usually 35-50 cm, rarely deeper (4); characterized by increased power, contain slightly more humus in the upper horizon (Figure 4).

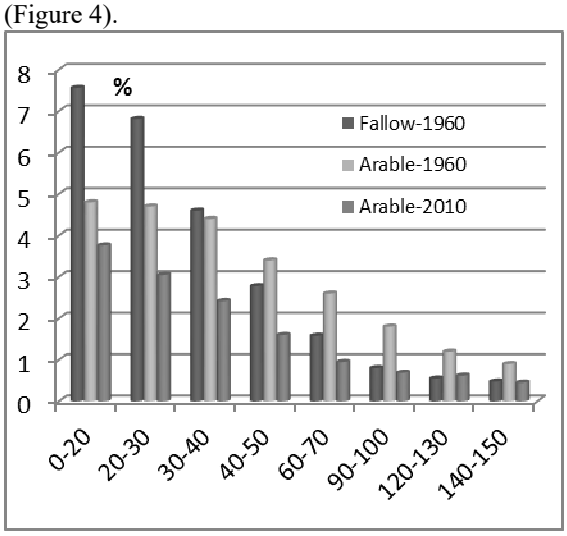

Fig.4 - Content of humus in arable and fallow ordinary chernozems, 1960 and 2010

According to the humus content, the studied ordinary chernozems falls into the submoderated humiferous soil class, which is not characteristic for the typical chernozem subtype with lute-clay texture and, therefore, represents a step towards southern (chestnut soils) chernozems (3). The average statistical data on micro-polygons confirm that after 10 years of cessation of fertilizer introduction their postaction on the humus content in the soil is not observed (Table 4).

Table 4 - Humus content in the ordinary chernozems on the fertilizers variants

Variant	Control	$N_{120}P_{120}K_{60}$	Manure 60 t/ha + $N_{90}P_{60}K_{60}$
0-22 cm	2,98±0,01	2,98±0,03	3,05±0,21
22-35 cm	2,87±0,02	2,83±0,05	2,89±0,19
35-50 cm	1,99±0,11	2,04±0,30	2,21±0,19

The determinations of humus index during the intensive agriculture period detected for the soil of the unfertilized variant a gradual decrease of the humus content in the years 1970-1990 (20 years) from 3.15% to 2.78% (with 0.37% in total or 0.018% on average annually). As a result of intensive use in agriculture for 36 years, the soil lost 0.3-0.4% humus from the upper layer. Since 1990, during extensive agriculture, the humus content in the researched soil has stabilized (3).

The ordinary chernozem in the south of Moldova is characterized by satisfactory properties (humus content) for growth and development the crop plants; as unfavorable factors can be considered: low content of humus content; low compaction resistance of the arable layer as a result of its dehumification and destruction; strong compaction of the postarable layer (20-35 cm).

The systematic administration of mineral fertilizers (1972-1996) did not lead to essential changes in the humus content. The application of organic fertilizers (60 t/ha of manure once in 5 years) stabilized the humus content at the level of 3.0-3.1% (Table 4).

For remediation of properties of the ordinary chernozem, it is necessary that the share of legume crops and perennial herbs in constitutes 20-25% rotation; to adhere at the advanced technologies of field crops cultivation and their rotation with an argued change of the depth of soil work and the surface lifting once in 3-4 years of the compacted soil layers.

For the improvement the nutrient regimes it is necessary to incorporate annually in the soil at least 30% of the secondary production of the cereal crops and 5-6 t/ha of manure (in average on the crop rotation).

The average statistics of the humus content (%) in the arable subtypes of chernozems of Moldova, studied in 1960 and 2010, show that losses of humus from the chernozem are higher, the less the chernozem is less fertile (they have a lower humus content).

Chernozems lost within the following 50 years from the arable humiferous layer (0-20 cm) the following content of humus (%): typical - 0.55; leached - 0.64; ordinary - 0.58; carbonatic - 0.47, and in total - 0.53%, or 0.011 annually (Table 5).

Table 5 - The average statistics of the humus content (%) in the arable subtypes of chernozems of Moldova

Dept, cm	Typical Chernozems	Leached Chernozems	Ordinary Chernozems	Carbonatic Chernozems	Chernozems in total

	1960	2010	Loss	1960	2010	Loss	1960	2010	Loss	1960	2010	Loss	1960	2010	Loss
0-20	4.67	4.12	0.55	4.46	3.82	0.64	3.47	3.01	0.58	3.54	3.07	0.47	4.04	3.51	0.53
20-40	3.98	3.71	0.27	3.37	291	0.46	3.10	2.78	0.52	2.90	2.53	0.37	3.38	3.00	0.38
40-50	3.20	-	-	2.81	-	-	2.71	-	-	2.70	-	-	2.71	-	-
60-70	2.44	-	-	2.12	-	-	2.02	-	-	1.80	-	-	2.11	-	-
90-100	1.46	-	-	1.43	-	-	1.20	-	-	0.90	-	-	1.29	-	-

Conclusions

The modern humus state of arable soils in Moldova is due to the length of their use. Studies conducted in Moldova more than 140 years ago by V.V. Dokuchaev, it was shown that chernozems contained 5-6% of humus. In subsequent years, the natural fertility of Moldavian soils has steadily declined, which has led to an average content of 3.1% humus in the upper layer of arable soils at present. The rhythms of these processes were different depending on the nature of the use of agricultural production. lands. The average loss of soil organic matter is 0.5 t/ha per year (1, 7).

The modern period is very important and can be called critical, bearing in mind the humus state of soils. If the degradation of natural fertility is not stopped by adequate measures, the level of humus content will reach values close to 2%, which corresponds to the lower threshold for chernozems. Humus stabilization at this level will limit grain yields by 1.5–2.0 t/ha. Fertility regeneration, starting from a critical level, will be very difficult to implement, it will take costs and efforts much longer and longer. Maintaining the speed of annual reduction of humus content presents a significant ecological and economic danger for the Republic of Moldova (7).

The quality status of the chernozems (and soils) must be maintained by administering the organo-mineral fertilizers at optimum doses, the cutting and incorporation in the soil of the vegetable residues and the secondary production, respecting crop rotation with introduction of the alfalfa and increasing the proportion of the legume crops up to 20-25%.

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SOILS OF THE REPUBLIC OF MOLDOVA: BASIC STAGES OF STUDY, CURRENT STATUS AND TRENDS OF EVOLUTION

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ABSTRACT

Soil science in its classical form appeared recently, about 140 years ago, with the publication of the book "Russian chernozem" ("Русский чернозем") in 1883, published by the founder of soil genetic science, Vasile V. Dokuchaev. But, the characteristic of the soils of our territory is first described in the works of the "father of history" Herodotus. From the ancient period to the present, the interest in soils has increased, because soil has always been the main determinant of the existence and human community development. The welfare of the people who settled on a certain territory depended on the degree of soil fertility. The stages of soil study show the main scientific achievements of a certain historical period. The scientific results obtained were made possible only by constant work on the soil study as a multifunctional natural object, ecosystemic base, source and space of the economy and as a means of production in agriculture. The next stage of soil study should be carried out at a higher level, using new information and technologies, concepts and modern opinions for this.

Key words: chernozem, degradation, evolution, soil science, stages of soil study.

Introduction

The chernozemic soils on the territory of Moldova represent the most important object for the most comprehensive geographic, genetic, cartographic, hydrological, chemical and geochemical, biological, agrochemical and agrotechnical research, and also represent an important object of intensive agricultural use. The Moldovan chernozems, together with chernozems of the North Caucasus and Danube regions of Western Europe form a special family, or facies, in a wide soils formation system of chernozem type, so characteristic for steppe, forest-steppe and prairie regions of Eurasia and North America (5).

Until recently, it was believed that the history of scientific ideas about the soil cover and other natural conditions of Moldova does not deserve much attention, since it is exhausted by a small number of names, studies and facts. However, a deeper study of literary sources shows that this is not so. The roots of soil science originate in ancient times. This science appeared simultaneously with the birth of agriculture, already in the 3rd millennium BC initial knowledge was gathered about the soil, its properties, and methods of it processing (9).

Materials and methods

On this topic, the theoretical method was used, which consists in the study and generalization of literary sources in the historical aspect.

Basically, the published works of the outstanding soil scientist, doctor of geographical sciences, professor I.A. Krupenikov, who stood at the origins of modern soil science in Moldova, were analyzed. Summarizing the factual material on soils, it was possible to identify the main stages of soil study, the current state and direction of evolution, and to efficiently outline the ways of their rational use and protection.

Results and discussions

I. Main stages of Moldovan soils study (5, 6, 8, 9)

1. From ancient times to Cantemir (beginning of the 18th century). The earliest information about our region dates back to the time of Herodotus. Already in antiquity (Herodotus) the steppe regions of Moldova and Ukraine were described as plain, treeless, “with deep soil”. The “General plan” of the steppes and forests on the territory of Moldova has long been formed in the form in which we know it now, although the forest area was, of course, larger. In the middle of the century, the agricultural development of Moldova was significant, and many soils were used for grains, vineyards and orchards. By the 16th-18th centuries, Moldova was satisfactorily depicted on geographical maps showing forests, steppes, main rivers and cities on them.

2. Dimitry Cantemir on the nature and economy of Moldova. The general meanings of the Cantemir “Descriptio Moldaviae” (“Description of Moldova”) in the history of physical and geographical studies are as follows: the first schematic representations of the topography and climate of the region are given, a lot of information about rivers, their use, and partly the mode; the forests are described, their borders are shown quite accurately at the beginning of the 18th century, on the basis of which one can judge the distribution of forests and steppes in that period; high soil fertility

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was emphasized, their importance as the most important wealth of the region was noted, was provided the information on distribution of grain crops, vineyards, orchards, vegetable gardens. Moldova was first identified as a natural region with its inherent physical, geographical and economic features.

3. From Cantemir to accession of Bessarabia to Russia. In the 18th century, after Cantemir, a lot of new valuable materials were accumulated on the soils, nature and economy of Moldova. At this stage, the range of information on soils, geography and relief of different parts of the country - its northern regions, the "Kodri Mountains", Budjak steppe, expanded.

The first schematic but scientific ideas arose about changes in soils and landscape from south to north; began to attach importance to the soils thickness and their color.

The first comprehensive soil-geological map of south-eastern Europe was compiled, on which there was a lot of data for Moldova. Materials on the soils and nature of Moldova were quite widely published in Russian and foreign works, commented on, included in atlases and dictionaries, and used in military affairs and for economic purposes. The best areas of horticulture, viticulture and winemaking (south-eastern of Transnistria, the vicinity of Akerman), and tobacco growing (Malovata) were identified, with a certain reference to soils.

4. The involvement of Moldova in the Russian science (from 1812 to middle of the 19th century). The first half of the last century was an important period in the study of Bessarabia, which coincided with the time of its rather noticeable economic development. Studies of the region nature, to a greater extent acquired a scientific character and at the same time received a well-known practical application. The study period results under consideration should be considered: a clearer, compared with the previous period, division of the country into three parts according to climate, topography, soil and agriculture; the emergence of new facts and ideas about the structure, thickness, fertility, geographical variability, and even about the origin of chernozem soils; the inclusion of natural science information about Bessarabia in all-Russian geographical reports; practical use of data on soils during land surveying, their allocation for immigrants, in justifying the placement of horticulture, viticulture and other agricultural sectors.

5. The beginning of the scientific statement of chernozems question of South-Western Russia (50-70 years of the 19th century). The most important achievements of this period should be considered: the establishment of four "steps" of chernozem (prototypes of modern subtypes), differing in fertility, thickness, "obesity", geographical and hypsometric confinement; the beginning of "binary" approach to soil classification, on the one hand, according to "organic composition" and, on the other, according to "mineral properties"; the division of the space between Prut and Ingul into four soil-landscape "bands", which were simultaneously considered as agricultural zones; revealing the connections between the terrain (absolute altitude, river terraces, watersheds) and soils - their "obesity", thickness and productivity; conducting the first chemical and physical studies of soils, establishing the features of their temperature regime.

6. Expeditions and researches of Dokuchaev. In the study of the chernozem zone of Russia Dokuchaev paid great attention to the soils of the south-western part of our country. The materials he collected in this region played a significant role in substantiating the laws of zones of nature and a number of important laws of the genesis and geography of chernozems and gray forest soils. At the same time, the natural - historical studies of Dokuchaev on the Dniester - Prut interfluves, which constituted the territory of the Bessarabia province, were of very significant importance.

Travelling on Bessarabia (1877 and 1898) Dokuchaev crossed it from Khotyn Height to the Danube and the Black Sea. The results of these trips are summarized in the "Russian Black Soils" (1883) and in the work "On the Question of the Bessarabia's Soils" (1900). These works laid the foundations of many modern ideas about the geographical distribution, genesis and soil properties of Moldova and the neighbouring regions of the Chernovtsy, Vinnitsa and Odessa regions of Ukraine. Information on the soils of Bessarabia is also given in many books, articles, reports and speeches (7, 10).

7. The content of studies conducted by V.V. Dokuchaev in Bessarabia. The first information on Moldovan soils, based on literature data, is given in the early works of Dokuchaev "Cartography of Russian Soils" in 1879 and "Results on Russian Black Soil" in 1877a. Later, guided by this program, Dokuchaev travelled and studied the entire steppe and forest-steppe stripes of European Russia. After reviewing the soils of Bessarabia, Dokuchaev concluded that here "we have representatives in all horizontal soil zones of European Russia, with the exception of the tundra," and identified the following "types" of soils in Bessarabia:

1. "Typically chernozemic", distributed in the northern third of the province, but at certain heights found in other parts of it.
2. “Mergelic-chernozemic” - the most characteristic for relatively lower expanses of the south.
3. "Saline soils", which are most found in areas adjacent to the Black Sea and the Danube.
4. "Typically forest soils" of northern and central Moldova, divided into "oak", relatively close to chernozems, and "beech", significantly podzolized.
5. "Abnormal soils", which included highly eroded soils of steep slopes, alluvial soils, sandy soils subject to deflation.

For leading "types" of soils, indicators of their morphology and some chemical properties are given, namely: analyzes of hygroscopic water, humus, gross chemical composition, 10% and 1% hydrochloric acid extracts, and sulphate extract. In addition to establishing a number of laws governing the distribution of chernozems and forest soils, the work “On the issue of soils of Bessarabia” specifies the idea of altitudinal differentiation of soils in the Dniester-Prut interfluves. Thus, Dokuchaev formulated the foundations of modern views on the Moldavian soils distribution and characteristics, as well as neighbouring territories, which constitute a well-known physical-geographical whole.

8. The role of Dokuchaev Bessarabia materials in substantiating some theoretical principles of soil science. The period of the Dokuchaev expeditions marked the period to purely scientific soil science both in Russia as a whole and in the south-western region - Bessarabia, for which important facts and regularities were established, namely: belonging to the chernozem zone; the specific nature of geological and geomorphological conditions and soils, the distinguishing feature of which is low humus content; contrast, diversity of the soil cover, its high-altitude differentiation, most pronounced in the interfluves of the Dniester and the Prut; wide opportunities for diverse specialization of agriculture, determined by the characteristics of soil and climatic conditions.

9. The period from the appearance of Dokuchaev's work on the soils of Bessarabia (1900) and until 1918 is rich in new trends in the development of scientific ideas about the soils of the region. For this period, it is important to note the following:
- Compilation of the first modern soil maps of Bessarabia and neighboring provinces.
- The study of deep sections (profile) of soils, in particular chernozems, accompanied by their "profile" analyzes, which revealed the deep desalination of south-western chernozems, their thickness, the nature of the distribution of carbonates and molehills.
- The division of chernozems into subtypes and establishment the fact of "extreme non typical of local chestnut soils".
- Confirmation of Dokuchaev’s thought about the low humus content of western chernozems as their significant provincial features.
- Concretization of the issue of eroded and cumulic soils, their distribution and causes of formation.
- The beginning of field experiments on the treatment, fertilizer and erosion protection of soils in a specific relation to soil conditions.
- Deepening the understanding of relationship between soils and culture of grapes and fruit trees. The beginning of special scientific studies on "orchards - vineyards soil science."
- Creation of extensive collections of Moldavian soils monoliths and, in general, of the South-West region and their display in museums of Chisinau and Odessa.
- Wide and qualified use of soil materials in geographical and agronomic monographs.

Significant disadvantage of the period under consideration, which had its consequences until very recently, was the conduct in Bessarabia of only survey, general provincial soil-cartographic works, and while in many other places in Russia, even in Asia, county and even province maps were compiled with great success.

10. The main scientific results of 1918-1944 period should be considered:
- Comparison of the Moldova's chernozems with soils of the more western regions of the Danube Region and use the scientific ideas Romanian researchers.
- Detailing the characteristics of chernozems, dividing them into groups according to humus content, "degree of degradation".
- Compilation of several county soil maps and the first soil cartograms.

11. The value and implementation of N.A. Dimo ideas. The modern period of soil study in Moldova begins with the scientific activity of Academician N.A. Dimo after his return to homeland in 1945 (after 50 years). He created a scientific school of soil scientists, continuing the ideas of Dokuchaev. The main achievements of this period should be noted as follows:
- the current state of rural soil mapping, which continues, although it needs to be accelerated and updated based on GIS;
- the past, present and future of the Moldovan black soil, considered by Dimo our main natural resource;

- the soils humus state in the aspect of different agronomic methods of their use (cultivation, fertilizer, crop rotation);
- the study of phosphorus in soils and the peculiarities of behavior of phosphorus fertilizers;
- the trace elements content in soils and plants;
- assessment and variability of physical properties and soil regimes, a new classification of soil types;
- the results of half century of experiments with fertilizers in relation to subtypes of chernozems and forest soils established (4).

II. Current state of Moldova's soil cover

Soil condition is unsatisfactory in approximately 60% of the area. In Moldova, as in other countries, the share of arable land per capita is decreasing. According to recent data, this area is 0.407 ha (14). The annual losses of the country's economy from soil degradation processes are enormous. The main activity causing negative changes in the state of soil cover is agriculture. Intensive land development and ploughing along the slope activate water erosion processes. Irrigation often causes secondary salinization of soils. The insufficient application of organic fertilizers, which does not compensate for the loss of organic substances, leads to dehumification, and the irrational use of pesticides leads to soil pollution. Excessive application of mineral (nitrogen) fertilizers causes their acidification, and unsystematic grazing of livestock leads to the destruction of vegetation, the intensification of water and wind erosion, and pollution of soils and reservoirs with manure (17).

Soils in Moldova are represented by fertile black soil and productive agricultural land. Almost every second hectare of land is of average quality, 700 thousand hectares (27% of agricultural land) are of good quality. However, soil tolerance decreased by 7 points over 30 years as a result of its intensive use in agriculture and climate change. Soils affected by various degradation processes occupy more than 1.9 million ha (15).

1. The modern humus state of arable soils in Moldova is due to the long period of their use in agriculture. Studies conducted in Moldova about 140 years ago by V.V. Dokuchaev, it was shown that chernozems contained 5-6% of humus. In subsequent years, the natural soil fertility of Moldova was constantly decreasing, which led to an average content of 3.1% humus in the upper layer of arable soils. The rhythms of these processes were different depending on the nature of the agricultural use lands. The average loss of soil organic matter is 0.5 t/ha per year (2, 12). The modern period is very important and can be called critical, bearing in mind the humus state of soils. If the degradation of natural fertility is not stopped by adequate measures, the level of humus content will reach values close to 2%, which corresponds to the lower threshold for chernozems. Humus stabilization at this level will limit grain yields by 1.5–2.0 t/ha. Fertility regeneration, starting from a critical level, will be very difficult to realized, it will take costs and efforts much longer and longer (1, 3, 11).

2. The state of nutrient regimes of soils (3,14,15). In the pedoclimatical conditions of Moldova, the optimal nutrient regimes is considered to be one that ensures the yield determined by the water availability of plants. Under conditions of negative humus balance, the after-effect of nitrogen fertilizers ceased after a few years. Currently, the *nitrogen nutrient regime* of soils is almost entirely determined by the humus content. Soils provide agricultural crops by nitrogen in all areas of the republic within 70-90 kg/ha per year. This level is only 60% of the necessary for optimal yields. Only 2% of arable land corresponds to this level

Phosphorus regime. In the soils of Moldova, phosphorus available to plants, like mineral nitrogen, is in the first minimum. Since the humus content has not changed during the 30-year period, it can be assumed that the immobilization of phosphorus was due to the gradual formation of insoluble compounds, which are not widely available to plants. A sharp decrease in the application of nitrogen fertilizers since 1992 did not allow the use of the accumulated phosphorus reserve, which was subject to chemical degradation. Consequently, phosphorus reserves in fertilized soils decreased to the level characteristic of unfertilized soils.

Potassium regime. Potassium state is predetermined by the mineralogical composition of soils. The forecast shows that until 2025 the potassium regime of Moldavian soils will not limit the production of high yields of most crops by 90% of the area. For demanding crops, the deficit can be compensated by plant debris and moderate doses of organic fertilizers. In recent decades, a negative balance of all nutrients has been established in soils: nitrogen in the range of 20-35 kg/ha, phosphorus - 25-40 kg/ha, potassium - 340-355 kg/ha (14, 15).

3. The deterioration of the *physical properties and regimes* of arable soils is due to deterioration of the structure and secondary compaction. To minimize these processes, it is necessary to introduce crop rotation with the participation of perennial grasses of 20-30%, introduce organic fertilizers, and optimize soil tillage systems. Local resources of organic matter

and nutrients necessary for plant nutrition and restoration of soil fertility consist of plant residues left on the field after harvesting, organic fertilizers of the livestock sector, various organogenic wastes of processing enterprises, agricultural raw materials, municipal services.

4. The current biological state of soils is determined by their taxonomic affiliation, duration of agricultural use, after-effect of applied intensive technologies in the period 1970-1990, intensified by anthropogenic impact on the soil and its biota in the subsequent period as a result of a significant deficit of fertilizers, disturbances crop rotation, deterioration of physical and chemical properties, etc. The number and variety of invertebrates and microorganisms, as well as the level of enzymatic activity of soils are reduced in according to a decrease in the energy potential of soils. Long-term agricultural use of soils has caused a change in the functioning of the biota complex. Changes in its composition persist for a long time and, according to some indicators, are irreversible (14, 15).

5. Problems of soil fertility conservation. Land degradation is the most important environmental problem for Moldova. The problem of soil erosion is especially acute, the area of eroded soil increases every year: from 28% in 1965 to 40% in 2015. The problems of salinization, compaction, water-logging, soil contamination, dehumification and loss of productivity are also aggravated (11, 12, 11).

The problem of degradation is serious, because the productivity of agricultural land decreases precisely when socio-economic changes occur. Until 1990, the main reason for the widespread development of soil degradation processes in Moldova was the excessive intensification of agricultural production, disturbance of ecological balance in landscapes. After 1990, the following events had a significant impact on soil resources and the agricultural system: the adoption of a new Land Code, the implementation of land reform, and the soil privatization. Land reform has fundamentally changed the structure of land tenure and land use. However, these and other land transformations did not create the conditions for the protection, land reclamation, and rational use of soils, increasing their fertility, and increasing agricultural production. products (14).

The scale of the present crisis in the agricultural sector production and its interaction with macroeconomic processes require an integrated approach to the protection and rational use of soils. Sustainable socio-economic development is possible only if the productive capacity of soils used in agriculture and forestry is maintained for a long time by preventing and combating the processes of their degradation.

Efforts to combat land degradation in Moldova so far have had only limited success. Such an example is the "Program for the conservation and improvement the soil fertility for 2011-2020" (Government Decision No. 626 of 08/20/2011) and Action Plans for its implementation - for 2011-2013, 2014-2016, 2017-2020 periods. The program provides for the following: creation and improvement of scientific and technical base to ensure the implementation of land reclamation works and its constant updating; creation of information system for soil quality and constant updating of the database; preventing the development of active forms of soil degradation on an area of 877 thousand ha of eroded land; introduction of methods for maintaining and improving soil fertility in arable land of 1.7 million hectares - until the end of 2020 (15).

For full implementation of all tasks set of the program, tactical efforts are needed: to train local land user personnel and the modern methods of land conservation and restoration, as well as create educational institutions for agricultural land owners, consultants and land users to train specialists; expand and strengthen national research capacity in order to identify and implement effective land conservation and restoration practices that meet the existing socio-economic and physical conditions of land use. It is also necessary to coordinate all measures, strategies and programs for conservation and restoration of land with national agricultural development programs, national environmental programs and country action plans in the field of climate change and desertification and others (3).

In the near future, it is necessary to provide the zonal and district programs for conservation and rational use of existing soil fertility, and within the framework of these documents, plan and carry out the following:

- conduct a complete inventory of available land - arable land, perennial plantations, pastures and fallow (no arable) plots and develop scientifically recommendations for their further rational use;
- carry out soil mapping, as well as agrochemical, agroecological and land reclamation surveys of all agricultural lands;
- for all households, regardless of ownership, to develop projects for rational use of available land resources and conduct on-farm organization of territories taking into account landscape, natural and economic features and shared ownership of citizens;

- design modern crop rotation, soil tillage systems, plant protection, fertilizer application, soil fertility restoration and other organizational and economic measures that ensure sustainable production in conditions of limited use of material resources [1, 9, 10].

Well-planned long-term national and regional land conservation and restoration programs must be accompanied by strong political support and adequate funding, and then success is guaranteed.

III. Trends of Moldovan soil evolution

In the "Russian Black Soil" by Dokuchaev (1883) we do not find any facts about the degradation of black soil, and only nine years later in the book "Our steppes before and now", the author writes: "... due to erosion the surface of the steppes, which means that physical evaporation increased by 25%, and in some places by 50%, endless plains in many places turned into hills, into narrow plateaus and slopes, and the area of various uncomfortable lands increased significantly" (8).

The ploughing of chernozems deprived him of the "protection inherent in his granular structure". Erosion of the chernozem intensified and his "almost widespread ploughing and, therefore, exhaustion" occurred. Chernozem - "an organism that is well-built and has high natural qualities, but its strength is torn, depleted, it is no longer able to work correctly". Before us is a bright and completely pessimistic forecast, although this word was not used then. "Dokuchaev considered forecasting the highest aspiration of any natural science" (16).

The modern period is marked by an increase in the number of different predictions about the soil cover evolution. Krupenikov (6) suggested 4 scenarios for predicting the soil resources state of the republic, different in their essence, environmental and social consequences, but all can be considered real.

The first - ***restoration*** scenario is based on the numerous statements that earlier the nature and soil cover of Moldova were ecologically impeccable, and the whole task is that the past simply needs to be restored, remediated. But these are precisely statements, not arguments, because there are no studies as such on this topic. This scenario proposes to double-triple the area of forests, but this will have to significantly reduce the arable land; do not use mineral fertilizers at all, but the proper fertility potential must be maintained in the soil; etc. Although the partial implementation of this forecast may be based on the improvement of "human qualities". According to Krupenikov (6), a restoration path of development is impossible for Moldova, but it is useful to listen to the opinion of its supporters.

The second scenario is ***pessimistic***, based on the principle of spreading in the near future what has happened in the recent past. For the possible development of natural phenomena or related to them, to which agriculture relates, it is quite acceptable as alternatives. When implementing this forecast, the soil erosion process will on average annually cover about 1% of the new cultivated soil areas and in 20-25 years, almost all slope lands will be transferred to the eroded soil group. This will be accompanied by the transition of weakly eroded soils to moderatly eroded soils, and then to strongly eroded soils, which is confirmed by the annual growth rates of the areas of these three categories of eroded soils. For example, in the center of Moldova, weakly eroded soils grow by an average of 0.3% per year, moderately and strongly eroded soils together by 0.6%, in the south of Moldova these two soil group are 0.2% and 0.9%, respectively; the situation is even more menacing.

If this forecast is realized, many deterioration processes of chemical composition, physical properties and biological regime of soils will undergo, crushing of the eroded soils areas on the slopes will intensify, they will become smaller and more contrasting, which will complicate land management and generally use the soil as a resource. The average bonitet of arable lands of the republic will decrease by several points (3-6).

Pessimistic forecast can be considered potentially dangerous, because it reproduces the recent past, when many decisions were made, and partly the conditions for the soils protection.

The third forecast - ***skeptical***, for two reasons. Firstly, it does not reproduce the past, but proceeds from a number of constructive premises. Secondly, it is aimed only at neutralizing negative processes, and not at turning them in a positive direction. For example, using the entire arsenal of means to combat soil erosion, farms on all cultivated lands will reduce its size to an acceptable minimum of about 5 t/ha per year. However, this indicator should not be understood as average, but as the limit for each inclined site. With such eroded sizes, the soil-forming process will compensate the erosion effect, but no more. The eroded soils are stabilizing in their current state (profile structure, thickness, humus reserves, bonitet), and the process of their bio-regeneration will go very slowly.

Changing in the cultivated areas structure, is true, but not formal development of crop rotation, their saturation with perennial grasses, rational irrigation with its gradual expansion, full and skilful

use of all types of organic fertilizers, biowaste from industry and municipal services, the composts use, will achieve a neutral humus soil balance, which in combination with a complex of anti-erosion technologies stabilizes the bonitet of all cultivated soils at more or less constant level.

In carrying out this forecast, it will be necessary to concentrate efforts on the maximum spatial limitation of soil use for non-agricultural purposes. This scenario, although it will not provide a noticeable turn in the direction of increasing soil fertility, will nevertheless create a favorable ecological background for increasing the general bio-productivity of agriculture in the republic. This will be due to the success of plant selection and agricultural technologies, which at present (scenario I) is offset by erosion and a decrease in soils humus content.

The fourth scenario is ***optimistic***, based on the idea of expanded reproduction of soil fertility and the advantages of soil cover. To implement an optimistic scenario, it is important not only to suppress soil erosion, but also to restore it by selective reclamation of part of moderately and heavily eroded soils on the slopes due to humus reserves of eroded and floodplain soils and silt sediments of water bodies. This path is difficult, but technically feasible, as proved by a series of field experiences in Moldova and Ukraine.

The implementation of the fourth scenario will require a system of land reclamation, agrotechnical, sanitary-hygienic, organizational and legal, scientific developments and decisions made on their basis. Therefore, it is still very necessary that environmental knowledge develop into the ecological consciousness of the majority.

This is the kind of alternative forecasting of the soil cover state proposed for Moldova at the first time. If we agree with the reality of these forecasts, then they should be carefully worked out a quantitative level and in the context of regional combinations of environmental conditions: in the most schematic form - north, center, south. Then the forecasts will become more convincing, and the second one can be called environmentally threatening, the third - environmentally optimized, the fourth - environmentally harmonious (**).**

Conclusions

The area of all chernozems in Moldova is about 2.5 million hectares, or about 80% of the republic territory, it can be considered that agricultural land is 80-85% located on chernozems. At present, in Moldova there are many problematic issues of agricultural importance, which rest against the need for an accurate and in-depth study of soils, especially chernozems.

The main tasks of soils studying described by N.A. Dimo in the book "Soils of Moldova, the tasks of their study and the most important features" (4), are relevant at the present time.

"All of the above allows us to consider as one of the main tasks of Moldavian soil scientists the most thorough study and establishment the laws of humus content and reserves in all types and subtypes of soils, their genera, types and varieties. Moreover, the definitions and calculations must be combined with the conditions of soil occurrence: relief and its slopes, parent rocks, the degree of soils development on the slopes and the state of their erosion, prescription of cultivation, etc. In any case, the cited materials make it possible to consider the chernozems of Moldova so peculiar that they cannot be classified as ordinary, low-humus and other units; to correctly attribute its to ploughed chernozems of the ***Moldavian province,*** understanding it geographically wider than the borders of our republic" (4).

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COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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DIVERSITY, ABUNDANCE AND DOMINANCE OF THE EPIGEAL ARTHROPODS IN THE VINE CROP, COROD LOCALITY, GALAŢI COUNTY, SOUTHERN MOLDAVIA, ROMANIA, 1983

VARVARA MIRCEA, PAŞA MARIN

ABSTRACT

The aim of the paper is to present the taxonomic structure of the epigeal arthropods (classes, orders of insects, families of Coleoptera, species of Carabidae, their abundance and dominance from a vine crop, Corod locality, southern Moldavia, Romania, 1983).

The material of the paper was collected from a vine crop, Corod village, Galați County, 1983, using 12 Barber pitfalls, protected against rainfalls, with preservative liquid, 4 %, formalin solution .

The interval and continuous period of collecting was between May 4th and September 22nd, 1983; in total 141 days. There were performed 15 collectings and analysed 180 samples. In total, there were collected 5,804 specimens of epigeal arthropods.

Taxonomically, the scientific material belonged to: three classes of arthropods; insects are eudominant 5,506 (94.87%); six orders of insects, Coleoptera 1,116 (20.27%); eleven families of Coleoptera, family Carabidae 165, (15.17%) with 11 species. *Pseudoophonus rufipes* De Geer 1774 with 70 specimens (42.42%) and *Carabus coriaceus* Linnaeus 1758,58 individuals (35.15 %).

The general ecological characteristics of the species of Carabidae are presented in table no.5.

Key words: Epigeal arthropods, classes, orders of insects, families of Coleoptera, species of Carabidae, abundance, dominance, ecological characteristics

Introduction

Nature, biosphere, ecosphere are governed by natural, biological and ecological laws. The fundamental ecological law is the unity and interaction between environment and organisms.

The biotope within an ecosystem has a determinant taxonomic role on the biocoenosis.

Geographically, Corod locality belongs to the Tecuci Plain with temperate continental climate.

The aim of the paper is to present the variation of the relative abundance and dominance of the epigeal arthropods from a vine crop, Corod locality, Galaţi County, Southern Moldavia, Romania,1983.

Objectives of the paper: There were established 7 objectives of the paper: 1. Documentation on the subject of the paper ; 2.Collecting the material from the vine crop; 3.The taxonomic determination of the entomologic material; 4. Knowledge of the presence of the classes of arthropods, orders of insects, families of Coleoptera and the species of the family Carabidae in the ecological conditions of the vine crop, Corod locality, Galaţi County, Southern Moldavia, Romania, 1983; 5. Knowledge of the variation of the concrete values of the relative abundance and dominance of the classes of Arthropods, orders of insects, families of Coleoptera, species of Carabidae; 6. Discussion of the results; 7. Ecological requirements of those 11 species of Carabidae identified in the Corod locality, Galaţi County.

The ecological factors influencing, by their variation, the plants, *Vitis vinifera* and their production are: soil and its texture, humidity, light and temperature. soil texture, higher humidity and temperature, southern, south-eastern, south-western slopes favorably influence the production of grapes.

Researches on the Carabidae (Coleoptera) in the period 1993-1997 in the vineyards of Galaţi county are published in 6 papers: 1.Tălmaciu, Georgescu, 1993; 2.Tălmaciu, Georgescu, Filipescu,1994; 3.Varvara, Tălmaciu, Georgescu, 1995; 4.Tălmaciu, Georgescu, Filipescu, Bădeanu, 1996; 5.Tălmaciu, Georgescu, Filipescu, Bădeanu, Radu, 1996; 6.Tălmaciu, Georgescu, Mitrea, Filipescu, Bădeanu, 1997.

Material and methods

The region from where the collectings and researches were effectuated belongs to the South of Moldavia, Corod locality,Galați County,1983.

The entomologic material is completely original and there was collected from the ecosystem of a vine crop to show the influence of the ecosystem on the number of taxonomic arthropods (classes of arthropods, orders of insects, families of Coleoptera),species of Carabidae, 1983 and their numbers.

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To collect the material rationally, ecologically and continually, there were used 12 Barber pit-falls. The traps were arranged in three rows. Each row had four pit-falls. The distance among lines and pitfalls was 5 m, being covered a total surface of 225 square meters.

The pitfalls functioned in the ecosystem from May 5th till September 22nd, 1983, in total, 141 days.

There were effectuated 15 collectings and analysed 178 samples that is the content from 178 pit-falls to determine the individuals belonging to classes of arthropods, orders of insects, families of Coleoptera, species of Carabidae.

Results and discussions

The results of the paper are shown in five tables and represented graphically in four histograms.

In presenting the sub unities, results, discussions and conclusions, we followed and respected the natural, logical and psychological principle from general to particular.

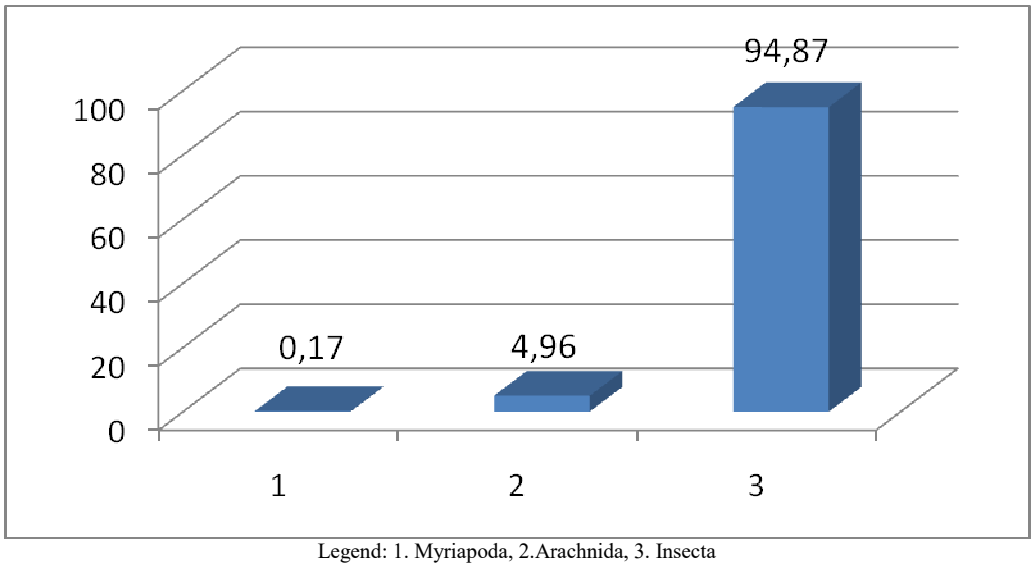
Taxa exist through individuals having specific morphological characters from kingdom to species.

The main numerical characteristic of each taxon is the number of individuals.

The total number of collected individuals was 5,804 (Table1, Fig.1).

Table 1 - The taxonomic structure, abundance and dominance of the epigeal Arthropods classes from the vine crop, Corod locality, Galaţi County, Southern Moldavia, Romania, 1983.

No.	Arthropods, Classes	Rel. abundance	%
1.	Myriapoda	10	0.17
2.	Arachnida	288	4.96
3.	Insecta	5,506	94.87
	Total	**5,804**	**100**



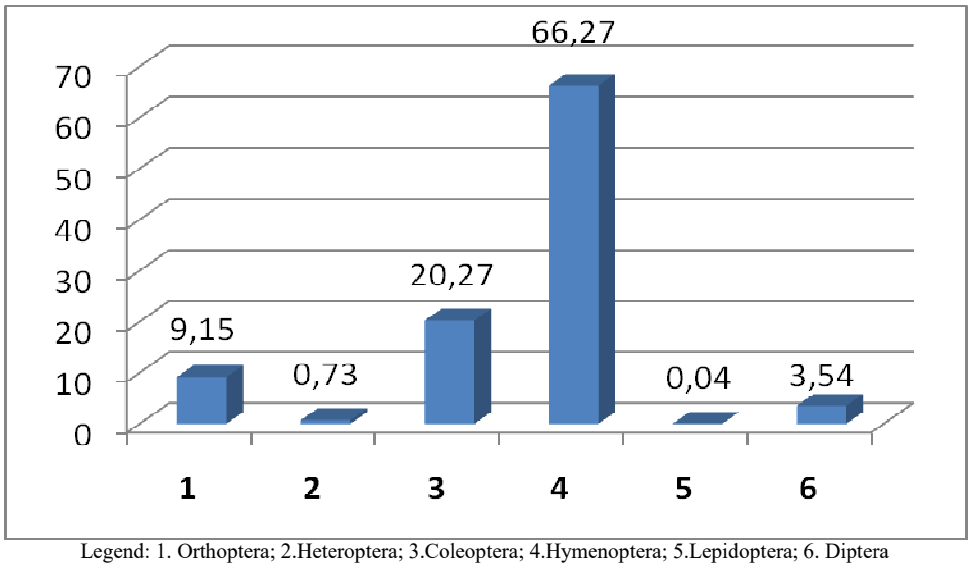
Legend: 1. Myriapoda, 2.Arachnida, 3. Insecta

Fig. 1 - The percentage variation of the epigeal individuals of the classes of Arthropods from the vine crop ecosystem, Corod locality, Galaţi County, Southern Moldavia, Romania, 1983.

The insects are represented through six orders. The orders Hymenoptera (66.27%) and Coleoptera (22.27%) are best represented (Table 2, Fig. 2).

Table 2 - The taxonomic structure, abundance and dominance of the epigeal Arthropods (Orders of Insecta) from the vine crop, Corod locality, Galaţi County, Southern Moldavia, Romania, 1983.

No.	Orders	Relative abundance	%
1.	Orthoptera	504	9.15
2.	Heteroptera	40	0.73
3.	Coleoptera	1,116	20.27
4.	Hymenoptera	3,649	66.27
5.	Lepidoptera	2	0.04
6.	Diptera	195	3.54
	Total	**5,506**	**100**



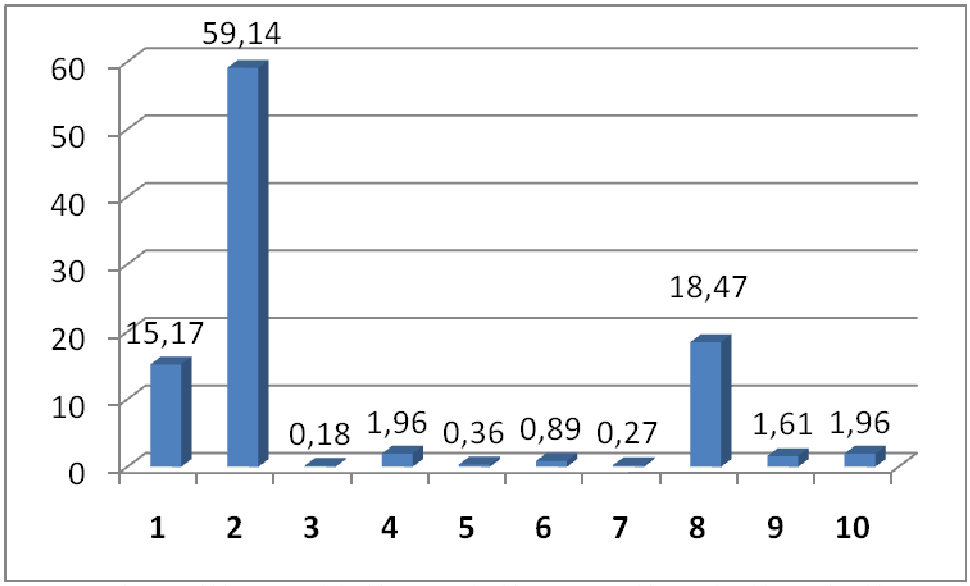
Legend: 1. Orthoptera; 2.Heteroptera; 3.Coleoptera; 4.Hymenoptera; 5.Lepidoptera; 6. Diptera

Fig. 2 - The percentage variation of the epigeal individuals of the Orders of Insecta from the vine crop ecosystem, Corod locality, Galați County, Southern Moldavia, Romania, 1983.

Within the Order of Coleoptera, there were identified 10 families. The following families are represented in the following percentages: Tenebrionidae (59.14%), Chrysomelidae (18.47%), Carabidae (15.17%) (Table 3, Fig. 3).

Table 3 - The taxonomic structure, abundance and dominance of the epigeal Arthropods (Families of Coleoptera) Corod locality, Galaţi County, Southern Moldavia, Romania, 1983.

No.	Families	Abundance	%
1.	Carabidae	165	15.17
2.	Tenebrionidae	663	59.14
3.	Scarabaeidae	2	0.18
4.	Dermestidae	22	1.96
5.	Histeridae	4	0.36
6.	Elateridae	10	0.89
7.	Cantharidae	3	0.27
8.	Chrysomelidae	207	18.47
9.	Coccinellidae	18	1.61
10.	Curculionidae	22	1.96
	Total	**1,116**	**100**



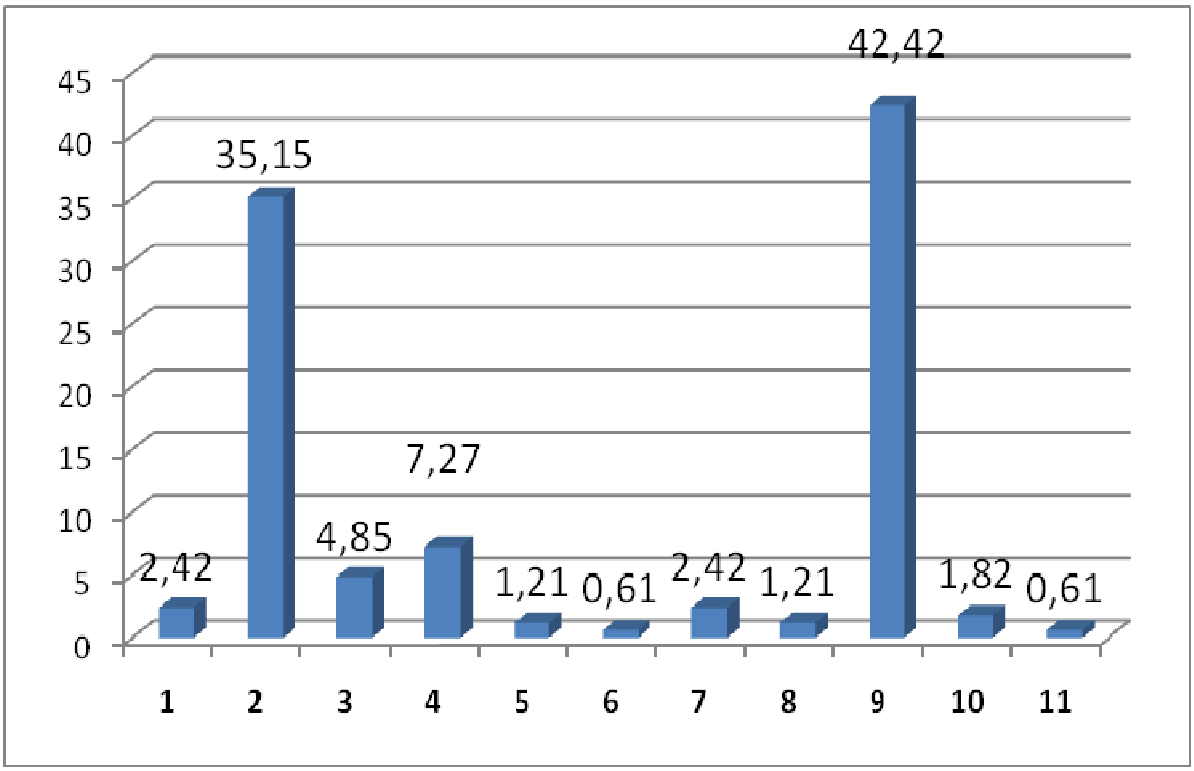
Legend: 1. Carabidae; 2.Tenebrionidae 3;Scarabaeidae; 4.Dermestidae; 5.Histeridae; 6.Elateridae; 7.Cantharidae; 8.Chrysomelidae; 9.Coccinelidae; 10.Curculionidae

Figure 3 - The percentage variation of the total collected number of epigeal individuals of the Families of Coleoptera from the vine crop, Corod locality, Galați County, Southern Moldavia, Romania, 1983.

Within the family Carabidae there were determined 11 species. Two species are best represented: *Pseudoophonus rufipes* (42.42%) and *Carabus coriaceus* (35.15%) (Table 4, Fig. 4).

Table 4 - The abundance and dominance of the epigeal species of Carabidae in the vine crop, Corod locality, Galaţi County, Southern Moldavia, Romania, 1983

No.	Species	Relative abundance	%
1.	*Calosoma auropunctatum* Herbst 1784	4	2.42
2.	*Carabus coriaceus* Kraatz 1877	58	35.15
3.	*Poecilus cupreus* Linnaeus 1758	8	4.85
4.	*P. sericeus* Fischer von Waldheim 1823	12	7.27
5.	*Calathus melanocephalus* Linnaeus 1758	2	1.21
6.	*Dolichus halensis* Schaller 1783	1	0.61
7.	*Amara equestris* Dejean 1831	4	2.42
8.	*A. convexior* Stephens 1828	2	1.21
9.	*Pseudoophonus rufipes* De Geer 1774	70	42.42
10.	*Harpalus politus* Dejean 1829	3	1.82
11.	*H. distinguendus* Duftschmid 1812	1	0.61
	Total	**165**	**99.99**



Legend: 1. *Calosoma auropunctatum*; 2.*Carabus coriaceus* ;3. *Poecilus cupreus*; 4. *P.marginalis*; 5.*Calathus melanocephalus*; 6. *Dolichus halensis*; 7. *Amara equestris*; 8. *A.convexior*; 9. *Pseudoophonus rufipes*; 10. *Harpalus politus*; 11. *H.distinguendus.*

ig. 4 - The percentage variation of the total collected number of the epigeal species of Carabidae from the vine crop, Corod locality, Galați County, Southern Moldavia, Romania, 1983.

The five main ecological requirements of the species (reproduction type, humidity preference, habitat preference, food regime and zoogeographical distribution) are shown in table 5.

Table 5 - Main ecological characteristics of the species of Carabidae in the vine crop, Corod locality, Galați County, Southern Moldavia, Romania, 1983.

No.	Species	1	2	3	4	5
1.	*Calosoma auropunctatum*	Sp	M	OLS	Z	Wp
2.	*Carabus coriaceus*	A	M	F	Z	E
3.	*Poecilus cupreus*	Sp	M	OLS	Z	Wp
4.	*P. sericeus*	Sp	Mcsb	Cr	Z	Wp.Pont.
5.	*Calathus melanocephalus*	A,Sp	M	Eu	Z	T
6.	*Dolichus halensis*	A	M	Cr	P	PL
7.	*Amara equestris*	Sp	M	OLS	P	Wp
8.	*A.convexior*	Sp	M	OLS	P	Es
9.	*Pseudophonus rufipes*	A	M	OLS	P	Wp
10.	*Harpalus politus*	Sp	M	OLS	P	Esb
11.	*H. distinguendus*	Sp,S	M	OLS	P	T

Legend: 1.Reproduction type; **2.**Humidity preference; **3.**Habitat preference; **4**.Food regime; **5**.Zoogeographical distribution; **A.**=Autumn; **Sp.**= Spring; **S.**= Summer ; **M.**= Mesophylous; **Mx.**= Meso-xerophylous **;** **Cr.** = C rop; **Eu.**= Eurytopic; **F**= forest; **Mcsb.**= mezo-xerobiont; **OLS.** = Openlandscape ; **Pont**.= pontic; **Wp.** = West -Palaearctic ; **E.**= Europe; **T.** = Transpalaearctic ; **Es**b.= Euro-Siberian.

Discussions

Methodically, scientific discussions should include syntheses, comparisons and especially interpretations. Everything in the objective nature, in the living nature, in ecosystems is in unity, connection, action, interaction. Everything is conected to everything! Nothing without a cause and effect. Biotope, habitat with their ecological factors influence the presence of the number of species and individuals of a population due to the influence of its ecological factors (soil, the texture of the soil,the crop plant, temperature, humidity, food).

The interaction of the above mentioned ecological factors was far less favorable to the species of Carabidae in the Corod vineyard in 1983, reflected by the total number of species and individuals belonging to the Carabidae family.

Comparing our results with those published by the authors, Tălmaciu, Georgescu, Mitrea, Filipescu, Bădeanu (1997), from the Bujorului Hills vineyard, Galaţi county, there are significant differences: In the Corod Vineyard,1983, 141 days of collecting, 11 species of Carabidae were collected, with a total of 165 individuals, compared to 20 species, represented by 2,377 individuals (Bujorului Hills, 1992).The percentage of species in the Corod vineyard was 35.48% lower compared to the Bujorului Hills, where the number of individuals was 93.31% higher, compared to 6.49%, Corod, 1983. Favorable or unfavorable local ecological factors dictate the number of species and individuals belonging to a biocoenosis. We can safely deduce that the moisture factor of the soil was the one that reduced the number of species and individuals in the vineyard crop, Corod, 1983.

The species collected from the concrete ecological conditions, Corod locality, 1983, belong to 100% mesophilic species, zoophagous species (45.45%) and pantophagous species (54.54%).

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Conclusions

The collecting effort of the epigeal material in the year 1983 from the vine crop, Corod, locality, 1983, the taxonomic identification of those 5,804 individuals (classes of arthropods, orders of insects, families of Coleoptera, species of Carabidae) give us the scientific right to conclude the following. Within the epigeal fauna of arthropods, the present taxa in the vine crop Corod, 1983 are : Myriapoda, Arachnida, Insecta; six orders of insects, (Orthoptera, Heteroptera, Coleoptera, Hymenoptera, Lepidoptera, Diptera); 10 families of Coleoptera (Carabidae, Tenebrionidae, Scarabaeidae, Dermestidae, Histeridae, Elateridae, Cantharidae, Chrysomelidae, Coccinelidae, Curculionidae); 11 species of Carabidae (*Calosoma auropunctatum*, *Carabus coriaceus, Poecilus cupreus, P. marginalis, Calathus melanocephalus, Dolichus halensis, Amara equestris, A. convexior*, *Pseudoophonus rufipes, Harpalus politus, H. distinguendus*).

The best represented taxa through individuals in the vine crop, Corod locality, 1983, are: Insecta, Hymenoptera, Coleoptera, Tenebrionidae, Chrysomelidae, Carabidae, the species *Pseudoophonus rufipes* and *Carabus coriaceus* (Carabidae).

Rezumat

Scopul lucrării este de a prezenta structura taxonomică și variația numerică a artropodelor epigee (clase, ordine de insecte, familii de coleoptere, specii de Carabidae (abundența și dominanța) dintr-o cultură de viță de vie, localitatea Corod, județul Galați,1983.

Materialul lucrării este original și a fost colectat dintr-o cultură de viță de vie, satul Corod, județul Galați, Moldova de sud, în anul 1983, folosind 12 capcane Barber, protejate împotriva precipitațiilor, cu lichid de conservare 4 % soluție de formalină.

Intervalul și perioada continuă de colectare a materialului entomologic a fost între 4 mai și 22 septembrie 1983, în total, 141 de zile. Au fost efectuate 15 colectări și analizate 180 de probe (15 colectări x 12 capcane). În total, s-au colectat 5.804 exemplare de artropode epigee.

Taxonomic, materialul colectat aparține la: trei clase de artropode; insectele sunt eudominante 5.506 (94,87%); șase ordine de insecte, ordinul Coleoptera 1.116 indivizi (20,27 %); unsprezece familii de coleoptere, familia Carabidae 165, (15,17 %) cu 11 specii. *Pseudoophonus rufipes* De Geer 1774 cu 70 de exemplare (42,42 %) și *Carabus coriaceus* Linnaeus 1758, 58 indivizi (35,15%).

Cerințele ecologice generale ale speciilor de Carabidae sunt prezentate în tabelul 5.

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COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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RESEARCHES CONCERNING THE DIVERSITY OF ROVE BEETLES (COLEOPTERA, STAPHYLINIDAE) FROM THE HEMEIUŞ DENDROLOGICAL PARK OF BACĂU COUNTY, ROMANIA

MIHAELA ARINTON*

ABSTRACT

The researches concerning the diversity of rove beetles from the Hemeiuş Dendrological Park of Bacău were made in 2009. The material was collected weekly, from May to October, by the method of Barber pitfalls placed in three different locations: lake area, deciduous forest and *Spirea* culture. Systematically, the fauna analysed for this dendrological park (253 rove beetles) belongs to 6 subfamilies (Oxytelinae, Omaliinae, Staphylininae, Aleocharinae, Paederinae and Steninae), 12 genera and 18 species.

Ocypus (Matidus) kuntzeni J. Muller, 1926 was the dominant species (81.02%). Five species were represented by a single specimen: *Atheta oblita* Erichson, 1839, *Atheta fungi* Gravenhorst, 1806, *Liogluta granigera* Kiesenwetter, 1850, *Paederus (Heteropaederus) fuscipes* Curtis, 1826 and *Stenus ochropus* Kiesenwetter, 1858. The largest number of rove beetles was collected from deciduous forest (185 specimens). The largest number of staphylinid species was collected from the *Spirea* culture (eleven species) and from deciduous forest (ten species).

Key words: rove beetles, diversity, Hemeiuş Dendrological Park

Introduction

Staphylinidae are the largest family of beetles, with over 63,000 species known worldwide and probably over 75% of tropical species still undescribed. It is the largest family in the British Isles and in America north of Mexico, and it may prove to be so in other regions when huge numbers of now-unknown species are described (if they are described before they become extinct by habitat destruction) (Frank JH & Thomas M. C., 1999).

Staphylinidae occupy almost all moist environments throughout the world. They live in leaf litter of woodland and forest floors and grasslands, in fallen decomposing fruits; under loose bark of fallen, decaying trees; drifted plant materials on banks of rivers and lakes; dung, carrion, and nests of vertebrate animals. Many are specialized to exist in nests of social insects. Many inhabit caves, underground burrows of vertebrate animals, and smaller soil cavities. Many live in mushrooms. Adults and even larvae of a few are associated with living flowers. Others climb on plants, especially at night, and hunt for prey. A few seem to live with terrestrial snails. Their distribution in arid environments is restricted to moist microhabitats (Frank JH & Thomas M. C., 1999).

Material and methods

The researches concerning the diversity of rove beetles from the Hemeiuş Dendrological Park of Bacău (fig. 1) were made in 2009.

Fig. 1 – Bacău County (Filip M. et al., 1996)

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The Hemeiuș Arboretum lies on a 49.5 ha containing 10 ha of larch trees and pine plantations, 2 ha of clonal collections with species of local and exotic spruce fir, 20 ha of riparian mixed forest, 15 ha of dendrological collection and glades, 1.5 ha of nursery and 1 ha of administrative land. The arborescent layer is dominated by *Quercus robur*, *Ulmus minor*.

The climate is continental, characteristic to the hilly land with wide depressions. In summer, there are long periods of drought and during the winter there are cold currents from the Bistriţa river meadow, fact that creates a specific more arid microclimate. The mean annual temperature is 9.2˚ C and the mean annual precipitation is 544 mm.

From the geographical point of view, the Hemeiuș Dendrological Park of Bacău is situated at the west border of the Moldavian Plateau, at the collision with the Moldavian Subcarpathians, in a Bistriţa river meadow, on a terrace of accumulative origin, 157 m altitude (Mihalache, 1989).

The material was collected weekly, from May to October (twenty two weeks), by the method of Barber pitfalls placed in three different locations: lake area, deciduous forest and *Spirea* culture (fig. 2).

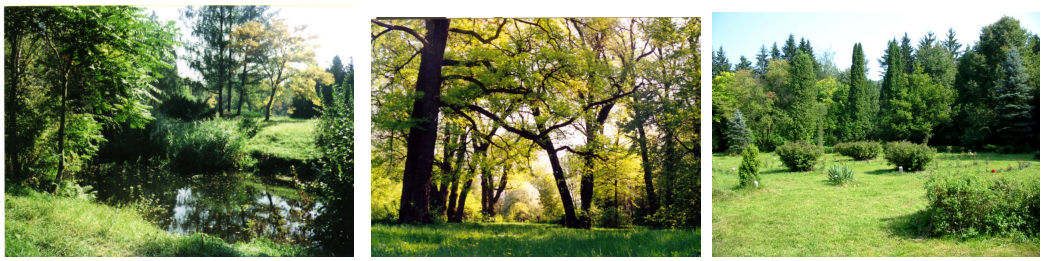

Fig. 2 – Aspects from the Hemeiuș Dendrological Park of Bacău (photo: Pavel Otilia)

Results and discussions

The material analyzed in this paper is represented by 253 specimens of rove beetles collected in 2009, in the Hemeiuș Dendrological Park of Bacău. Systematically, these coleopterans belong to 18 species included into twelve genera, respectively, into six subfamilies: Oxytelinae, Omaliinae, Staphylininae, Aleocharinae, Paederinae, Steninae (table 1).

Table 1 - The fauna of Staphylinidae collected in Hemeiuș Dendrological Park, in 2009

No.	Species	Lack area (I)	Deciduous forest (II)	*Spirea* collection (III)	T
	Oxytelinae				
1	*Anotylus insecatus* Gravenhorst, 1806		4		4
2	*Anotylus sculpturatus* Gravenhorst, 1806		2		2
	Omaliinae				
3	*Omalium caesum* Gravenhorst, 1806		2		2
4	*Omalium ferrugineum* Kraatz, 1857			2	2
	Staphylininae				
5	*Ocypus (Matidus) kuntzeni* J. Muller, 1926	13	163	29	205
6	*Ocypus (Pseudocypus) fulvipennis* Erichson, 1840	1		2	3
7	*Ontholestes haroldi* Eppelsheim, 1884			3	3
8	*Philonthus (Philonthus) succicola* Thomson, 1860	1	3	3	7
9	*Philonthus (Philonthus) tenuicornis* Mulsant & Rey, 1853		5	2	7
10	*Platydracus (Platydracus) latebricola* (Gravenhorst, 1806)	1		2	3
11	*Tasgius (Rayacheila) morsitans* Rossi, 1790	2	2		4
12	*Tasgius (Rayacheila) globulifer* Geoffroy, 1785		2		2
	Aleocharinae				
13	*Atheta oblita* Erichson, 1839			1	1
14	*Atheta fungi* (Gravenhorst, 1806)			1	1
15	*Liogluta granigera* Kiesenwetter, 1850			1	1
16	*Drusilla canaliculata* Fabricius, 1787	3	1		4
	Paederinae				
17	*Paederus (Heteropaederus) fuscipes* Curtis, 1826			1	1
	Steninae				
18	*Stenus ochropus* Kiesenwetter, 1858		1		1
	No. specimens	21	185	47	253
	No. species	6	10	11	

Analyzing the results it is easy to remark that *Ocypus (Matidus) kuntzeni* J. Muller, 1926 (fig. 3) was the dominant species – it was represented by the largest number of specimens (205 insects, respectively 81% - fig. 4). This species, together with *Philonthus (Philonthus) succicola* Thomson, 1860 were collected in all three locations: lake area, deciduous forest and *Spirea* culture.

Five species were represented by a single specimen: *Atheta oblita* Erichson, 1839, *Atheta fungi* Gravenhorst, 1806, *Liogluta granigera* Kiesenwetter, 1850, *Paederus (Heteropaederus) fuscipes* Curtis, 1826 and *Stenus ochropus* Kiesenwetter, 1858 (fig. 5).

Fig. 3 – *Ocypus (Matidus) kuntzeni* J. Muller, 1926

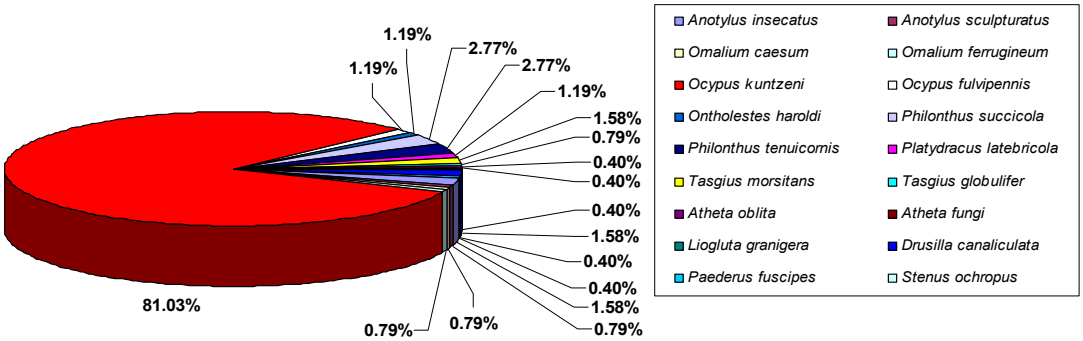

Fig. 4 – The percentages distribution of staphylinid species collected in the Hemeiuş Dendrological Park of Bacău County, in 2009

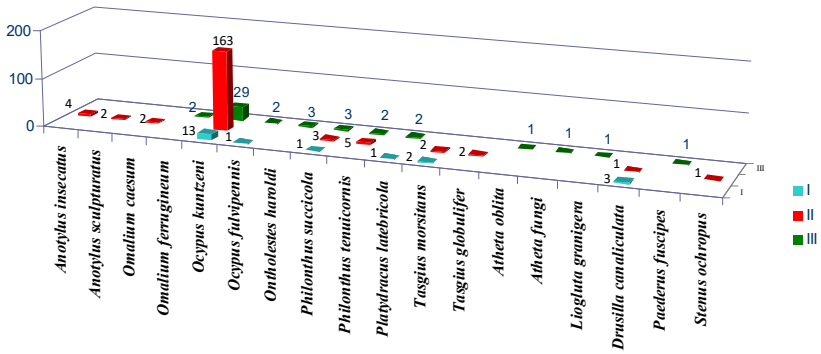

Fig. 5 – The Staphylinidae species collected in the Hemeiuş Dendrological Park of Bacău County, in 2009

The largest number of rove beetles was collected in the deciduous forest (185 specimens). The largest number of species was collected in the *Spirea* culture (eleven species) and deciduous forest (ten species).

In the lack area 21 rove beetles (six species) were collected during the twenty two weeks of study (table 2). For this location *Ocypus (Matidus) kuntzeni* J. Muller, 1926 was the dominant species (13 specimens – 62%). The largest number of specimens was registered in July (July, 16). For this area, the rove beetles were captured till the end of August (fig. 6).

185 specimens were collected in the deciduous forest. Systematically, these belong to 10 species (table 3). The dominant species for this area was the same *Ocypus (Matidus) kuntzeni* J. Muller, 1926 (fig. 7). For the deciduous forest, the largest number of species was collected in May (May 25).

The largest number of specimens was captured in August: 47 rove beetles on the 6th of

August and 42 insects on August 17. Five species were identified only in the deciduous forest: *Anotylus insecatus* Gravenhorst, 1806 (fig. 8a), *Anotylus sculpturatus* Gravenhorst, 1806 (fig. 8b), *Omalium caesum* Gravenhorst, 1806 (fig. 8c), *Tasgius (Rayacheila) globulifer* Geoffroy, 1785 (fig. 8d) and *Stenus ochropus* Kiesenwetter, 1858 (fig. 8e).

Ocypus (Matidus) kuntzeni J. Muller, 1926 was also the dominant species in the *Spirea* collection (table 4). Eleven species were identified for this studied area. Regarding the 47 specimens collected during the twenty-two weeks of study in the *Spirea* collection, the largest number of rove beetles was collected in August (August, 6 – 21 insects – fig. 9). Six species were identified only for this area of study: *Omalium ferrugineum* Kraatz, 1857, *Ontholestes haroldi* Eppelsheim, 1884, *Atheta oblita* Erichson, 1839, *Atheta fungi* (Gravenhorst, 1806), *Liogluta granigera* Kiesenwetter, 1850 and *Paederus (Heteropaederus) fuscipes* Curtis, 1826 (fig. 10).

Acknowledgements

Many thanks to scientific researcher dr. Irina Mihailov from Institute of Zoology ASM, Virology Department Quarantine Centre, Ministry of Agriculture (Republic of Moldova) for the collaboration, respectively for identifying the entomological material. Our thanks also go to our colleague dr. Otilia Pavel for the documentation and for the photos regarding the Hemeiuş Dendrological Park of Bacău.

Conclusions

1. The studies concerning the diversity of rove beetles from the Hemeiuş Dendrological Park of Bacău were made in 2009. The insects were collected using pitfalls placed in three locations: lake area, deciduous forests and *Spirea* collection.

2. Systematically, the 253 specimens of Staphylinidae, collected in the Hemeiuş Dendrological Park of Bacău, belong to 6 subfamilies (Oxytelinae, Omaliinae, Staphylininae, Aleocharinae, Paederinae and Steninae), 12 genera and 18 species.

3. The Staphylininae subfamily was very well represented - 8 species (44.44%) and 234 individuals (92.5%).

4. Ocypus (Matidus) kuntzeni (J. Muller, 1926) was the dominant species (81%). Five species were represented by a single specimen: *Atheta oblita* Erichson, 1839, *Atheta fungi* Gravenhorst, 1806, *Liogluta granigera* Kiesenwetter, 1850, *Paederus (Heteropaederus) fuscipes* Curtis, 1826 and *Stenus ochropus* Kiesenwetter, 1858.

5. The largest number of rove beetles was collected from deciduous forest (185 specimens).

6. The largest number of staphylinid species was collected from the *Spirea* collection (eleven species) and from deciduous forest (ten species).

Rezumat

Cercetările asupra faunei de stafilinide din Parcul Dendrologic Hemeiuș Bacău au fost realizate în perioada 2009, materialul fiind colectat săptămânal cu ajutorul capcanelor Baerber, începând din luna mai și până în octombrie. Au fost amplasate 3 baterii în 3 locații diferite: în zona lacului, în pădurea de foioase și în colecţia de *Spirea*. În total, în cele 22 de săptămâni de studiu, au fost colectate 253 de stafilinide, care din punct de vedere sistematic aparţin la 18 de specii, respectiv 12 genuri și 6 subfamilii (Oxytelinae, Omaliinae, Staphylininae, Aleocharinae, Paederinae și Steninae).

Ocypus (Matidus) kuntzeni (J. Muller, 1926) a fost specia dominantă (81%). Cinci specii au fost reprezentate printr-un singur individ: *Atheta oblita* Erichson, 1839, *Atheta fungi* Gravenhorst, 1806, *Liogluta granigera* Kiesenwetter, 1850, *Paederus (Heteropaederus) fuscipes* Curtis, 1826 and *Stenus ochropus* Kiesenwetter, 1858. Cel mai mare număr de stafilinide a fost colectat în pădurea de foioase (185 de exemplare). Cel mai mare număr de specii au fost identificate în cultura de *Spirea* (11 specii) și în pădurea de foioase (10 specii).

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Table 2 - The fauna of Staphylinidae collected in the lack area, in 2009

No.	Species	19 May	25 May	03 Jun	09 Jun	15 Jun	22 Jun	1 Jul	7 Jul	16 Jul	23 Jul	30 Jul	6 Aug	12 Aug	17 Aug	26 Aug	3 Sep	10 Sep	17 Sep	22 Sep	28 Sep	7 Oct	13 Oct	T
1	*Ocypus kuntzeni*						1		1	7	4													13
2	*Ocypus fulvipennis*									1														1
3	*Philonthus succicola*						1																	1
4	*Platydracus latebricola*									1														1
5	*Tasgius morsitans*						1									1								2
6	*Drusilla canaliculata*		1		2																			3
	Total		**1**		**2**		**3**		**1**	**9**	**4**					**1**							**21**

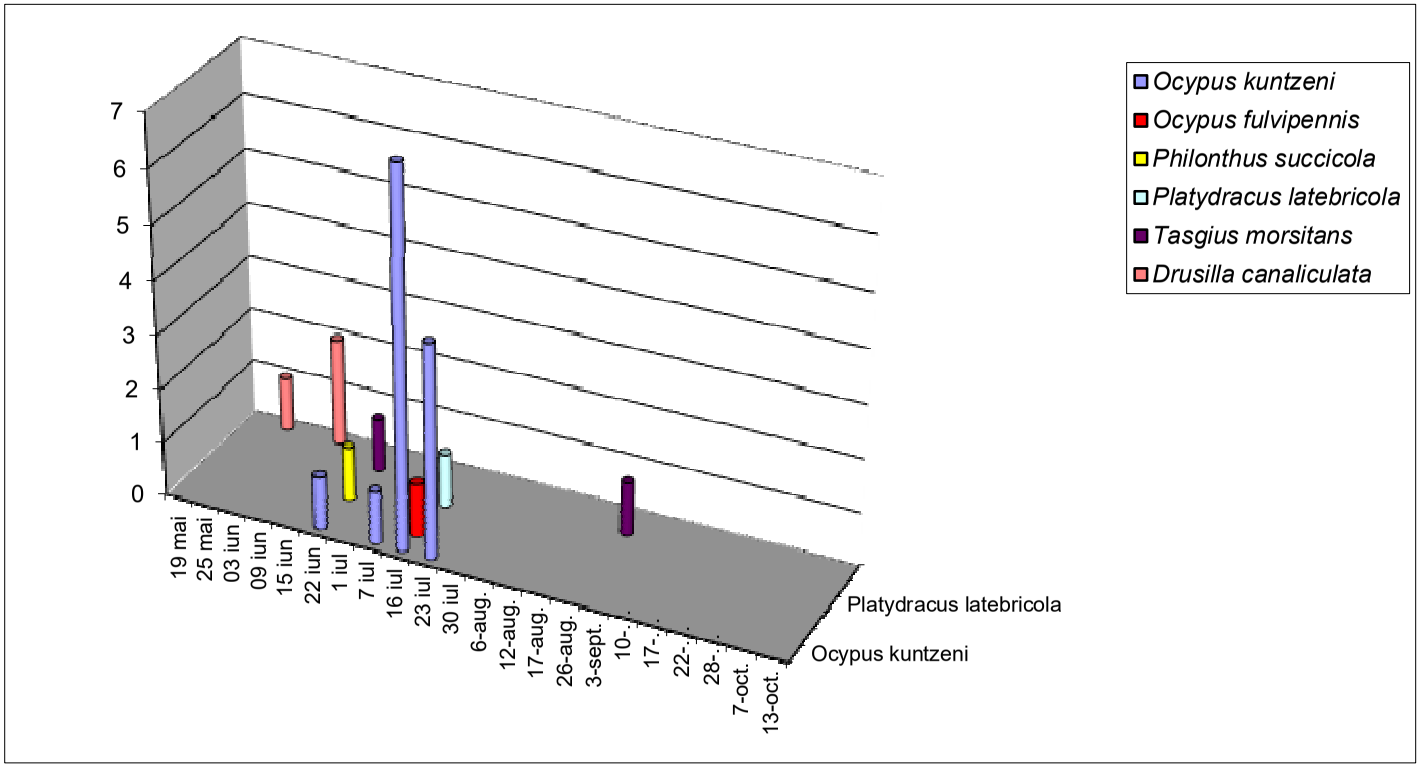

Fig. 6 – The Staphylinidae species collected in the lack area, in 2009

Table 3 - The fauna of Staphylinidae collected in the deciduous forest, in 2009

No.	Species	19 May	25 May	03 Jun	09 Jun	15 Jun	22 Jun	1 Jul	7 Jul	16 Jul	23 Jul	30 Jul	6 Aug	12 Aug	17 Aug	26 Aug	3 Sep	10 Sep	17 Sep	22 Sep	28 Sep	7 Oct	13 Oct	T
1	*Anotylus insecatus*	1													3									4
2	*Anotylus sculpturatus*		2																					2
3	*Omalium caesum*		2																					2
4	*Ocypus kuntzeni*		4	1	1			3	5	7	20	12	45		39	18	7				1			163
5	*Philonthus succicola*										1	2												3
6	*Philonthus tenuicornis*											5												5
7	*Tasgius morsitans*												2											2
8	*Tasgius globulifer*		1	1																				2
9	*Drusilla canaliculata*		1																					1
10	*Stenus ochropus*																	1						1
	Total	1	10	2	1			3	5	7	21	19	47		42	18	7	1			1			185

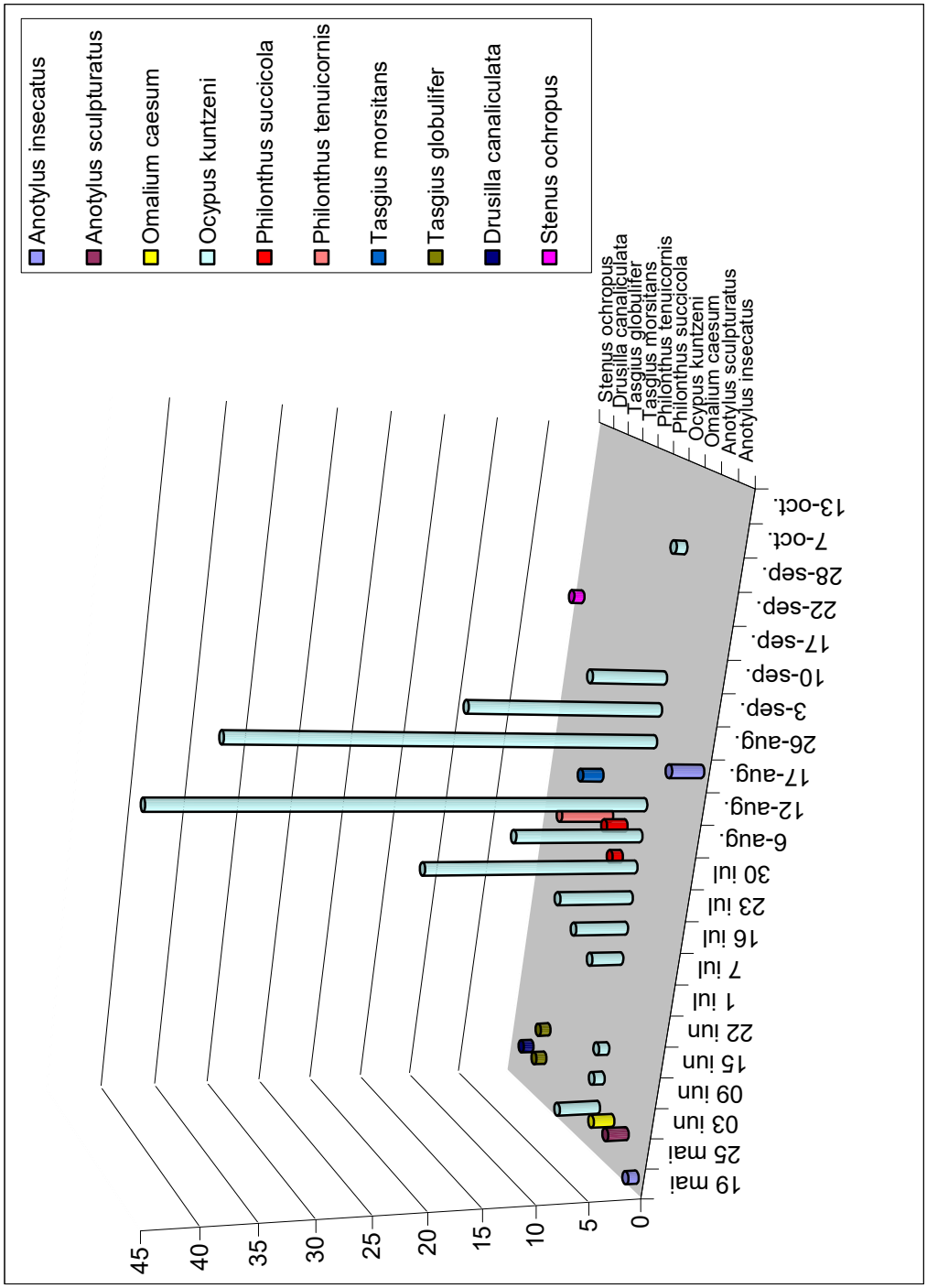

Fig. 7 – The Staphylinidae species collected in the deciduous forest, in 2009

Fig. 8 - The five rove beetle species collected only for in the deciduous forest: a) *Anotylus insecatus* Gravenhorst, 1806 (https://www.biolib.cz/en/image/id266759/); b) *Anotylus sculpturatus* Gravenhorst, 1806 (https://baza.biomap.pl/en/taxon/species-anotylus_sculpturatus/photos_tx); c) *Omalium caesum* Gravenhorst, 1806 (https://www.biolib.cz/en/image/id106022/); d) *Tasgius (Rayacheila) globulifer* Geoffroy, 1785 (https://www.fugleognatur.dk/gallery.asp?mode=ShowLarge&ID=353704); e) *Stenus ochropus* Kiesenwetter, 1858 (https://www.coleoptera.org.uk/node/21887)

Table 4 - The fauna of Staphylinidae collected in the *Spirea* collection, in 2009

No.	Species	19 May	25 May	03 Jun	09 Jun	15 Jun	22 Jun	1 Jul	7 Jul	16 Jul	23 Jul	30 Jul	6 Aug	12 Aug	17 Aug	26 Aug	3 Sep	10 Sep	17 Sep	22 Sep	28 Sep	7 Oct	13 Oct	T
1	*Omalium ferrugineum*																						2	2
2	*Ocypus kuntzeni*	1			1			2					15			9	1							29
3	*Ocypus fulvipennis*																	2						2
4	*Ontholestes haroldi*												2					1						3
5	*Philonthus succicola*		2				1																	3
6	*Philonthus tenuicornis*												2											2
7	*Platydracus latebricola*												1						1					2
8	*Atheta oblita*		1																					1
9	*Atheta fungi*												1											1
10	*Liogluta granigera*																						1	1
11	*Paederus fuscipes*		1																					1
	Total	1	4		1		1	2					21			9	1	3	1				3	47

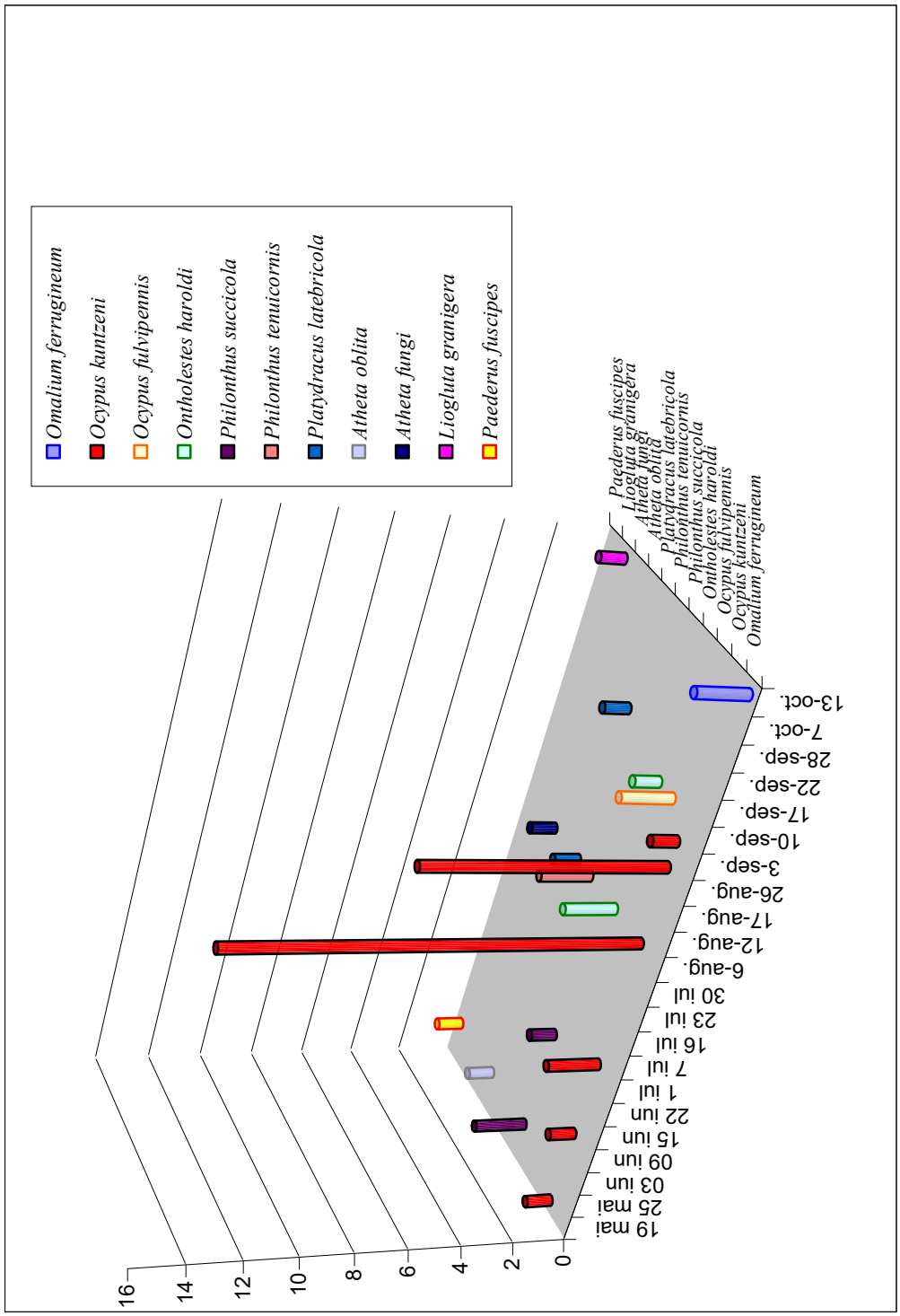

Fig. 9 – The Staphylinidae species collected in the *Spirea* collection, in 2009

Fig. 10 - The five rove beetle species collected only for in the deciduous forest: a) *Omalium ferrugineum* Kraatz, 1857, b) *Ontholestes haroldi* Eppelsheim, 1884 (https://www.biolib.cz/en/image/id13407/), c) *Atheta oblita* Erichson, 1839 (https://www.coleoptera.org.uk/sites/www.coleoptera.org.uk/files/imce/species/Atheta%20oblita.jpg), d) *Atheta fungi* Gravenhorst, 1806 (https://baza.biomap.pl/en/taxon/species-atheta_fungi/photos_tx), e) *Liogluta granigera* Kiesenwetter (https://baza.biomap.pl/en/taxon/species-liogluta_granigera/photos_tx/tlsn/y), 1850 f) *Paederus (Heteropaederus) fuscipes* Curtis, 1826 (https://www.biolib.cz/en/taxonimage/id197756/?taxonid=6240)

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

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COLLYRIA COXATOR (VILL.) (HYMENOPTERA: ICHNEUMONIDAE) A NEW PARASITOID SPECIES FOR *PALAEOCIMBEX QUADRIMACULATUS* (MÜLL.) (HYMENOPTERA: CIMBICIDAE)

RAOUL CONSTANTINEANU,
CAMIL ȘTEFAN LUNGU CONSTANTINEANU*

ABSTRACT

In 1930 Professor Dr. Docent Mihai Constantineanu collected some larvae of *Palaeocimbex quadrimaculatus* from an almond orchard at 28.4.1930 nearby Paris, France, from an almond orchard, *Prunus dulcis* (Mill.) D. A. Webb. and reared in laboratory. From a larva of this cimbicid species he obtained a specimen of a parasitoid species identified by us as *Collyria coxator*. *Palaeocimbex quadrimaculatus* - *Collyria coxator* is a new relationship in science.

Key words: *Palaeocimbex quadrimaculatus*, Cimbicidae, *Collyria coxator*, Ichneumonidae, new relationship in science.

Introduction

Collyria coxator (Fig. 1, 2) is a common parasitoid of the European wheat stem-sawfly, *Cephus pygmaeus* L. (Hymenoptera: Cephidae), a main pest of the wheat crops. In 1930 Professor Dr. Docent Mihai Constantineanu obtained by rearings from a larva of *Palaeocimbex quadrimaculatus* an unidentified species. Later, at 28.11.2018, the emerged ichneumonid species, was identified by the authors as an adult of *Collyria coxator*, which is a new parasitoid species for *Palaeocimbex quadrimaculatus*, which is considered one of the most damaging pests of almond orchards, but may also attack apricot, cherry, peach, pear and plum trees.

Untill now were recorded a total of seven primary ichneumonid parasitoid species from *Palaeocimbex quadrimaculatus*. Thus, *Opheltes glaucopterus* (L.) was recorded by D. Faggioli, 1938, in H. Özbek, 2014 and V. M. Yermolenko, 1972; *Listrognatus mactator* (Thunb.) was recorded by İ. Özgen et al, 2010; *Phobetes nigriceps* (Grav.) was cited by V. M. Yermolenko, 1972 and H. Özbek, 2014. V. M. Yermolenko had cited four primary ichneumonid parasitoid species: *Phobetes* sp. (cited as *Ipoctonus* sp.), *Aritranis heliophila* (Tschek.) (cited as *Hoplocryptus mediterraneus* Tschek.), *Cylloceria melancholica* (Grav.) (cited as *Lampronota melancholica* (Grav.) and *Agrothereutes mandator* (L.) (cited as *Spilocryptus cimbicis* Tschek) (V. M. Yermolenko, 1972). L. Berland recorded two secondary ichneumonid parasitoids: *Mesochorus cimbicis* Ratz. and *Mesochorus splendidulus* Grav. (in V. M. Yermolenko, 1972).

It is very important that *Palaeocimbex quadrimaculatus*, with its length of 25 mm, not to be misidentified as *Vespa crabro* L., because of the batesian mimicry phenomenon.

Material: 1 ♀ emerged at 16.5.1930 from a larva of *Palaeocimbex quadrimaculatus*, collected by Professor Dr. Mihai Constantineanu at 28.4.1930 nearby Paris, France, from an almond orchard, *Prunus dulcis* (Mill.) D. A. Webb. and reared in laboratory.

♀. Vertex thick dotted; hairy eyes, antennae filiform. Temples obviously punctuated on smooth shining area. Thorax shining, with fine punctuation. Propodeum weakly rugose. The areolet is lacking. Abdomen weakly punctuated, shining; the ovipositor weakly curved downward, with small teeth on ventral margin, with small teeth on ventral margin. Tergites 8 and 9 are elongated.

Black. Ventral side of antennae reddish. Legs black. Coxae, trochanters hind femora (with the exception of red base), middle femora (with the exception of reddish base and peak) and the black base of fore femora; hind tibiae with yellowish base; the rest part of legs are yellow. Abdomen is reddish, with dark base and peak. Tergites 2-3 shining, smooth, anterior part of the first and base of fourth red-brown. Sternites are reddish-yellow.

Length: 8 mm.

Hosts: *Cephus pygmaeus* L., *Trachelus tabidus* F. (Hym., Cephidae) (Atanasov A. et al, 1981), *Cynips quercus-folii* L. (Hym., Cinipidae) (C.

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Pisică, 1972). *Palaeocimbex quadrimaculatus* (O. F. Müller, 1766) is a new host in science for *Collyria coxator* (Vill.) and for the entirely Cimbicidae family.

Geographical distribution: It is a palaearctic species, being recorded from: Austria, Belgium, Bulgaria, Czech Republic, Czechoslovakia; Finland, France, Georgia, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Russia (Astrakhansk, Kamchatka, Krasnodarsk, Pskov, Rostov, Sankt Petersburg, Stavropolsk, Tambov), Spain, Sweden, Switzerland, Turkey, Ukraine and United Kingdom; Afghanistan, Azerbaijan, China (Qinghai), Iran, Jordan, Kazakhstan, Syria and Uzbekistan. It was introduced and established in North America to control *Cephus cinctus*, a pest which makes very much damages for the wheat crop, a cereal grain which is a worldwide staple food. It was recorded from Canada (Alberta, Ontario, Saskatchewan) and U.S.A. (Delaware, Maryland, New Jersey, New York, Pennsylvania and Virginia). (Taxapad Ichneumonoidea. *Yu D.S.K.*, 2009). In Romania is a common species, being recorded from Caraorman, C.A. Rosetti, Murighiol - Danube Delta Biosphere Reserve, Tulcea county; Agigea, Eforie Sud, Eforie Nord, Techirghiol, Valu lui Traian, Constanța county; Mraconia valley – Ogradena, Dubova, Ieșelnița, Mehedinți county; Ponoare, Corni - Liteni, Suceava county; Ipotești, Botoșani county; Valea lui David, Cârjoaia, Iași county; Ciric – Iași, Iași county; Fundulea, Ilfov county; Oradea, Sânnicolau de Beiuș, Bihor county; Mehadia, Caraș Severin county; Ineu, Arad county; Gâmbaș, Alba county; Hodod, Satu Mare county; Brașov, Brașov county; Saschiz, Mureș county (C. Pisică, I. Popescu, 2009).

Fig. 1 - Adult of *Collyria coxator* (Vill.), ♀ (Hym.: Ichneum.) - dorsal view.

Fig. 2 - Adult of *Collyria coxator* (Vill.), (Vill.), ♀ (Hym.: Ichneum.) - lateral view.

Conclusions

1. Until now were recorded seven ichneumonid primary parasitoid species for *Palaeocimbex quadrimaculatus*: *Opheltes glaucopterus*, *Listrognatus mactator*, *Phobetes nigriceps*, *Phobetes* sp., *Aritranis heliophila*, *Cylloceria melancholica*, *Agrothereutes mandator* and two ichneumonid secondary parasitoid species: *Mesochorus cimbicis* and *Mesochorus splendidulus*.

2. *Collyria coxator* is a new parasitoid species for *Palaeocimbex quadrimaculatus*.

3. We record a new host – parasitoid relationship in science: *Palaeocimbex quadrimaculatus* - *Collyria coxator*.

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COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

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DIVERSITY OF USEFUL ENTOMOFAUNA IN RYE CULTURE FROM THE HORODNIC DE JOS LOCALITY, SUCEAVA COUNTY

IOAN MOGLAN*, ELENA DANIELA BOSOVICI**

ABSTRACT

From the investigated rye culture, 243 specimens of useful insects were collected and analyzed and 38 taxa were identified, which belonged to the orders: Hemiptera-Suborder Heteroptera, Thysanoptera, Neuroptera, Diptera, Hymenoptera and Coleoptera. At the level of order of insects, the abundance with the highest value was found in the case of Hymenoptera, which held 48.56% of the total useful analyzed insects. The smallest abundance held it the order Neuroptera (1.24%).

Maximum of activity of this ecological category of insects was recorded in May-June, varying as period and duration from one group of insects to another.

Regarding the efficiency of predators *Chrysopa carnea*, *Cantharis rustica*, Tachyporus sp., *Coccinella 7 – punctata, Propylea 14 – punctata*, Nabidae and Syrphidae, the number of individuals of these species registered in this culture, in one place, reduced the number of aphids daily by 2.090 individuals. The number of individuals *Cantharis rustica*, *Chrysopa carnea* and Sirfidae registered in this culture, in one place, destroyed 250 numbers of Tizanopteras daily.

Key words: Rye culture, useful entomofauna, dynamics of the useful entomofauna, efficiency of some predatory insect species in reducing the number of aphids and tripods.

Introduction

Rye, a cereal grain, native to Central and South-West of Asia, is of major importance in the nutrition of the human being and animals, especially in the countries of northern Europe. It is also used in the pharmaceutical industry. In Romania, this plant is grown, especially in the northern part of the country, where the environmental conditions are more favorable to the culture of this plant. It makes good use degraded land, less suitable for the cultivation of other plant species. Due to its importance, knowledge of the pest and predatory and parasitoid insect complex is of great importance for the protection of this crop.

Material and method

The collectings of the entomological material were made from the rye plants, from the culture of Horodnic de Jos, Suceava county, during the April-July 2014 period. In total, 6 collectings were made, the one collected in April and July, and two in May and June.

The collectings were made with the entomological fillet, at each sampling, 100 mowings was performed with the fillet, 50 mowings on the plants at the edge of the crop, and another 50 mowings in the middle of it.

The collected material was stored in 80% ethyl alcohol, brought to the laboratory where it was identified and processed.

Results and discussions

In Romania no systematic research has been done regarding the entomofauna in rye culture. On the other hand such investigations has been carried out on other species of rare cereals, mainly wheat, by various researchers with numerous studies, of which only some works (1, 2, 4, 5, 6, 7)

From the investigated rye culture, in those 6 samples, 243 specimens of useful insects were collected and analyzed and 38 taxa were identified, which belonged to the orders: Hemiptera-Subordinul Heteroptera, Thysanoptera, Neuroptera, Diptera, Hymenoptera and Coleoptera (Table 1).

At the level of order of insects, the abundance with the highest value was found in the case of Hymenoptera, which held 48.56% of the total useful analyzed insects, followed by the Orders Thysanoptera (18,11%) and Diptera (15,23%). The smallest abundance held it the order Neuroptera (1,24%) (Table 1). The largest biological diversity is presented by the order Hymenoptera. (23 taxa), followed by the order Coleoptera (6 taxa) (Table 1).

The predatory entomofauna was represented by *Orius niger*, Nabidae, *Aeolothrips intermedius, Chrysopa carnea*, Tachyporus sp., *Cantharis*

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rustica, *Dolichosoma lineare*, *Coccinella 7-punctata*, *Adonia variegata*, *Propylea 14 – punctata,* Syrphidae, Anthomyiidae, Sarcophagidae, Dolicopodidae, Sciomyzidae and Formicidae, and the parasitic one by the taxa: Ichneumonidae, Braconidae, *Tryoxis brevicornis*, Cynipidae, *Mesopolobus* sp., *Pachyneuron* sp., *Callitula* sp., *Asaphes* sp., *Polynema* sp, *Pteromalinae*, Encyrtidae, Eulophidae, Diapriidae, Scelionidae, *Trissolcus* sp., *Telenomus* sp., Scelionidae, Platygastridae, *Inostemma* sp., *Synopeas* sp., Ceraphronidae and Megaspilidae. In the case of the predatory entomofauna, most individuals belonged to the species *Aeolothrips intermedius* (44 individuals), and in the case of parasitoid insects, most abundant were Eulophidae, which represented 23.73% of the Parasitoid Hymenoptera, followed by *Mesopolobus* (22.89%), and at the opposite pole was *Trissolcus* sp, *Synopeas* sp. and Pteromalinae (Table 1).

Table 1 - Abundance and dominance of the predatory and parasitoid entomofauna collected from the rye from Horodnic de Jos, Suceava county, during April-July, 2014

Nr	Taxon	Sampling data						Total	
		17 April	11 May	25 May	10 June	26 June	12 July	nr	%
	ORD. HEMIPTERA	**1**	**1**	**1**	**2**	**11**	**2**	**18**	**7,41**
	SUBORD. HETEROPTERA	**1**	**1**	**1**	**2**	**11**	**2**	**18**	7,41
1.	Nabidae	1	1			11	1	14	5,77
2.	*Orius niger*			1	2		1	4	1,65
	ORD.THYSANOPTERA	**2**	**10**	**11**	**16**	**3**	**2**	**44**	**18,11**
3.	*Aeolothrips intermedius*	2	10	11	16	3	2	44	18,11
	ORD. NEUROPTERA	**1**				**1**	**1**	**3**	**1,24**
4.	*Chrysopa carnea*	1				1	1	3	1,24
	ORD. DIPTERA		**2**	**1**	**4**	**22**	**8**	**37**	**15,23**
5.	Syrphidae				3	11	2	16	6,59
6.	Anthomyiidae			1		9	4	14	5,77
7.	Sarcophagidae		1			2		3	1,24
8.	Dolicopodidae		1				2	3	1,24
9.	Sciomyzidae				1			1	0,42
	ORD. HYMENOPTERA	**15**	**12**	**18**	**31**	**27**	**15**	**118**	**48,56**
10.	Ichneumonidae	1		1	1		2	5	2,06
11.	*Tryoxis brevicornis*		2			4	3	9	3,71
12.	Braconidae		1			1		2	0,83
13.	Cynipidae	4	3	3				10	4,12
14.	Mesopolobus sp	3		1	17	4	2	27	11,12
15.	Callitulla sp.				2	4		6	2,47
16.	Pachyneuron sp.			1	1			2	0,83
17.	Asaphes sp.				1		1	2	0,83
18.	Pteromalinae	1						1	0,42
19.	Encyrtidae					1		1	0,42
20	Eulophidae	5	3	10	2	4	4	28	11,53
21.	Polynema sp.		1					1	0,42
22.	Platygaster sp.			1		2	1	4	1,65
23.	Inostemma sp.				1		1	2	0,83
24.	Synopeas sp.				1	1	1	3	1,24
25.	Trissolcus sp.			1				1	0,42
26.	Telenomus sp.					1		1	0,42
27.	Diapriidae				1	1		2	0,83
28.	Scelionidae		1		1			2	0,83
29.	Platygastridae		1		2			3	1,24
30.	Ceraphronidae				1	1		2	0,83
31.	Megaspilidae	1				2		3	1,24

32.	Formicidae					1		1	0,42
	ORD. COLEOPTERA	**4**	**3**	**6**	**6**	**2**	**2**	**23**	**9,47**
33.	*Tachyporus sp.*			1	2			3	1,24
34.	*Cantharis rustica*	2				1	1	4	1,65
35.	*Dolichosoma lineare*				2			2	0,83
36.	*Coccinella 7-punctata*	1	1	3	1	1		7	2,88
37.	*Adonia variegata*		1	1			1	3	1,24
38.	*Propylea 14-punctata*	1	1	1	1			4	1,65
	TOTAL INSECTS	**23**	**28**	**37**	**59**	**66**	**30**	**243**	

Regarding at Coccinelides, only three species have been identified in the rye culture in this area: *Coccinella 7-punctata, Adonia variegata* and *Propylea 14 – punctata.*

Regarding to the dynamics of the useful entomofauna, the important groups of entomophages were already present in the culture in the middle of April, (first survey), maximum of activity, in the case of the species *Aeolothrips intermedius* it has been registered since the first half of May to the first half of June, in the case of Hymenoptera, the highest number of individuals were registered from the second half of May until the end of June, in the case of Coleoptera from the second half of the month May more until the first half of June (Table 1).

Regarding the efficiency of predators *Chrysopa carnea*, *Cantharis rustica*, Tachyporus sp., *Coccinella 7 – punctata, Propylea 14 – punctata*, Nabidae şi Syrphidae, based on the data provided by Malschi and Mustea (1999)(6), regarding the daily ration of prey, in the case of the rye culture analyzed by us, the number of individuals of these species of predators registered in this culture, in one place, reduced the number of aphids daily (*Sitobion avenae* and *Schizaphis graminum*) by 2,090 individuals. The number of individuals *Cantharis rustica*, *Chrysopa carnea* and Sirfidae registered in the investigated culture, in one place, destroyed 250 numbers of Tizanopteras daily (Table 2).

No.	Predators	Af destroyed/daily/ of 1specimen pr (nr) (1)	Tr destroyed/daily/ of 1specimen pr (nr) (1)	Nr predatory	Af destroyed	Tr destroyed
1	Nabide	60	-	14	840	-
2	*Chrysopa carnea*	30	10	3	90	30
3	Sirfidae	25	10	16	400	160
4	*Cantharis* sp.	40	15	4	160	60
5	*Tachyporus* sp.	30	-	3	90	-
6	*Coccinella 7 - punctata*	50	-	7	350	-
7	*Propylea 14 - punctata*	40	-	4	160	-

Table 2 - Number of adult aphids and tripods destroyed daily by predators in the rye culture in the locality Horodnic de Jos, Suceava county, in 2014

(1) – after D. Malschi and D. Mustea, 1999; Af – afids; pr – predators; expl - specimen; Tr – tripes

Conclusions

1. From the investigated rye culture, 243 specimens of useful insects were collected and analyzed, 38 taxa were identified, which belonged to the orders Hemiptera-Subordinul Heteroptera, Thysanoptera, Neuroptera, Diptera, Hymenoptera and Coleoptera. Dominant were Hymenopters, followed by the Orders Thysanoptera and Diptera.

2. The predatory entomofauna was represented by the taxa: *Orius niger*, Nabidae, *Aeolothrips intermedius, Chrysopa carnea*, Tachyporus sp., *Cantharis rustica*, *Dolichosoma lineare*, *Coccinella 7- punctata*, *Adonia variegata*, *Propylea 14 – punctata,* Syrphidae, Anthomyiidae, Sarcophagidae, Dolicopodidae, Sciomyzidae and Formicidae. Most individuals belonged to the species *Aeolothrips intermedius*

3. The parasitic entomofauna was represented by: Ichneumonidae, Braconidae, *Tryoxis brevicornis*, Cynipidae, *Mesopolobus* sp., *Pachyneuron* sp., *Callitula* sp., *Asaphes* sp., *Polynema* sp, *Pteromalinae*, Encyrtidae, Eulophidae, Diapriidae, Scelionidae, *Trissolcus* sp., *Telenomus* sp., Scelionidae, Platygastridae, *Inostemma* sp.,

Synopeas sp., Ceraphronidae and Megaspilidae. Abundance with the highest value presented it Eulophids.

4. Maximum of activity of this ecological category of insects was recorded in May-June, varying as period and duration from one group of insects to another.

5. Regarding the efficiency of predators, all the individuals of *Chrysopa carnea*, *Cantharis rustica*, Tachyporus sp., *Coccinella 7 – punctata, Propylea 14 – punctata*, Nabidae and Syrphidae, in one place, reduced the daily number of aphids with 2,090 individuals. The number of individuals of *Cantharis rustica*, *Chrysopa carnea* and Sirfidae destroyed 250 individuals of Tripes daily.

Rezumat

S-au colectat şi analizat 243 exemplare de insecte utile şi s-au identificat 38 de taxoni, din ordinele: Hemiptera-Subordinul Heteroptera, Thysanoptera, Neuroptera, Diptera, Hymenoptera şi Coleoptera. Entomofauna prădătoare a fost reprezentată de: *Orius niger*, Nabidae, *Aeolothrips intermedius, Chrysopa carnea*, Tachyporus sp., *Cantharis rustica*, *Dolichosoma lineare*, *Coccinella 7- punctata*, *Adonia variegata*, *Propylea 14 – punctata,* Syrphidae, Anthomyiidae, Sarcophagidae, Dolicopodidae, Sciomyzidae şi Formicidae, iar cea parazitoidă de: Ichneumonidae, Braconidae, *Tryoxis brevicornis*, Cynipidae, *Mesopolobus* sp., *Pachyneuron* sp., *Callitula* sp., *Asaphes* sp., *Polynema* sp, *Pteromalinae*, Encyrtidae, Eulophidae, Diapriidae, Scelionidae, *Trissolcus* sp., *Telenomus* sp., Scelionidae, Platygastridae, *Inostemma* sp., *Synopeas* sp., Ceraphronidae şi Megaspilidae.

Maximum de activitate s-a constatat, în general, în mai-iunie, variind ca perioadă şi durată de la un grup de insecte la altul.

In ce priveşte eficienţa prădătorilor *Chrysopa carnea*, *Cantharis rustica*, Tachyporus sp., *Coccinella 7 – punctata, Propylea 14 – punctata*, Nabidae şi Syrphidae, toţi indivizii la un loc, au redus zilnic efectivele de afide cu 2090 de exemplare, iar indivizii de *Cantharis rustica*, *Chrysopa carnea* şi Sirfide, la un loc, au distrus zilnic 250 de exemplare de Tizanoptere.

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BIOTOPIC PREFERENCES OF SHREW SPECIES (SORICOMORPHA: SORICIDAE) IN THE REPUBLIC OF MOLDOVA

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ABSTRACT

Although the shrews are the smallest mammals of the world, they have an important role in nature, being important link within the animal trophic chains. Five shrew species inhabit in Moldova: common shrew (*Sorex araneus*), pygmy shrew (*S. minutus*), bicolored white-toothed shrew (*Crocidura leucodon*), lesser shrew (*C. suaveolens*), water shrew (*Neomys fodiens*) and Mediterranean shrew (*Neomys anomalus*). The studies were performed during 2003-2016 în various types of ecosystems and ecotones on the territory of the republic. 732 shrews from 5 species were collected: 304 common shrews (*Sorex araneus*), 171 pygmy shrews (*S. minutus*), 131 white-toothed shrews (*Crocidura leucodon*), 112 lesser shrews (*C. suaveolens*) and 14 Mediterranean shrews (*Neomys anomalus*). The highest diversity was registered in wet biotopes and their ecotones. The *Sorex* species have significant predilection for the ecotones of wet biotopes, Crocidura species – for wet biotopes, forest belts and agrocenoses, while *N. anomalus* – only for wet habitats. The Cluster analysis showed high similarity of shrew communities from paludous biotopes all over the territory of the republic and between various types of ecotones. The highest zonal abundance of all species was registered in the central part. Three species (*C. leucodon*, *N. fodiens N. anomalus*) are included in the Red Book of Moldova.

Key words: shrews, ecology, distribution, abundance, dynamics, biotopic predilection, similarity

Introduction

The shrews (Soricidae, Soricomorpha) are the smallest and short-time living mammals with the life cycle of about one year. This group of great importance for ecosystem functioning was rather poor studied in the Republic of Moldova in comparison with other mammal groups. On the republic territory there are 6 shrew species: common shrew (*Sorex araneus*), pygmy shrew (*S. minutus*), bicolor white-toothed shrew (*Crocidura leucodon*), lesser shrew (*C. suaveolens*), water shrew (*Neomys fodiens*) and Mediterranean water shrew (*N. anomalus*), of which the bicolor, water and Mediterranean shrews are rare species listed in the Red Book of Moldova (10). The water shrew (*N. fodiens*) wasn't recorded in our studies neither in other researchers studies for over 90 years. The species is mentioned only by Brauner (15), after which it was cited as occurring on the territory of the republic even after numerous studies of small mammal fauna (6, 13, 19). But all the researchers that studied the shrew fauna didn't find the water shrew on the republic territory (20, 21, 24).

The studies of shrews started in the 60's of the past century with subsequent publication of a valuable paper (21), which is the only work dedicated exclusively to insectivore species. After that this group study was practically abandoned and till 90's data on shrews can't be found. In the 90's can be found several papers concerning small mammal fauna, including the shrews (3, 23, 24). After 2000 data on shrew species can be found in some works of general character (4, 5, 6). In the last decade the intense study of shrews was resumed (7, 8, 9, 10, 26 etc.) and data on their faunistics, ecology, biotopic preferences, status can be found.

Shrews are hygrophilous species that occur mostly in wet habitats and near various water basins, but they also inhabit the woods, forest shelter belts and plantations, they can be met in open biotopes and even in anthropogenic ecosystems, such as agricultural, rural or urban ones. The shrews are sensitive to anthropogenic disturbances and can serve as indicators of ecosystem stability.

The paper presents multiannual data on the spreading of the shrews in different types of ecosystems, in the ecotone zone, the biotopic distribution and relative biotopic predilection.

Materials and methods

The studies have been carried out in 2003-2016 in various types of ecosystems on the whole territory of the Republic of Moldova (fig. 1).

In the northern zone the studies were performed in Soroca, Râşcani, Briceni, Glodeni, Edineţ, Rezina, Drochia, Făleşti and Ocniţa districts; in the central zone – Chişinău municipality, Orhei, Străşeni, Călăraşi, Ungheni, Nisporeni, Anenii-Noi and Criuleni districts; in the southern zone – Cimişlia, Ştefan-Vodă, Căuşani, Basarabeasca, Cantemir, Cahul and Taraclia districts. The

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territories of the reserves „Codri”, „Plaiul Fagului”, „Pădurea Domnească”, „Prutul de Jos” were investigated, as well as anthropogenic ecosystems. The following types of ecosystems were considered: forest, paludous, riparian, agrocoenosis, wet forest, as well as different types of ecotone: forest belt, forest-paludous, forest-agrocoenosis, paludous-agrocoenosis, paludous-grassland, wet ditch.

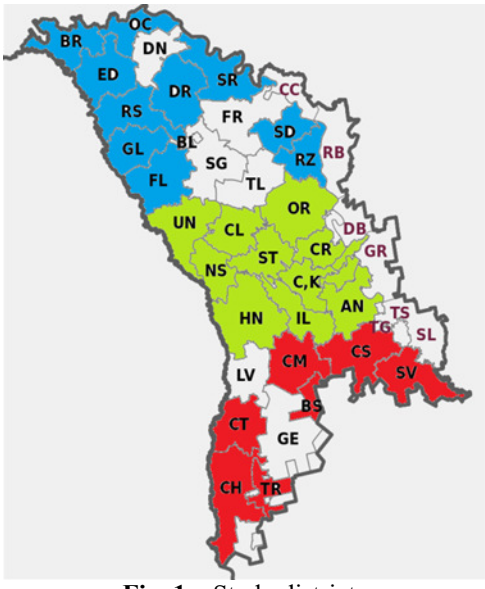

Fig. 1 – Study districts

The material was collected with snap traps, live traps and by collecting dead individuals. The traps were placed in line of 40 to 100 pieces, baited with bred imbued with sunflower oil. All caught individuals were identified, the sex, age and reproductive status were described. The ecological analysis of the material included the indexes of abundance, frequency, similarity (Cluster analysis) and relative biotopic predilection according to formula:

Ip = (nb*N - nc*Nb)/(nb*N + nc*Nb - 2nb*Nb),

where nb – number of individuals of certain species in a biotope, nc - number of individuals of certain species in all biotopes, Nb - number of individuals of all species in a biotope, N - number of individuals of all species in all biotopes (18). The index value ranges from -1 to 1: if the index value is between 0.31 and 1 the predilection of a species for a biotope is significant, -0.3 – 0.3 the species is indifferent toward a certain biotope, from -0,31 to -1 the species has no predilection for the biotope. The diversity of shrew communities was calculated using Shannon, Simpson and Berger-Parker indexes, the species richness – using Margaleff index.

Results and discussions

In total 732 shrews from 5 species were collected: 304 common shrews (*Sorex araneus*), 171 pygmy shrews (*S. minutus*), 131 bicolor shrews (*Crocidura leucodon*), 112 lesser shrews (*C. suaveolens*) and 14 Mediterranean water shrews (*Neomys anomalus*). During the whole study period the water shrew wasn’t recorded. The most frequent and abundant is the common shrew, recorded in all studied areas and in most ecosystems, followed by the lesser and bicolor shrew. The most rare and less frequent was the Mediterranean shrew, which is a hydrophilous stenotopic species, listed in the Red Book of Moldova (11) as endangered species.

The shrews prefer natural ecosystems that are less affected by anthropogenic activity. Thus, most species and most individuals have been recorded in nature reserves, wet valleys in deep forests, in the abundant aquatic vegetation of water basins, where human access and anthropic activity are limited.

Sorex araneus is a common and the most spread species among shrews. It was registered in the majority of studied biotopes, with a frequency of 84% in natural and of 17% in anthropogenic ones. In the southern zone it was found in the reserves Codrii Tigheci, Prutul de Jos (Beleu lake), on the banks of Manta lake and in agrocoenosis nearby, in swamp sectors, wet ditches with hydrophilous vegetation, in reed from lake shore, in woods, in forest belts and at ecotone zone. In the center of the republic the common shrew is widely spread in Codri and Plaiul Fagului reserves in various types of biotopes: in woods, at forest edge, in wet valleys, on the shore of water basins, in swamp sectors, in agricultural ecosystems situated on the reserve territory or nearby. Also, the species was registered in various natural and anthropogenic ecosystems from the central districts, mostly in woods, paludous biotopes (ponds, fish farms, swamp sectors), at forest edge, in shelter belts and in agrocoenosis near water basins. In the northern zone it is widely spread in the reserve Pădurea Domnească in most of studied ecosystems as well as in various biotopes from the northern districts. In general, during the study years the common shrew was the most abundant species in woods, paludous biotopes, wet forests, at the ecotone forest-paludous and forest-agrocoenosis (fig. 2). In previous researches the species was registered as common on the whole territory (14, 21), in forest ecosystems and wet habitats from the reserves Codri (14, 15), Plaiul Fagului (4, 23, 26), Pădurea Domnească (5), in wet biotopes of Prutul de Jos reserve (12, 23), in forest belts (25), in woods (1, 2, 8) and in other types of ecosystems on the whole territory of the republic (7, 9, 19).

Sorex minutus is rather spread almost as the common shrew, but is more rare. It prefers the same habitats as the previous species and in the optimal biotopes the pygmy shrew can be even more abundant than the common one. Thus, the species was recorded in all the districts mentioned for the common shrew in most of the ecosystems, but with lower frequency – 68% in wet habitats and only 9% in anthropogenic ones. The pygmy shrew is wide spread in the most ecosystems of the reserves Prutul de Jos, Codri, Plaiul Fagului, Pădurea Domnească. In woods it prefers wet valleys, swamp sectors wet ditch with hygrophilous vegetation, forest edge, more seldom it can be met in forest belts, agrocoenosis and meadows. Unlike the common shrew, it avoids the recreational sectors. Near the water basins the species is even more abundant than the common shrew. It was registered in agrocoenosis, but only at their ecotone with wet biotopes. In previous studies the pygmy shrew was registered as widespread on the republic territory, but less numerous than the common shrew (14, 21). It was mentioned the species preference for humid forest sectors, for habitats near forest rivulets of the reserves (4, 5, 14, 15, 23, 26), its higher abundance in paludous habitats of Prutul de Jos reserve (12, 23), in forest ecosystems (1, 2, 8), as well as in other types of ecosystems from (9, 19).

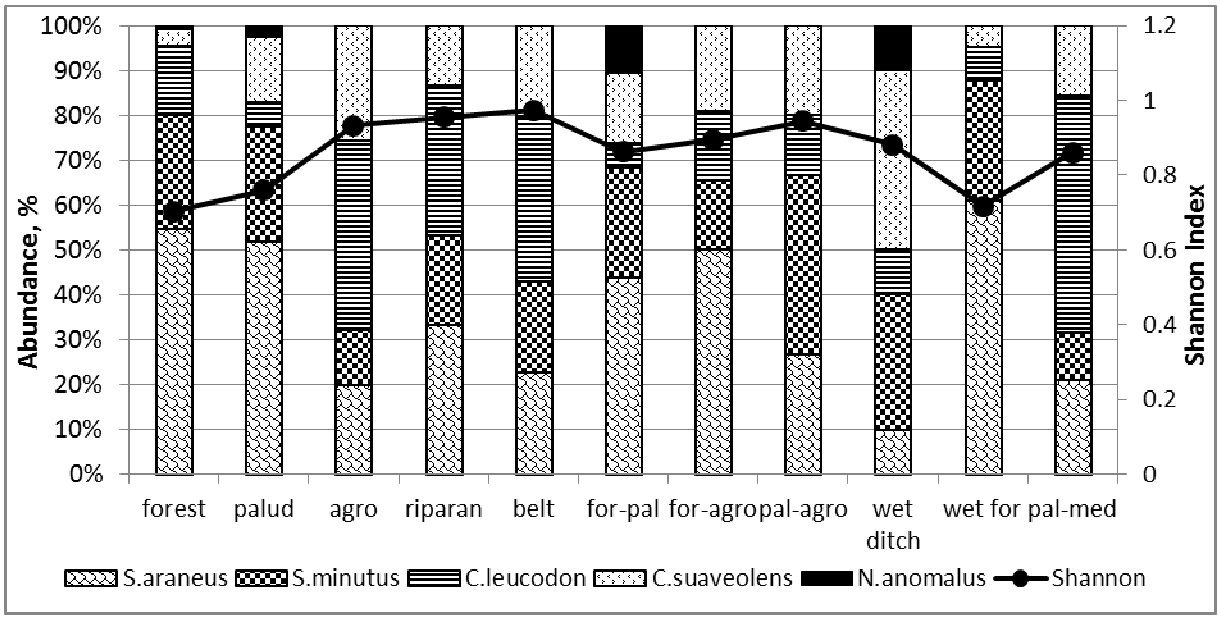

Fig. 2 – Abundance and diversity of shrew communities in various types of ecosystems in 2003-2016

Crocidura leucodon is a vulnerable species listed in the Red Book of Moldova (11). Nevertheless, in its preferred habitats it was registered rather frequent (42%). It is a less hygrophilous species in comparison to *Sorex* genus species. The bicolor shrew was also registered in open type and more arid biotopes, such as pastures, meadows, valleys with shrub vegetation. In the southern zone the species was recorded only in forest type ecosystems: woods, forest edge, forest bels and plantations and in humid ditch with hygrophilous vegetation. In the center of the republic the species was abundant in agricultural ecosystems and forest belts, being registered also in various types of ecotones (fig. 2). In the northern zone the bicolor shrew was found mostly in paludous and riparian habitats. In the past century the species was mentioned as very rare (14, 17, 21, 27) registered only in the woods from the central zone. In the last two decades it was found in wet habitats and agrocoenosis from the reserves Plaiul Fagului (4, 23, 26), Pădurea Domnească (5, 23), Prutul de Jos (12), protected areas (Trebujeni, Unguri-Holosnita, La Castel) and in various types of ecosystems from the whole territory of the republic (1, 2, 7, 8, 10, 19).

Crocidura suaveolens has the same biotopic preferences as the previous species, but it is more spread and frequent (47%-63%). It was recorded in anthropogenic ecosystems and even in localities, being also called „garden shrew". In previous studies the species presence is mentioned for the three zone of Moldova (14, 20, 21). In the last decades the species was registered in open biotopes from the reserves (4, 23, 26), as well as in various ecosystems on the whole territory (1, 2, 7, 8, 10, 19).

It is cited as common species in localities (11, 19), where it is dominant and the most spread in urban ecosystems (13).

Neomys anomalus is the most hydrophilous species among the shrews from our territory. It is a rare endangered species listed in the Red Book of Moldova (11). It was registered in paludous biotopes, wet ditch with hydrophilous vegetation, in wet valleys from natural woods in the center of the republic and at ecotone forest-paludous biotope, where it was rather abundant (fig. 2). It is the most anthropophobic species among shrews and can serve as indicator of surface water pollution. The Mediterranean shrew was mentioned as rare species in the first studies (17, 20), but later Lozan (21) mention that it is a rather common shrew species in paludous and riparian habitats from central and southern zones, being even more abundant than the common shrew (up to 10% among small mammals in the southern zone). Toward the end of the past century the species became very rare and abundance decreased from 10% in the 1960's to 0.4% in the 90's (3, 24). After 2000 the Mediterranean shrew was registered in small amount in reserves (4, 5, 26) and in wet habitats from several districts of the republic (2, 7).

After analyzing the diversity indexes it was emphasized that the Shannon and Simpson indexes are the highest in riparian biotope, in shelter belts, wet ditch and at the ecotone paludous-agrocoenosis, where the individuals are relatively even distributed among species (tab. 1). The Simpson dominance index is the highest in wood, paludous biotope and wet forest, where all the species are present, but only one dominant and constitute about half of shrew community. Species richness evaluated after Margaleff is the highest in riparian habitats and wet ditch, where the individual number is low, but their distribution among species is even. The Berger-Parker index indicate the highest diversity in wood, paludous and wet forest biotopes, at ecotone paludous-meadow, where 1-2 species dominate and constitute more than 70% of shrews (tab. 1).

Table 1 - Indexes of diversity and species richness of shrew communities in 2003-2016 in R. Moldova

	wood	paludous	agro	riparian	belt	for-pal	for-agro	pal-agro	wet ditch	wet forest	pal-med
Shannon J'	0.703	0.76	0.932	**0.954**	**0.974**	0.863	0.894	**0.945**	0.881	0.717	0.861
Simpson dom.	**0.382**	**0.357**	0.291	0.229	0.26	0.279	0.308	0.273	0.2	**0.438**	0.322
Simpson div.	2.618	2.804	3.441	**4.357**	**3.839**	3.587	3.25	3.667	**5**	2.284	3.109
Margaleff	1.959	1.687	2.047	**3.401**	2.079	2.278	2.827	2.42	**4**	2.48	**3.128**
Berger-Parker	**0.545**	**0.519**	0.422	0.333	0.369	0.439	0.5	0.4	0.4	**0.61**	**0.526**

The analysis of relative biotopic predilection for the entire republic territory showed that *S. araneus* has significant predilection for paludous biotopes and wet forest (tab. 2) and by zones it has significant predilection for the ecotone forest-paludous in the south (0,412), for woods (0,36) and paludous biotope (0,38) in the central zone and for the ecotone forest-agrocoenosis in the northern zone (0,34). *S. minutus* has significant predilection for the ecotone paludous-agrocoenosis on the whole territory, for agrocoenosis in the south (0,384), for forest-paludous ecotone (0,347) in the centre and for the ecotones paludous-agrocoenosis (0,521) and paludous-meadow (0,527) in the northern part. *C. leucodon* has significant predilection for agrocoenosis, shelter belts, riparian biotope and paludous-meadow ecotone (tab. 2) in all studied districts, for woods (0,46), forest belt (0,57) and paludous-agrocoenosis ecotone (0,64) in the south, for agrocoenosis (0,49), riparian (0,329), forest belt (0,359) and paludous-meadow ecotone (0,448) in the center, for paludous (0,42) and riparian (0,63) biotopes in the northern zone. *C. suaveolens* has significant predilection for agrocoenosis and wet ditch on the entire territory, for paludous (0,357) and wet ditch (0,528) in the southern zone, for forest belt (0,318), the ecotones forest-agrocoenosis (0,364) and paludous-agrocoenosis (0,36) in central part, for agrocoenosis (0,656) and paludous-meadow ecotone (0,328) in the northern part. *N. anomalus* has general and zonal significant predilection only for wet habitats (tab. 2)

Table 2 - Values of relative biotopic predilection index in shrew species on the republic territory

	wood	paludous	agro	riparian	belt	for-pal	for-agro	pal-agro	wet ditch	wet forest	pal-med
S.araneus	0.163	**0.373**	-0.38	-0.111	-0.32	0,029	0.097	-0.228	-0.615	**0.383**	-0.233
S.minutus	0.054	0.067	-0.34	-0.079	-0.08	0,027	-0.211	**0.385**	0.126	0.074	-0.185
C.leucodon	-0.09	-0.122	**0.489**	**0.309**	**0.41**	-0,566	-0.078	-0.154	-0.286	-0.234	**0.512**
C.suaveolens	-0.709	-0.041	**0.397**	-0.07	0.159	0,017	0.119	0.143	**0.456**	0.531	0.016
N.anomaluis	-0.423	**0.427**	-	-	-	**0,798**	-	**-**	**0.699**	**-**	-

The similarity between shrew communities from various types of biotopes from the northern, central and southern zones was calculated and the Cluster analysis was performed (fig. 3). A separate cluster is formed by the ecotone forest-agrocoenosis, forest belt from the north and forest-paludous ecotone form the south with the highest similarity of over 90%. Another cluster is formed by paludous biotopes from the three zones and forest ecosystems from the center, which had a rich shrew fauna and the similarity of more than 80%. In many cases the biotopes are grouped by zones, which prove the zonal similarity of shrew biotopic distribution. This, a similarity of about 80% was registered between the forest belt and forest-agrocoenosis ecotone from the northern part (83,33%), between forest belt and agrocoenosis in center (81,48%), between forest and forest belts in the southern zone (78,79%), as well as between the forest ecosystems from the central and northern zones (80,77%) that form a cluster. Another cluster is formed by wet biotopes and their ecotones from the northern and southern zones with a similarity ranging between 70-80%: forest-paludous N – paludous-agrocoenosis N – wet forest S – paludous-agrocoenosis S (fig. 3). The lowest similarity was found between riparian biotopes from the north and south and agrocoenosis from the southern part (less than 60% similarity).

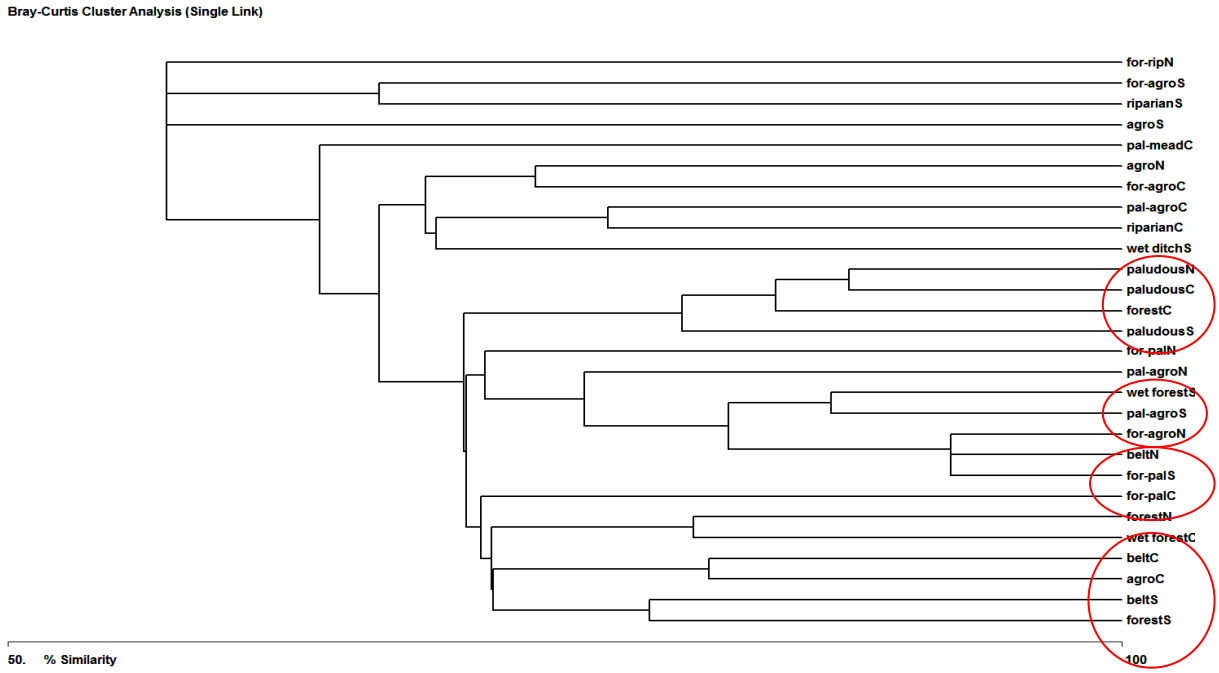

Fig. 3 – Similarity dendrogram of shrew communities in the studied biotopes (N-north, C-center, S-south)

The total zonal abundance of shrew species was assessed (fig. 4). Fot all the species the highest abundance was registered in the central part due to the existence of many types of ecosystems

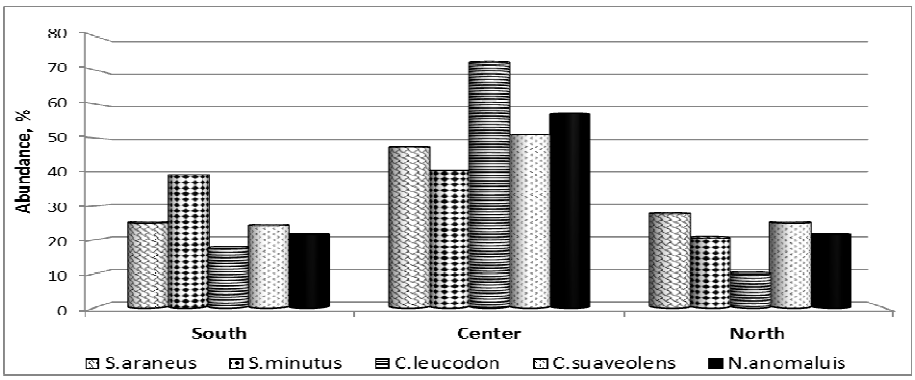

Fig. 4 – Total zonal abundance of shrew species

suitable for shrews: the Codri forest, Orhei forest, reserves, protected areas, various wet and marsh habitats, river meadows. The highest share of bicolor shrew in the center in comparison to northern and southern zones is due to the presence of many open biotopes (pastures, meadows, valleys with shrub vegetation, fallow ground) and forest ecotones. The high abundance of lesser shrew in the central part can be explained by intense studies in urban and rural environment, where this species is rather frequent. The Mediterranean shrew was recorded mostly in the central part, in wet habitats of the reserves and protected areas. In the past century it was extremely abundant in southern part, especially in Prut flooded meadow, where specific floating islands of reed and other aquatic vegetation were formed (21). The lowest abundance of all species was registered in the northern zone, where forests occupy small areas and the aquatic ecosystems are in lower amount. Also, the central part was studied more intense and more data were gathered here, which probably influenced upon the results on zonal distribution of species.

The shrews are important elements of terrestrial ecosystems and can serve as indicators of their functional stability. The rare semiaquatic species are indicators of surface water pollution and their continuously decreasing trend indicate the alarming situation of wet habitats on the entire republic territory.

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Conclusions

During the study years 732 shrews from 5 species were collected: 304 common shrews (*Sorex araneus*), 171 pygmy shrews (*S. minutus*), 131 white-toothed shrews (*Crocidura leucodon*), 112 lesser shrews (*C. suaveolens*) and 14 Mediterranean shrews (*Neomys anomalus*). The most spread and abundant was the common shrew, the rarest – the Mediterranean water shrew. The highest diversity was registered in wet biotopes and their ecotones. The *Sorex* species have significant predilection for the ecotones of wet biotopes, *Crocidura* species – for wet biotopes, forest belts and agrocenoses, while *N. anomalus* – for wet habitats only. The Cluster analysis showed high similarity of shrew communities from paludous biotopes all over the territory of the republic and between various types of ecotones. Shrew species are good indicators of ecosystem stability, therefore they quickly react to the anthropic climatic changes.

Rezumat

Cercetările au fost efectuate în anii 2003-2016 in diverse tipuri de ecosisteme și ecotonuri pe teritoriul republicii. În total au fost colectați 732 chițcani din 5 specii: 304 chițcani comuni (*Sorex araneus*), 171 chițcani pitici (*S. minutus*), 131 chițcani de câmp (*Crocidura leucodon*), 112 chițcani de grădină (*C. suaveolens*) și 14 chițcani de mlaștină (*Neomys anomalus*). Cea mai mare diversitate a fost înregistrată în biotopurile umede și ecotonurile acestora. Bogăția specifică este cea mai mare în habitatele riverane și șanțuri umede, unde numărul indivizilor nu este prea mare însă ei sunt repartizați mai uniform pe specii. Speciile gen. *Sorex* au predilecție semnificativă pentru ecotonurile habitatelor umede, cele ale gen. *Crocidura* – pentru habitate umede, perdele forestiere și agrocenoze, iar *N. anomalus* – doar pentru habitate umede. Analiza Cluster a arătata o similaritate mare între comunitățile de soricide din ecosistemele palustre pe tot teritoriul republicii și între cele din diverse tipuri de ecoton. Cea mai ridicată abundență a tuturor speciilor de chițcani a fost semnalată în zona centrală. Speciile de chițcani sunt buni indicatori ai stabilității ecosistemelor, reacționând rapid la modificările antropice și climatice. Trei specii (*C. leucodon*, *N. fodiens N. anomalus*) sunt introduse în Cartea Roșie a Republicii Moldova.

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THE TROPHIC SPECTRUM OF THE LONG-EARED OWL (*ASIO OTUS OTUS* LINNAEUS, 1758) FROM BACAU LOCALITY, BACAU COUNTY

DALIA PARASCHIV*

ABSTRACT

In this study, the trophic spectrum of the *Asio otus otus* (Linnaeus, 1758) species was identified by analyzing 82 pellets collected in November, Bacău County. The average number of individuals/pellet was 2.56, and the length of the pellets varied between 1.2 and 5.6 cm. The trophic spectrum of *A. otus otus* species was dominated by *Microtus arvalis* (Pallas, 1779) microtide. Its share was 78.02% of all small and December of 2011 and 2012. The pellets were collected from the "Victor Anestin" Astronomical Observatory courtyard in Bacău mammals identified, followed by *Apodemus sylvaticus* (Linnaeus, 1758) with 11.21%, *Apodemus flavicollis* (Melchior, 1834) with 6.27% and *Apodemus agrarius* (Pallas, 1771) with 4.05%. The *Mus musculus* (Linnaeus, 1758) species was poorly represented, with only one individual (0.44%).

Key words: pellets, *Asio otus otus* L., small mammals

Introduction

The long-eared owl (*A. otus otus*) is one of the most widespread strigiform species in Europe and in Romania. In our country these populations are sedentary. The sexual maturity is reached at two years old. The reproduction takes place beginning with the end of March, the eggs being usually laid till the end of the first April decade. Later eggs belonging to young specimens or even to inferior-status adults are laid in the second half of April, the beginning of May. The number of eggs laid by the long-eared owl is approximately 5, but sometimes 7-8 eggs may be laid, a fact depending on the food resource richness. Rich years in trophic resources see even 2 yearly egg clutches. During winter the individuals gather themselves in colonies, in various habitats, including human localities and so the may be found in gardens, parks, deserted coniferous places (preferring the species of the *Thuja spp.* genus). The diet of the long-eared owl mainly consists of micromammals and small-sized birds, the pellet analysis providing information both about their way of eating and the structure and the dynamics of the small mammals communities in the respective areas (2).

Material and methods

During November and December months of the 2011 and 2012 years we collected 82 soil pellets from the *A. otus otus* species in the yard of the Astronomical Observatory ”Victor Anestin” Bacău (Fotos 1 a, b). The nest was situated in a thuja (*Thuja orientalis*), the long-eared owl family including 7 individuals (4 adults and 3 juveniles). The first pellet group was collected in 22.11.2011 (27 pellets) and the fourth group in 06.12.2012 (16 pellets). Each pellet was measured, weighed and afterwards unfolded. The bone fragments were cleaned and sorted into categories. Small mammal species were determined according to dentition, jaw and mandibular bones, by using the specialty literature (6,7).

Results and discussions

After analyzing the 82 pellets in the four groups, we identified skeletal fragments from 223 individuals which belong to the Rodentia Order, to 2 families (Arvicolidae and Muridae), to 3 genera and to 5 species: *M. arvalis*, *M. musculus*, *A. agrarius*, *A. flavicollis*, *A. sylvaticus*.

The pellet length varied between 1.2 and 5.6 cm. The minimal number of individuals/pellet was 1, the maximal number was 5, and the average was 2.56.

The trophic status of the *A. otus otus* species is dominated by the *M. arvalis* microtid, with a total number of 174 individuals. Its weight represents 78.02% of the small mammal total identified in the 4 pellet group analysed, followed by *A. sylvaticus* with 11.21%, *A. flavicollis* with 6.28% and *A. agrarius* with 4.05%. The *M. musculus* species was poorly represented, with only one individual (0.44%) (table 1, figure 1).

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M. arvalis was the best numerically species in each of the 4 pellet groups that we studied, with a total number of 174 individuals (figure 2).

Comparing our study with a previous one concerning small mammal species identified in *A. otus otus* pellets in Bacău locality, we could notice that the *M. arvalis* microtid was the dominant species, the long-eared owls capturing their prey in the Bacău town surroundings, where agricultural fields exist (4) (table 2).

In the specialty literature the *A. otus otus* species' preference for the common vole may be explained on one hand through the fact that this rodent prefers open fields, i.e. the hunting areas of the long-eared owl, and on the other hand through the poor agility of this small mammal, through its gregarious behaviour and its high prolificity, being an abundant and accesible food source (1,3,5).

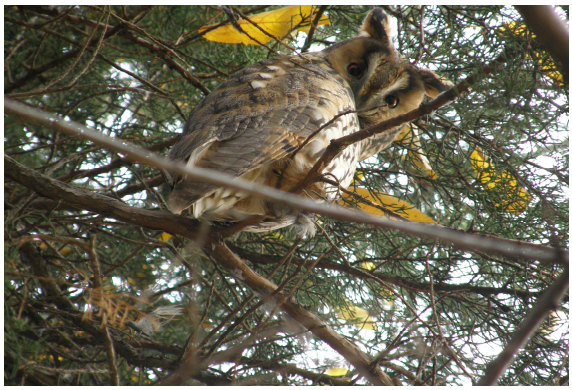

Photo 1. - Aspects of the field: a) the long-eared owl specimen; b) pellets identified (original)

Table 1 - The number of specimens and the weight of small mammal species in the *A. otus otus* pellet groups analyzed

Pellet groups		**Species**					**Total**
		M. arvalis	***A. sylvaticus***	***A. flavicollis***	***A. agrarius***	***M. musculus***	
22.11.2011	No. of specimens	53	9	5	2	0	69
	%	76.81	13.04	7.24	2.89	0	100
17.12.2011	No. of specimens	27	4	0	1	0	32
	%	84.37	12.5	0	3.12	0	100
09.11.2012	No. of specimens	63	9	6	5	1	84
	%	75	10.71	7.14	5.95	1.9	100
06.12.2012	No. of specimens	31	3	3	1	0	38
	%	81.57	7.89	7.89	2.63	0	100
Total	**No. of specimens**	**174**	**25**	**14**	**9**	**1**	**223**
	%	**78.02**	**11.21**	**6.28**	**4.05**	**0.44**	**100**

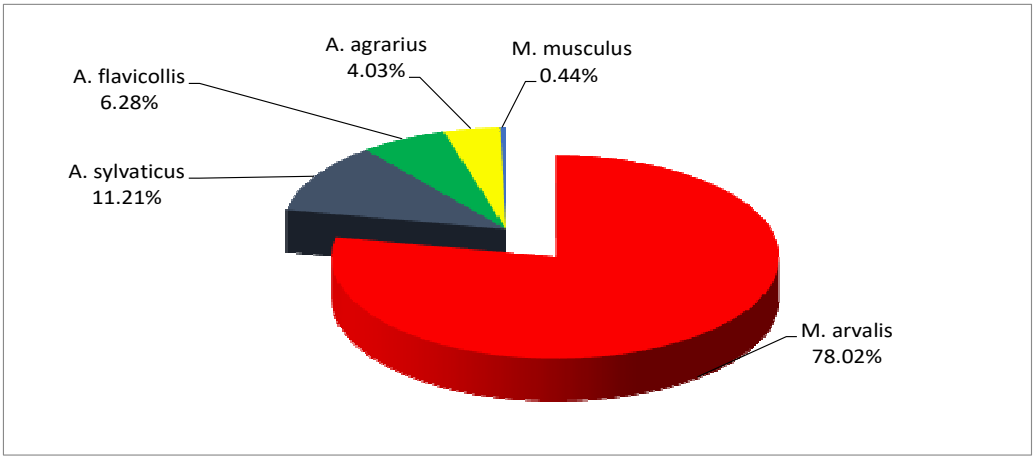

Figure 1 - The percentage of the small mammal species identified in *A. otus otus* pellets, in Bacău locality

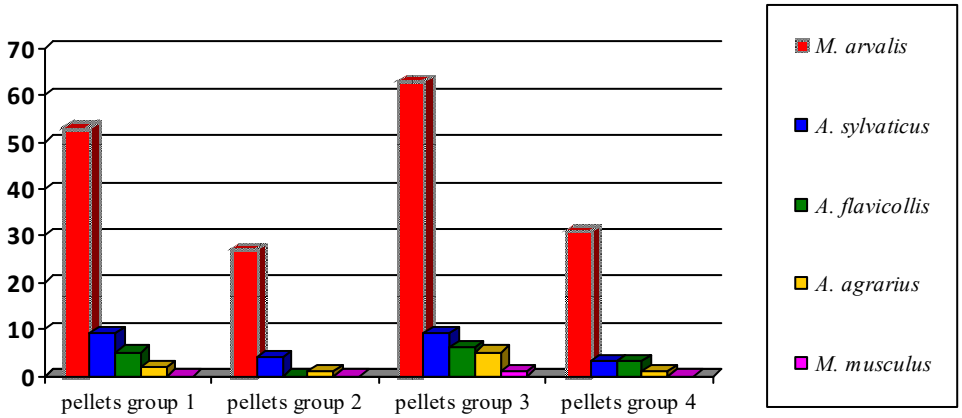

Figure 2 - The trophic spectrum of the *A. osus osus* species in the 4 pellet groups analyzed

Table 2 - The small mammal species identified in *A. otus otus* pellets in Bacău locality, in comparison with a previous study

No.	Species	LAIU et al., 2002		Our study	
		A	D%	A	D%
1	*Crocidura suaveolens*	1	0,14	-	-
2	*Pitymys subterraneus*	1	0,14	-	-
3	*Microtus arvalis*	548	73,95	174	78,02
4	*Rattus norvegicus*	1	0,14	-	-
5	*Mus musculus*	82	11,06	1	0,44
6	*Apodemus sylvaticus*	66	23,38	25	11,21
7	*Apodemus flavicollis*	5	0,67	14	6,28
8	*Apodemus agrarius*	-	-	9	4,05
9	*Micromys minutus*	3	0,40	-	-

Conclusions

The long-eared owl's diet was researched according the examination of 82 pellets collected during November and December 2011 and 2012 in the Bacău town.

The pellet length varied between 1.2 and 5.6 cm. The minmal number of individuals/pellet was 1, the maximal number 5, and the average was 2.56.

In each of the 4 pellet groups the dominant species was *M. arvalis*, this being the main prey of the long-eared owl. Thus, we can state that the de *A. otus otus* individuals captured their prey in the surroundings of the Bacău town where agricultural fields exist.

Because *M. arvalis* is harmful for agriculture, the large number of this species in the diet of *A. otus otus* underlines the importance of this bird in the regulation of the rodent populations in agrocenoses.

Rezumat

În studiul de față a fost identificat spectrul trofic al speciei *Asio otus otus* (Linnaeus, 1758), prin analiza unui număr de 82 de ingluvii, colectate în lunile noiembrie și decembrie ale anilor 2011 și 2012. Ingluviile au fost colectate din curtea Observatorului Astronomic „Victor Anestin" din localitatea Bacău, jud. Bacău. Numărul mediu de indivizi/ingluvie a fost 2,56, iar lungimea ingluviilor a variat între 1,2 și 5,6 cm. Regimul trofic al speciei *A. otus otus*, a fost dominat de microtidul *Microtus arvalis* (Pallas, 1779). Ponderea acestuia a fost de 78,02% din totalul mamiferelor mici identificate, urmat de *Apodemus sylvaticus* (Linnaeus, 1758) cu 11,21%, *Apodemus flavicollis* (Melchior, 1834) cu 6,27% și *Apodemus agrarius* (Pallas, 1771) cu 4,05%. Specia *Mus musculus* (Linnaeus, 1758) a fost slab reprezentată, fiind întâlnit un singur individ (0,44%).

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THE MOVEMENT OF SATELLITES AND COSMIC SPEEDS

CRISTINA - DANIELA APETROAEI*

ABSTRACT

Newton guessed the possibility of sending bodies into space. The bodies whose speed is lower than the first cosmic speed will fall on the Earth, and if the speed is higher the vehicle will leave the Earth for good.

Key words: satellites, cosmic speed

Introduction

Newton realized that a vehicle launched at a sufficiently high speed would be able to rotate around the Earth in a geostationary orbit. If the speed grows even more, the vehicle could finally leave the Earth (fig. 1)

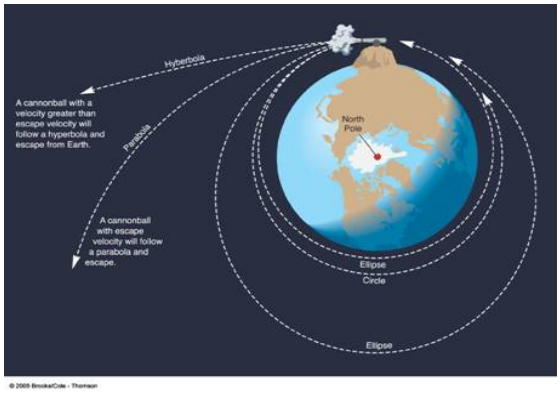

Fig. 1 - A projectile may describe different trajectories depending on the launch speed

According to the Principle II of classical mechanics, a force acting on a body imparts an acceleration, that is: F = m·a.

In the case of a rotating body, acceleration is given by mathematical expression

$$a=\frac{v^2}{R}, \text{ so } F=\frac{mv^2}{R}.$$

This force is due to the gravitational pull between the Earth and the satellite ($F=\gamma\frac{mM}{R^2}$).

Drawing the two forces results:

$$\frac{mv^2}{R}=\gamma\frac{mM}{R^2}. \quad (1)$$

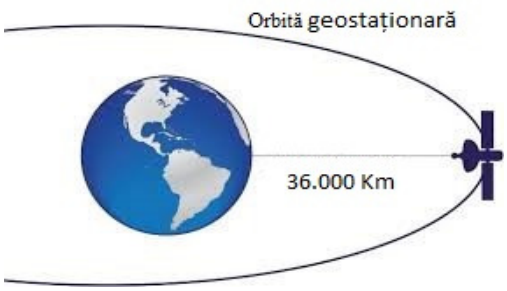

Fig. 2 - Moving a satellite on a geostationary orbit

The relationship is valid for a satellite very close to Earth (r = R). In this case, from (1) we obtain:

$v=\sqrt{\frac{\gamma M}{R}}=\sqrt{g\cdot R}=7{,}91\ Km/s$, which represents the **first cosmic speed.**

Let us observe: the determination of the first cosmic speed has neglected the strength of the air resistance.

Tab. 1 - The value of the first cosmic speed decreases with the height

H (km)	0	250	500	750	1.000	1.500	1.690	2.000	5.000
V^1_o	7,91	7,76	7,62	7,48	7,35	7,12	7,03	6,90	5,92
T (ore)	1,41	1,49	1,58	1,66	1,75	1,93	2,00	2,10	3,35

There are a variety of different orbits that can be adopted by satellites. The choice of one depends

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on the service that the satellite needs to provide and the area it needs to serve.

In some cases, the orbit may be low, only 160 km, while others can be over 36 000 km. Satellites rotate around the Earth, so they are attracted to gravitational force. If you do not have one his own movement, would fall back on Earth, igniting in the upper atmosphere. But the centrifugal force pushes the satellite away from the Earth.

For any given orbit there is a speed for which these two forces balance. Obviously, as the orbit is lower, the gravitational attraction is higher and the satellite has to rotate around the Earth faster to offset this attraction. At high heights the gravitational pull is smaller and therefore the angular velocity must be less. For a very low orbit, at 160 km, a speed of 21,160 km / h = 5,877 km / s is required, so the satellite will surround the Earth in 90 minutes. At an altitude of 36 000 km, a speed of nearly 11,265 km / h = 3,129 km / s is required, giving a 24-hour rotation period (geostationary satellite).

A satellite can surround the Earth on two types of orbits. The first is the circular orbit, at which distance from Earth remains constant. The second type of orbit is the elliptical (Figure 3). When a satellite surrounds the Earth, the orbit describes a plan that passes through the geocentre.

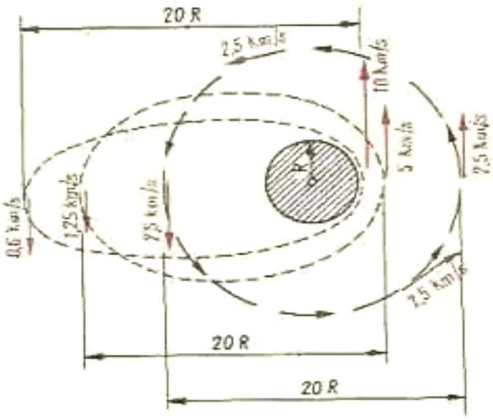

Fig. 3 - The satellite orbits

In the case of an elliptical orbit, the velocity changes according to the position in orbit. The maximum speed is when the satellite is closest to the Earth (perigeus) and must overcome the greatest gravitational force and is minimal at the highest apogee distance.

For an elliptical orbit, the center of the Earth is in one of the outbreaks of the ellipse (Figure 3). A satellite can rotate around the Earth in different planes. The angle of inclination of the orbit is the angle between a straight line perpendicular to the plane of the orbit and the right that passes through the Earth's poles. The orbits that pass over the equator are called equatorial orbit and those that cross the poles are called polar orbits.

The artificial satellites used are classified as follows:

1. By their nature:
- Passive satellites that do not have onboard equipment; they are a simple reflective medium of the radio waves transmitted from the ground;
- Active satellites, which are equipped with signal processing, space-guiding and execution of commands received from the ground.

2. By way of transmitting information:
- Real-time response satellites, when ground stations ensure continuous satellite visibility;
- Memory satellites (delayed response), when on certain portions of the trajectory it is not visible from the ground and it is necessary to record all the information to be transmitted later

3. In the form of the trajectory, the satellites may have:
- Circular orbit;
- Elliptical orbit.

4. After the angle of inclination of the satellite orbit (i) to the terrestrial equator:
-for i = 0 degrees, equatorial satellites;
-for i = 90 degrees, polar satellites;
-for tilt values between 10 - 80 degrees, ordinary satellites.

5. In terms of altitude:
- Low altitude satellites for altitudes between 1000 and 5000 km;
- Medium altitude satellites, placed between 5000 and 20 000 km;
- High altitude satellites, between 20 000 and 35 800 km.

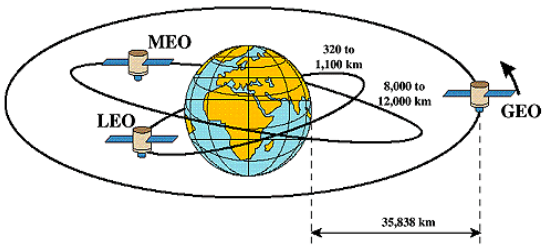

Fig. 4 - The satellites LEO, MEO, GEO

The main issues of Earth's artificial satellites are:
- launching and placing on orbit;
- satellite operation;
- to maintain connections with the ground control panel;
- their use for solving problems of sea or air navigation, communications, scientific research, exploration of alien space, etc.

After placing it on orbit, it is very important to study the undisturbed motion of the satellite, as well as the perturbations of the orbital elements of the satellite.

Depending on the cosmic velocity, the object can be:

- Satellite, with movement on a circle or ellipse;
- Interplanetary ship with movement on the parabola or hyperbolic.

The second cosmic speed, also called the speed of release, is the speed that a body must initially have to get out of the gravitational field of the Earth. Its value is 11.2 km / s.

The third cosmic speed is the initial speed that a body must have to leave the solar system and has a value of 16.7 km / s.

Artificial satellites have helped solve some issues related to:

- Management of seagoing and spacecraft on sea or air communications;
- Determination of their position and movement elements (such as: speed, acceleration, travel direction);
- Warning of ships on crash situations, catastrophes, determining where it happened and triggering rescue operations;
- Extension of long-distance communications and transmissions, transmission of permanent meteorological information, prevention of crews from the occurrence of dangerous meteorological or hydrological phenomena;

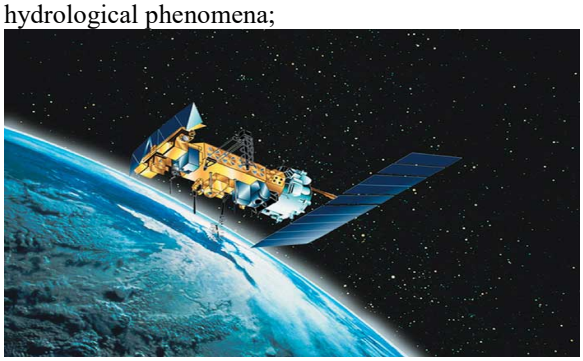

Fig. 5 - Meteo satellite

- Design of land surface;
- Exploring large areas.

The use of artificial satellites starts from a number of their properties, such as:

- global coverage;
- fast action;
- high probability of determining low- navigation parameters in any terrestrial area irrespective of the position and timing of motion of the sea going vessels or aircraft;
- resolving navigation problems in any kind of meteorological conditions, day and night, with great precision and in very short time.

Conclusions

Ever since the establishment of the expression of gravitational force, Newton intuited the possibility of sending bodies into space. If a body is launched horizontally, at the top of a mountain, with higher speeds, there will be a speed at which will not fall on Earth, managing to make a complete rotation around it.

Bodies that print at a speed lower than the first cosmic speed will fall on Earth. At higher speeds, the vehicle will finally leave the Earth.

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EVALUATION OF THE ANTHROPIC IMPACT ON THE QUALITY OF DRINKING WATER IN THE REPUBLIC OF MOLDOVA

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MARINA VINOGRADOVA, ADRIANA DRUŢA

ABSTRACT

In the increasing conditions of the anthropogenic factor of the hygienic state of water sources, there is a big problem of determining the role of water quality in shaping and changing the health status of the population. Public health is affected not only by environmental pollutants, but also by a number of biological, social, climatic, and geographical factors and conditions. There is also a problem with the chemical quality of drinking water, which, among the other environmental problems, is affecting the incidence of chronic non-communicable diseases.

Key words: Impact, drinking water, pollution, health, diseases.

Introduction

The anthropic impact on natural ecosystems is a combination of changes that occur as a result of human activity outside of environmental laws. Human beings and the environment interact with each other with a permanent exchange of matter, energy and information. Some natural cataclysms such as floods, earthquakes, volcanic eruptions have disrupted and will further affect human activity. However, humans also contribute to the deregulation of the ecosystem through harmful actions to the environment, and these cataclysms can sometimes be seen as an environmental response to this harmful activity.

The increase in human population and improvements in living standards, industrialization, and technology have led to the overthrow of the planet's support capacity, breaking the balance between people and the environment. The aquatic environment, of all ecosystems, is most affected by pollution, creating many problems for preserving and improving its quality. To a greater or lesser degree, it is difficult to avoid water pollution.

Deterioration of aquatic ecosystems through pollution is a detrimental change in the animal and plant world due to the invasion of pollutants into the environment [3]. Pollutants are waste products of human activity. The main effects of anthropic impact on natural ecosystems are the following pollution factors:

• chemicals: pesticides, gases, organic substances;

• physical: heat, radiation;

• biological: viruses, pathogenic bacteria.

Pollution is directly proportional to the quantitative growth of humanity, human needs and the development of new technologies. Since the permissible limits of pollution for human safety are not known, there is a tendency to underestimate its effects.

Physical pollution:

· Thermal or heat pollution: Various atmospheric gases lead to global warming through the greenhouse effect, the effects of global warming are catastrophic;

· Radioactive pollution: sources of radiation are sources of radioactive deposits, which got into the water with rain, and water used in factories;

Chemical pollution:

· Chemicals used in industry and agriculture are the most widespread and the most dangerous forms of pollution. Harmful agents released into the environment: pesticides, heavy metals, DDT are accumulated along trophic chains at increasing concentrations through the phenomenon of biological amplification. These substances are generally non-biodegradable or hardly biodegradable and therefore persist for a long time in the ecosystem. Examples of pollutants: a) Gases: carbon monoxide, sulfur dioxide, which in combination with precipitation water, produces acid rain; b) Nitrogen compounds contribute to the formation of smog; c) Halogen derivatives cause burns in plants and the disease called fluorosis in animals (bone deformation and tooth decay); d) Powders: quartz

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particles, calcium, asbestos, soot, lead particles, mercury, zinc, etc.

Biological pollution: Is produced directly by:

· the discharge of domestic and industrial wastewater into the watercourses or indirectly through their contamination with fermentable organic substances;

· water eutrophication: a natural process of accumulation over time of increased amounts of organic substances on the bottoms of natural water sources which contributes to the development of microorganisms that destroy the ecological equilibrium of the ecosystem [2].

Waters represent a basic natural source, that is of multilateral significance in human life. All physiological and biochemical processes take place in the aquatic environment. The quality of drinking water essentially influences human and animal health. Thus it is known that water has a very varied chemical composition, containing a large number of dissolved chemical elements. If the normal chemical composition of water is contaminated as chemicals are carelessly discharged into the ecosystem, the result can be an increase in the number of situations where such pollutants can affect human health.

The influence of minerals on health is complex. There are not only the direct effects of minerals on the human body, which physiologically are varied and multilateral. These pollutants can also interfere with the body's absorption and use of vitamins and enzymes, causing changes in hormones and other physiological problems. In the Republic of Moldova, one of the the main risks to health is the pollution of drinking water sources.

Nitrates are the most known toxic substances found in water. They should not exceed 50 mg / l. Consuming large amounts of water full of nitrates can cause the condition called the "nitrate intoxication" Water nitrates and human food are resorbed into the upper part of the intestine in a healthy body. In the case of dyspepsia and infections, favorable conditions are created for the transformation of nitrates into nitrites, which, in turn, block the transport of oxygen to the tissues. The existence of nitrates in drinking water is one of the biggest concerns in Moldova since about 65% of the fountains and 7% of the artesian wells used by the population contain water with concentrations above 50 mg / l of nitrates. The most affected districts are Teleneşti, Cahul, Floreşti, Ialoveni, Edineţ, Rezina, Hânceşti, Drochia, Făleşti, Cantemir, Râşcani. The concentration of the nitrates in some water resources of these districts reaches very high parameters - 100-750 mg / 1 (2 to 15 times more than the maximum admissible limit).

Some mineral substances in water have been called "bio elements" or "mineral vitamins." Most of these elements are obtained by ingesting food, however small amounts are absorbed from the atmosphere, this is normal and acceptable except the cases with air from heavily polluted regions. We also should note that water is a significant source for many mineral elements. Taking into account its dissolving capacity, water can extract different microelements from the soil, rock, construction materials, food and even from dishes and other utensils used in food preparation. It also can extract a various range of metals: cadmium, cobalt, copper, nickel, chromium, manganese, and others with toxic action, depending on its hardness or softness.

It is known that the hardness in water is caused by the presence of calcium and magnesium salt and also by hydrogen-carbonate ions found in soft waters. Local hygiene and epidemiology centers carried out the analysis of the groundwater in Călaraşi, Anenii-Noi, Hâncesti, Criuleni and Ceadâr-Lunga districts regarding the degree of mineralization and hardness of the water in the wells. The results of the investigations revealed that the water from the fountains, compared to the artesian water, is characterized by a high degree of mineralization and a high hardness - up to 95.6% (Lăpuşna village). The total hardness of the water is greatly increased in all mentioned localities. Thus, the number of samples that are higher than the standard of AMC (Agrometeorological Monitoring Center) varies from 76.6% to 100%.

If water does not contain enough salts as Ca2 + and Mg2 +, the mortality from cardiovascular diseases gets higher. An inverse correlation has been established between water hardness and cardiovascular mortality: the more reduced water hardness is, the lower the risk of those diseases." In heart function, Ca2 + has a particular role in decreasing its concentration (AMC = 30-100 mg / 10), resulting in arrhythmias, disorders in blood clotting processes, and worsening of rickets. Also, Mg2 + plays an important role in cardiac automatism, in cases of Mg2 + deficiency (AMC = 10-40 mg / l) the risk of morbidity of newborns and hypertonic seizures is increased. Additionally, surveys indicate that about 50% of the rural population have no access to drinking water of a good quality. A big part of the rural population uses water with an increased content of fluorine (4-10 mg / l), hydrogen sulfide (5-20 mg / l), iron (1-2.5 mg / l), which affects their health condition.

Also, inorganic substances play a big role in maintaining the acid-base balance, in the active reaction of blood and tissues at a relatively constant level, as well as in hematopoiesis and immunity. Exceeding certain optimal quantities of elements, generates diseases as dangerous as those obtained due to their deficiency. For example, lack of

adequate iron concentrations (AMC = 0.3 mg / l) causes anemia, just as the excess of these concentrations in certain tissues or organs causes liver disease, diabetes and increases the risk of heart attack [5].

The excess of salt or water hardness higher than 15 mmol / l (AMC = 7 mmol / l) contributes to the occurrence of cholelithiasis, renolitics, osteoarthritis, as well as higher concentrations of fluorine over 5 mmol /1 (AMC= 0,75-1.5 mmol / l) lead to osteofluorose. High fluoride content was found in some centralized water sources. The highest degree of pollution was established in the Glodeni, Făleşti, Nisporeni, Ceadâr-Lunga and Taraclia districts, where the fluoride occurrence in water exceeds the standard of AMC by 50-100%.

The second group includes the Călăraşi district. Here the fluorine occurrence exceeds the AMC standard by 20-50%. In the third group exceeding concentrations are 10-20%. These are the districts of Anenii-Noi, Floreşti and Ungheni. The ratio of samples exceeding the AMC norms of fluorine in Moldova was on average 15% in 2007 compared to 12.9% in 2010. The number of people at risk of getting a disease caused by the absence or excess of fluoride is about 860 thousand, or in other words, it is 20% of the country's population.

In the case of large amounts of Ca2 + in the organism, the cellular permeability is reduced and hypotonia appears as a result, and in the case of an increased amount of Mg2 +, the nervous system is negatively affected. The content of salt used by people for a long time, can also cause some premorbid conditions of the body. It can also associate with the genetic and biological particularities of the individual contributes to the triggering of water-related chemical pathologies.

The salt composition of water also affects blood biochemical indices. Thus, in the south of the Republic, where the water contains a large amount of dry residue, sulfates, hydrocarbons, chlorides, potassium and sodium, nitrates, a higher level of the following parameters in blood has been established, compared to the central area: calcium by 25% more; sodium - by 7%; albumin - by 9.2%, as well as decreased levels of phosphorus (by 9%) [1]. At the same time, some metabolic indices (minerals, carbohydrates, proteins) were observed in comparison with the biochemical indices of the population of the central part of the republic.

For the most part, many diseases can be avoided by distributing good quality drinking water to urban and rural populations. Sufficient amounts of quality water are not currently available to people nor to the natural or anthropic ecosystem needs. We could say that although water is a regenerating resource, quality drinking water resources are insufficient to our planet and are becoming increasingly restrictive. Not all needed water can be provided due to numerous restrictions, and pollution is one of them. There are several types of water pollution, depending on the dissolved or disposed substances. We should also remember that water is the best solvent and dispersant in nature [4].

The evaluation of the relationships and links that exist between the anthropic component and the environment emphasizes the environmental potential of a territory and how it is used by society. The societal-environmental connections have experienced different types of manifestations, with different degrees of impact (negative and positive) on the environment, and the most damaging types appeared due to the activity of modern society. The elaboration of a study focused on the anthropic impact on water quality in the Republic of Moldova was a real challenge because of the complexity of the problem and the methodology used to investigate it. The study area represents a space with a great human impact with spatio-temporal dynamics marked by numerous changes and evolutionary bifurcations.

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COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA" BACĂU

STUDII ŞI COMUNICĂRI 2018	Vol. 27: 62-66

A WEBSITE FOR *STUDII ȘI COMUNICĂRI* - THE SCIENTIFIC JOURNAL OF THE "ION BORCEA" NATURAL SCIENCE MUSEUM COMPLEX

BOGDAN TOMOZII, FLORIN TOFAN, BOGDAN BARABAŞ*

ABSTRACT

Early in 2018 we celebrated half a century since the publication of the first issue of *Studii și Comunicări*, the scientific journal of the "Ion Borcea" Natural Science Museum Complex of Bacău. On this occasion, we inaugurated the web site dedicated to the journal, a valuable tool for disseminating scientific information in the online academic environment and promoting the educational and exhibition activities of the museum to the large public. From the Content section, the online visitor can access to all available papers published in *Studii și Comunicări* since 1968 to date. The site is bilingual and can be accessed in both Romanian and English languages.

Key words: website, scientific journal, *Studii și Comunicări*

Introduction

In the current information context, the media, especially the Internet, have transformed the dynamics of the scientific information system. These new communication possibilities make information dissemination quick and allow researchers to share research results and access journals and scientific data through computers.

In 2018, we celebrated half a century since the first appearance of the journal *Studii și Comunicari*, the scientific review of the "Ion Borcea" Natural Science Museum Complex. The journal *Studii și Comunicari* was founded in 1968 at the initiative of historian dr. Iulian Antonescu and biologist dr. Constantin Șova. Over time, the journal was printed through the care of the managers of the institution Dr. Constantin Șova, Dr. Neculai Barabaș and Dr. Gabriela Gurău.

In order to meet this moment and to integrate the journal into the international information flow, we have proposed to carry out a project whose purpose is to create and launch a website dedicated to the journal.

The existence of a website at the present time is no longer a wish, but an obligation for increasing the visibility of the journal and for fast dissemination of the results of scientific research and of the educational and exhibition projects carried out by curators and collaborators of the institution.

Another raison d'etre of this web page also comes from the need to comply with the criteria set by the forum that administers the process of evaluating the quality of scientific journals in Romania (former National Council for Scientific Research in Higher Education (CNCSIS) - current UEFISCDI), minimum criteria for the existence of the function of dissemination of information at national level through scientific journals. Among these criteria is the existence of a website which should include at least: the publishing house, the editorial board, instructions for authors; institutional way to get reprints after any article (not necessarily free).

The existence of a website has an important impact both on the journal and on the articles included in it.

At the journal level, one of the criteria for evaluating the scientific quality of journals is the number of indexes in various international databases (ISI Web of Science). A scientific journal is easily indexed if it is found on the Internet in digital format.

At the scientific article level their availability online ensures easy identification in the virtual space and their citation in other specialized articles. It is one of the criteria for qualitative evaluation of scientific papers.

The journal "*Studii și Comunicări*" is an authentic scientific product of the "Ion Borcea" Natural Science Museum Complex and cover a varied range of topics in the field of natural sciences: geology, paleontology, botany and zoology, but also museology.

The articles included in the journal were the fruit of scientific meetings organized by the museum over time, such as: *Habitat 76, Era omului, Știința și condiția umană, Ecologia și protecția ecosistemelor, Biologia și Dezvoltarea durabilă.*

In "*Studii și Comunicări*" published well-known personalities of Romanian Biology, such as

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acad. Constantin Motaș, acad. Mihai Bacescu, acad. Constantin Toma, prof. dr. Corneliu Zolyneak, prof.dr. Traian Ștefureac, prof. dr. Sergiu Cărăușu, prof. dr. Dumitru Mititelu, prof. dr. Sergiu Haimovici, prof. dr. Adriana Murgoci, prof. dr. Petre Neacșu, prof. dr. Victor Nadolschi, prof. dr. Gheorghe Mustață, prof. dr. Nicolae Valenciuc, dr. I E Fuhn, dr. Xenia Scobiola Palade, dr. Dinu Paraschivescu, dr. Ion Nemeș etc.

Today „*Studii și Comunicări*" can be found in specialized libraries in museums, research institutes and universities in over 45 countries of the world, institutions with which the museum had book exchanges over time.

Material and method

The realization of the project involved activities on several levels. All volumes of "*Studii și Comunicări*" published between 1968-2017 were scanned using the Konica Minolta Bizhub C253 Multifunctional copier. Portable Document Format (pdf) articles were extracted from the scanned volumes on each author / authors using Adobe Acrobat Pro Extended software. The contents of each volume were edited in MS Word 2007, and the titles of the papers were linked to the corresponding articles in pdf format. The articles were then uploaded to the website.

The website was created using HTML, CSS and JS code and can be viewed in any modern browser such as Firefox, Google Chrome, Opera, Safari etc.

Results and discussions

Twenty six numbers (Fig. 2) have been scanned to date, totaling 30 volumes, with over 8800 pages (Fig. 4) and approximately 803 papers have been extracted (scientific articles, anniversary notes, commemorations, reviews, etc.) (Fig.3), published by over 550 authors in the period 1968-2017.

The website has been structured into 9 sections (Fig.1): Home, About, Contents, Instructions for authors, Editorial, Buy print, Contact, Search, Advanced Search. The Home section contains identity data of the scientific journal, which include the institution that publishes the volume, the range of scientific topics covered by the journal, the publishing house and the year the journal was founded. The About section includes a brief history of the journal's appearance and evolution over time. The Contents section includes the actual links to the volumes of *Studii și Comunicări*. The Editorial section shows the composition of the editorial board, the editorial secretaries and the editorial manager.

The main pages of the site are bilingual, respectively Romanian and English, and those that present the contents of the volumes can be automatically translated into several languages, using a translation script from Bing.

Due to its specificity it is designed to be only partially responsive, for viewing a PC, laptop or tablet with a minimum resolution of 800 pixels is needed.

Fig. 1 – The Home page of the journal "*Studii și Comunicări*"

The scientific papers constitute a digital archive, and in order to easily find the papers, two search systems were developed based on keywords, consisting of the authors' names and words from the title of the paper.

Incomplete keywords can also be used for search, but they must contain at least three letters. Simple search identifies the volume in which the paper was published, while advanced search allows all papers containing the search terms to be displayed, from all published volumes.

The search is very fast, being executed on average in 0.04-0.05 seconds. In the resulting page the search terms are highlighted in bold. The search system is based on an open source application, namely Tipue Search, which has been configured to be implemented on the site. This choice was made taking into account that it allows extremely fast searches, faster than on the MySQL system, being also less vulnerable than this one.

The graphical interface is simple and user friendly and in this case allows the user easy access to the searched papers. The site is configured to present new information in new windows or tabs, depending on the configuration of the user's browser, allowing the user to easy access information at multiple levels and switching, at desire, to the information previously searched. Creating databases, which are in JSON format, required the creation of an application in HTML, PHP and JS, running on a local server, for convenient editing. The application was also published on Github, in open source, under MIT license. The Notepad ++ editor was also used to make certain changes to the content, using regular expressions.

The website was launched on the address : http://www.studiisicomunicaribacau.ro/.

Rezumat

În anul 2018 am celebrat jumătate de secol de la apariția primului număr din *Studii și Comunicări*, revista științifică a Complexului Muzeal de Științele Naturii "Ion Borcea" Bacău. Cu această ocazie am lansat un site dedicat acestei reviste, un mijloc util și valoros de diseminare a informației științifice în mediul academic virtual și de promovare a activităților educaționale și expoziționale desfășurate de specialiștii muzeului către publicul larg.

Website-ul este împărțit în 9 secțiuni: Acasă, Despre, Cuprins, Instrucțiuni pentru autori, Comitetul editorial, Cumpără imprimat, Căutare și Căutare avansată.

Din secțiunea Cuprins, vizitatorul poate accesa toate volumele revistei *Studii și Comunicări* publicate din anul 1968 până în prezent.

Site-ul este bilingv, putând fi accesat atât în limba română cât și în engleză.

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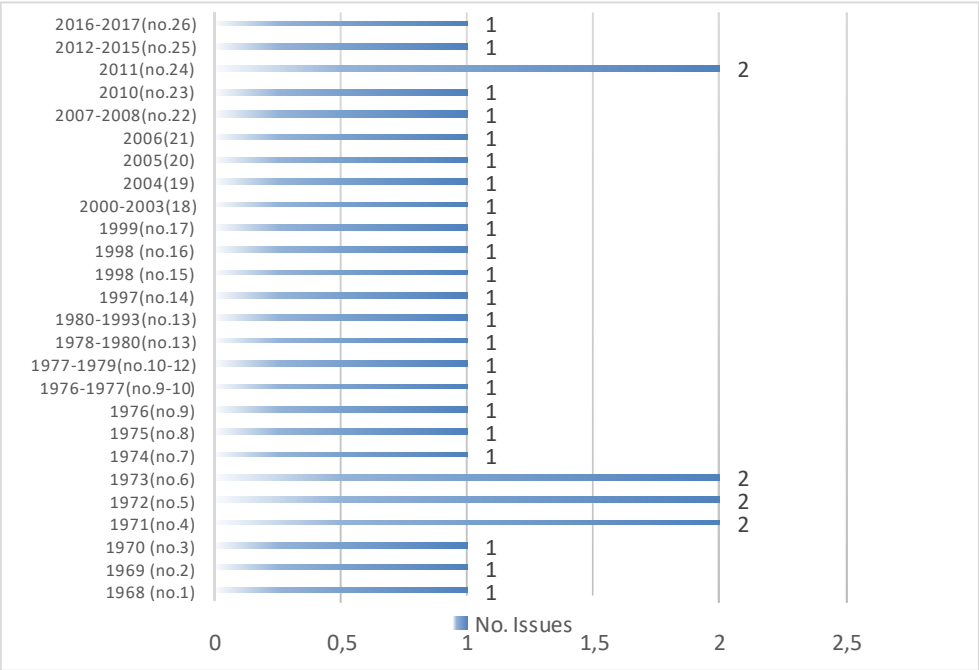

Fig. 2 - Number of issues published per volume/year (period) of publication

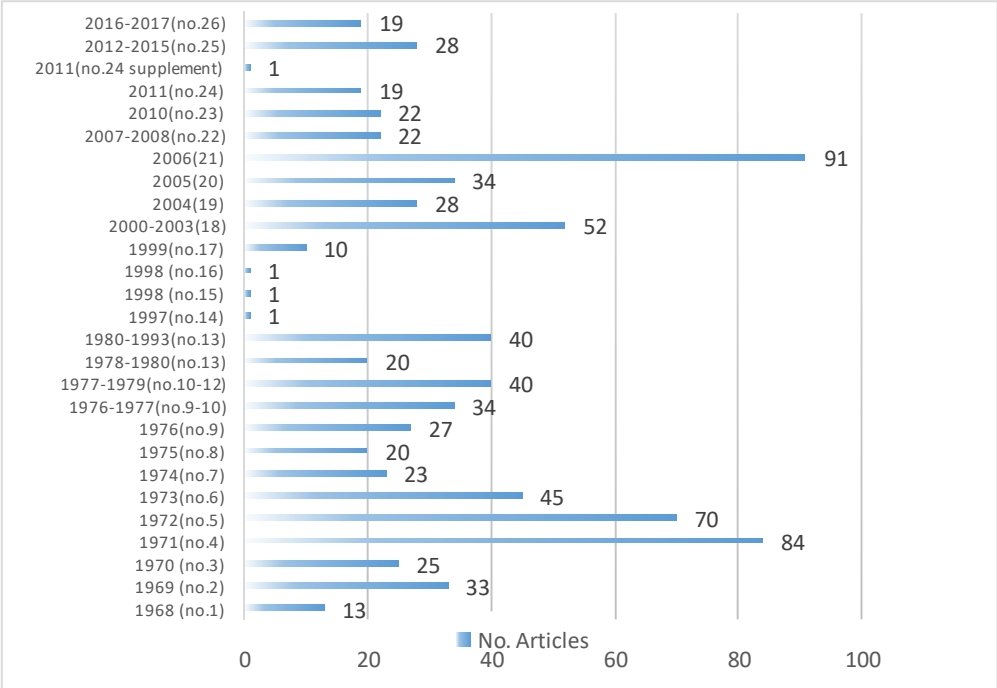

Fig. 3 - Number of articles per volume / year (period) of publication

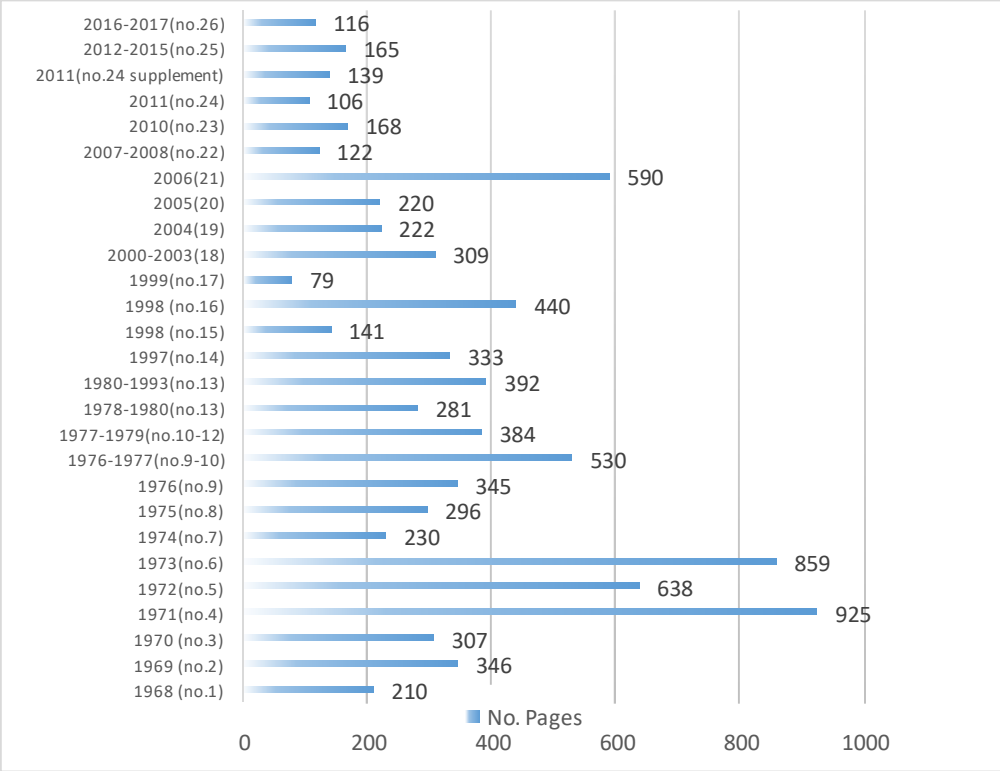

Fig. 4 - Number of pages per volume / year (period) of publication

COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2018	Vol. 27: 67-71

THE VALORISATION OF THE MUSEUM HERITAGE THROUGH CULTURAL AND EDUCATIONAL ACTIVITIES (2015-2018)

ANCA TUDOR ANDREI, DALIA PARASCHIV, LACRAMIOARA ZAHARIA, IRINA ARDEI, BOGDAN TOMOZII, FLORIN TOFAN*

ABSTRACT

„The calendar of the nature” - project implemented at the initiative of a group of curators who have developed cultural-educational activities in the museum.

Nature calendar data are events celebrated around the world in order to highlight the environmental problems.

Considering the interest shown by the public for the cultural-educational activities organized by the museum, we realized that the implementation of this project gives us the opportunity to value the items in the museum heritage to educate the public towards knowing and protecting nature.

Key words: museum heritage, educational activities, valorisation

Introduction

The museum is a permanent institution, in the service of the community, opened to public, whose object of activity is collecting, preserving and exhibiting cultural assets, which are of scientific, historical, artistic, technological or other value. Therefore, according to the definition of the museum, one of its main functions is the valorization of the assets held in order to be studied by specialists, but also for educating the public.

In the current context, the museum becomes an important factor in the educational act. The museum collections is a reservoir of resources which can backup and broaden the school pedagogical sequences and can become an extra-educational environment, complementary to the school education. The school-museum partnership guarantees a complete education by combining the formal character of school didactic methods with the non-formal one wich is characteristic of the education offered through museum activities.

The public can have access to the museum patrimony through permanent and temporary exhibitions that they can visit, but also through participation in cultural-educational activities with multimedia presentations or workshops, organized in the museum. Designing these activities is always a challenge for museum specialists, because it is necessary to identify optimal and interactive communication strategies with the public in order to achieve the established educational objectives. Such relationships with the public are a means by which pieces of heritage in the museum's collections, which are not exhibited, can be presented /valued. Thus appears the opportunity to draw attention to the assets in museum collections that are not included in the exhibition themes.

Through this sort of interaction with the public, in addition to exhibiting collections which delight the eye and entice the visitors, the contemporary museum becomes an institution that actively promotes both culture and education.

Materials and methods

In 2015 we initiated a project called „*The calendar of the nature*", through which we organized in partnership with kindergartens, schools and high schools, cultural-educational activities and workshops in order to celebrate different ecological events of national and international importance. These events were selected from the calendar of nature, in agreement with the project partners, and taking into account the specificity of the collections we have available.

The events celebrated by activities carried out in this project were the following:

- World Wetlands Day (4 activities) - 2 February
- The Forest Month (10 activities) 15 March – 15 April
- World Water Day (3 activities) - 22 March

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~ International Bird Day (1 activity) - 1 Aprilie
~ World Migratory Bird Day (3 activities) - 10 May
~ Earth Day (1 activity) - 22 April
~ International Day for Biological Diversity (7 activities) - 22 May
~ World Environment Day (6 activities) - 5 June
~ World Maritime Day (1 activity) - 25 September
~ World Habitat Day (3 activities) - 1 October
~ World Animal Day (7 activities) - 4 October
~ World Food Day (1 activity) - 16 October
~ International Black Sea Day (3 activities) - 31 October

The material resources consisted of authentic and auxiliary cultural assets in the museum's patrimony.

Authentic pieces, being original cultural assets, are the most important instruments for transmitting information to the public in order to establish interactions and to create emotions. These goods were presented through interactive methods, which facilitated both the assimilation of theoretical notions, as well as the formation of analysis and synthesis skills.

Photo 1 - International Bird Day – "Crai Nou" Kindergarten

Photo 2 -International Day for Biological Diversity "Al. I. Cuza" Secondary School

Authentic specimens from botanical and zoological collections were used, which are not exposed to the public:

~ herbarized specimens of algae and vascular plants;
~ thematic insectaries from the entomology collection;
~ shells and snails from the malacology collection;
~ wet preserved fish species;
~ wet preserved species from herpetology collection;
~ naturalized birds from the ornithology collection;
~ naturalized mammals from the mammal collection.

Photo 3 - International Black Sea Day –

Photo 4 - World Environment Day –

„Al. cel Bun” Secondary School

The activities were carried out with the pupils of different ages: preschools and students of primary, secondary and high school. The authentic pieces were selected taking into account the type of perception specific to each age.

Photo 5 -International Day for Biological Diversity – “Ion Ghica” College

Different types of molds were used for the interactive activities. Thus, the public was able to make observations on molds of animals (amphibians, reptiles), patterns of plant morphology (molds of different flowers and sections through vascular plant organs) and molds of human body anatomy. These materials have been useful both for highlighting the criteria for identifying some species of plants and animals, as well as for understanding their physiology and etiology.

To ensure the interactive character of the educational endeavor, were developed tasks which consisted of laboratory work, in which specific techniques and equipment were used. The students showed a special interest for this type of activity, during which they acquired skills of making microscopic preparations and observing them, learning to manipulate the laboratory instruments, the microscope and the stereomicroscope.

The auxiliary materials are ideal for the study because they offer the advantage of making repeated observations, using simultaneously the visual perception of detail and tact, without risking damage the authentic piece. Also, with the help of the auxiliary materials, the macro- and microscopic details of cytology and histology can be highlighted, which are more difficult to observe on authentic piece.

The multimedia materials made were communication tools for theoretical information, being designed in such a way to stimulate as much as possible the assimilation capacity and mental processing of the information, in different categories of public.

To obtain optimal results we used specific teaching methods (observation, description, modeling, comparison, problematization, etc.), to which were added many interactive activities.

“G. Vrânceanu” College

Another category of materials used in cultural-educational activities is auxiliary pieces. Some of them represented the theoretical support, designed according to the topics approached, in the form of Power Point presentations, videos and games for the magnetic board.

Photo 6 -To know the human body – “G. Vrânceanu” College

Workshops with microscopy themes included execution of microscopic preparations with plankton samples and sections through vascular plant organs.

The interactive tasks included in the cultural-educational activities were:

~ games on magnetic board (solving thematic integrals, creating trophic chains, ecological themed puzzles, etc.);
~ studying the anatomy of plants, animals and humans on molds;
~ olfactory identification of some species of aromatic plants.

Purpose and objectives

The cultural-educational activities gives us the opportunity to educate the public in the sense of knowing and protecting nature, valuing the assets of the museum's heritage.

The aim of the project was to involve the young generation in the process of ecological education, by valuing the assets from the patrimony of the museum, which are not found in permanent and temporary exhibitions.

The objectives of the project were the following:

1. Knowing and understanding the value of the museum heritage;
2. Presentation of cultural assets that are not accessible to the public in the exhibitions;
3. articipation of the museum in educating children and adolescents for the protection of the environment;
4. Creating a favorable context for discovery the young people interested in the museum field of activity.

Results and discussion

By carrying out the activities included in the project, we have exploited authentic cultural assets from 7 collections in the museum's patrimony (algology, vascular plants, entomology, malacology, fish, ornithology, mammalogy).

The project implementation team managed to create a series of multimedia materials that can be used in educational activities:

~ 15 biology themed PowerPoint presentations;

~ 12 translated films;

~ applications for magnetic board (10 integrals, 6 puzzles, 7 trophic chains).

The implementation of the project „*The calendar of the nature*" consisted of 47 cultural-educational activities, in which 2917 children and adolescents were involved. The age group best represented in this sample of audiences was the high school students (Fig.1). Most of the visitors (91%) come from urban schools (Fig. 2).

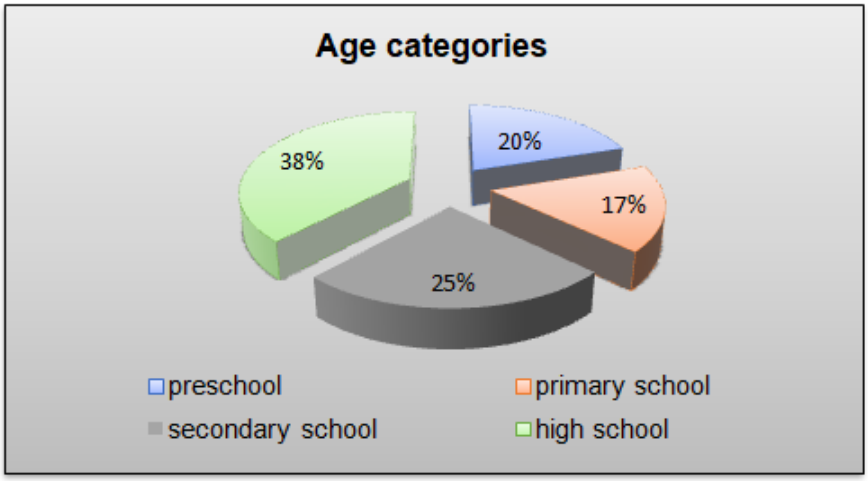

Fig. 1 - Participants in activities by age categories

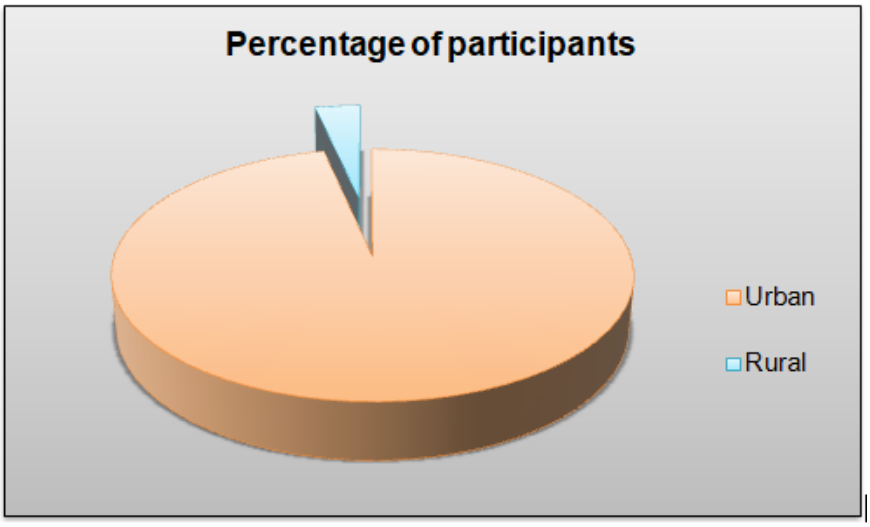

Fig. 2 - Participants in activities by urban/rural provenance

The public who participated in these activities was especially interested in the events organized under the theme „Forest Month", which took place every year, from March 15 to April 15. Also, they presented interest and topics addressed for the celebration of the data of May 22 - „International Biodiversity Day" and October 4 - „World Animal Day" (Fig.3).

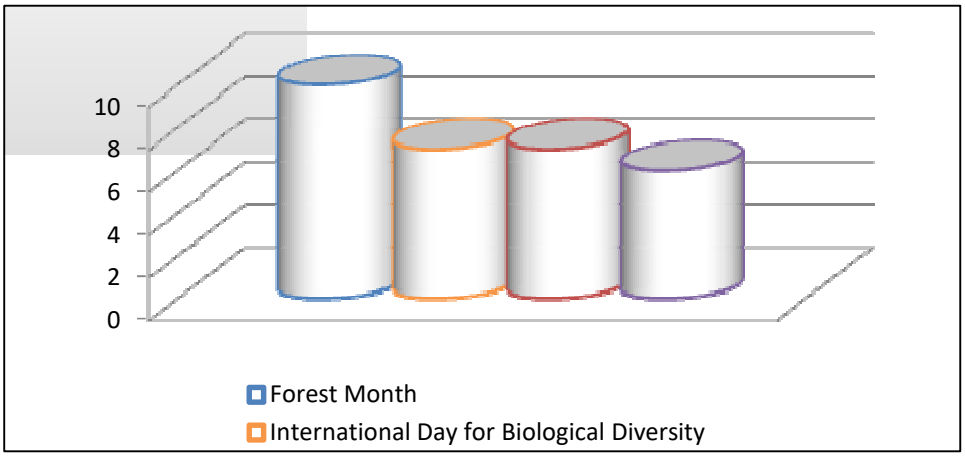

Fig. 3 – The public preferences regarding the topics proposed

Conclusions

Analyzing the results obtained after the implementation of the project „*The calendar of the nature* " and comparing them with the purpose and objectives proposed, we notice the positive effect generated for both parts the museum and society. The cultural-educational activities become a means of promoting the museum heritage. In this way, the public can receive information about the living world and the importance of protecting biodiversity, the museum becoming an ideal partner for schools in the act of education. The non-formal character of museum education complete the teaching in school thus the pupils grow into an active, involved and conscious members of the future society.

The cultural-educational activities included in the project, increased the performance indicator regarding the number of visitors of the institution.

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COMPLEXUL MUZEAL DE ŞTIINŢELE NATURII „ION BORCEA” BACĂU

STUDII ŞI COMUNICĂRI 2018	Vol. 27: 72-74

IN MEMORIAM – CURATOR CONSTANTIN TĂRĂBUȚĂ (1933 - 2003)

Bogdan TOMOZII*, Petruța BLIDIRIȘANU**, Maria APETREI***, Cătălina IVAN**

ABSTRACT

Constantin Tarăbuță was born on March 26th, 1933 in the commune Pufești, Vrancea County. After completing the university studies he moved to Roman in 1962, where encouraged by Professor Iulian Antonescu, a well-known Romanian cultural figure, participates at the foundation of the Museum of Natural Sciences, under the coordination of the historian dr. Vasile Ursachi and with the direct support of the local authorities. During his more than 30 years of work, the curator Constantin Tărăbuță together with his colleagues carries out a fruitful museum activity constituting a valuable patrimony, which has placed the Museum of Natural Sciences from Roman among the recognized cultural institutions in Romania.

Key words: Constantin Tarăbuță, curator, museum founder, natural science, Roman

Fig. 1 – Curator Constantin Tărăbuță in his late 60s.

In 2017, we celebrated 55 years since the foundation of the Museum of Natural Sciences from the city of Roman and 14 years since the passing away of its founder, curator Constantin Tărăbuță, a well-known personality of the city cultural life.

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** Museum of Natural Sciences Roman
*** Museum of Natural Sciences Piatra Neamț

Constantin Tarăbuță was born on March 26th, 1933 in the commune Pufești, Vrancea county. He attended the Faculty of Biology of the University “Al. I. Cuza” Iași, promotion 1959. He marries with Mrs. Teodora Tărăbuță, who will work as a biologist at the Plant Protection Directorate, with whom he will have two sons, Octavian Tărăbuță (1966) and Radu Tărăbuță (1977-2004). After completing his university studies he returns to his native places, wishing to establish a Museum of Natural Sciences in Adjud. He begins his activity by initiating the collections necessary to arrange future exhibitions. In 1962 he moved to Roman city, encouraged by Professor Iulian Antonescu a well-known Romanian cultural figure, to participate in the setting up of the Museum of Natural Sciences, under the coordination of the historian dr. Vasile Ursachi and with the direct support of the local authorities. The museum is arranged in the street Alexandru cel Bun no. 5, in the former house of Dr. Alexandru Theodori, the first director of the city Hospital, in a space composed of 8 rooms and a piece of land of approx. 5 ha destinated for a zoo. Here the museum worked until 1997.

A modest first temporary exhibition is organized, both from thematic and informational point of view. With reduced financial possibilities, but with passion, dedication and sustained work, the young curator lays the foundation of the Entomology collection, which in 1968 already numbered 6500 specimens, the most numerous belonging to Order Coleoptera (3520 specimens), followed by Order Lepidoptera (2000 specimens).

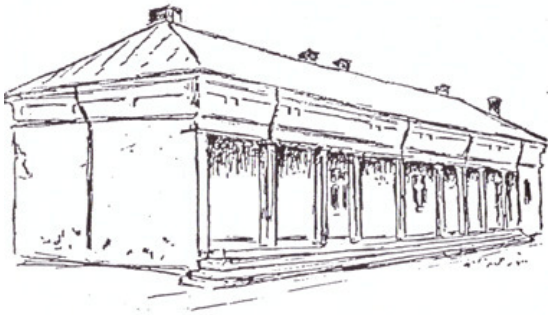

Fig. 2 – The building of the Museum of Natural Sciences from Roman between 1962-1997 (the former house of Dr. Alexandru Theodori and the establisment of "Bishop Melchisedec" Foundation) (1849).

The first 150 naturalized pieces are also purchased, to which is added a collection of live animals belonging to the Zoological Garden arranged in the courtyard of the museum. The Zoo Park is constituted between 1963-1967 and includes species found in the forests near the Roman city: roe deer, wild boar, wild cat, wolf, day and nocturnal birds of prey. To these are added some exotic species: dingo dog, Cameroon goat, yak. The botanical collection with the first 1000 herbarium sheets is also initiated, totaling about 350 species.

Under the coordination of the young curator Constantin Tărăbuță, only 2 years after the museum was founded, in 1965, the first permanent exhibition opens, on an area of 300 square meters, with a theme that highlights the diversity of flora and fauna of the Siret river meadow and from Central Moldovan Plateau. In carrying out this exhibition, the staff of the Museum of Natural Sciences of Piatra Neamț was also involved, coordinated by Dr. Mihai Ciobanu. The exhibition was organized on modern ecological criteria, the species of flora and fauna from the representative ecosystems being presented to the visiting public through dioramas, thematic showcases, color slides and maps exceptionally executed.

Temporary exhibitions are also organized that address a variety of topics. Within the museum, a section of Vivarium is set up in an annex building, where exotic ornamental birds and species of singing birds are displayed. This lively corner, animated the exhibition and represented a new attraction for visitors.

A good part of the time allocated to the museum activity, Constantin Tărăbuță dedicates it to the enrichment and diversification of the museum patrimony.

Fig. 3 - Curator Constantin Tărăbuță with colleagues, curator Petruța Bliderișanu, Filip Constantin, Alexandrina Stegaru, Maria Andrieș.

The patrimony consists of several collections (herbarium, mineral and malacology collection etc), of which the Entomology collection is distinguished by number of specimens. In the field of Entomology, his true passion, the curator Constantin Tărăbuță carries out a regular work of research that involves numerous trips to the field, from where he collects, prepares, identify and builds a collection of over 40,000 specimens coming in most part from the central area of Moldova. The Entomology collection consists mainly of Coleoptera species collected from various habitats. This includes rare species, as well as species harmful to crop plants, forest, pastures and meadows. Nor is the botanical collection to be neglected, this amounting to the end of the 80s, 11,000 sheets of herbarium with numerous species of vascular plants gathered through the care of the curators dr. Felicia Monah and Petruța Blidirișanu.

Constantin Tărăbuță participates in various scientific events held in the country, where presents his contributions to the study of the insects fauna of the Roman city and its surroundings. In collaboration, he compiles the collections catalogues of some families of Coleoptera from the

patrimony of the Museums of Natural Sciences from Roman, Piatra Neamț and Bacău.

We can not overlook another side of his personality, that of a teacher. The curator Constantin Tărăbuță had a real teaching talent, appreciated by generations of visitors who stepped on the threshold of the museum. He participates as a lecturer in the professional training programs of the specialized personnel in the museums of the natural sciences, where he shares with the new generations of museum workers his rich experience.

As his descendant in the realm of Jean-Henri Fabre, I remember how Constantin Tărăbuță, with the patience of the old school teacher, in front of a black Carl Zeiss Stereo Microscope and of an open insects box from his rich collection, guides you step by step through the maze of the insects identification keys, towards the correct taxon. The boxes made of purple cardboard were hiding priceless entomological treasures, which you were waiting to discover, with every visit to his office. This collection reveals a huge amount of work, of collection, preparation and systematic arrangement, as only a true professional can do it.

Sometimes, the teacher organized trips to Siret river meadow or closer to the museum, in the bishopric orchard. Here, passing through the narrow stone gate, we discovered a small paradise garden, sheltered by high stone walls from curious eyes. Near the ponds with weeping willows, the teacher presents a new entomology lesson, holding between his fingers a longhorn beetle, of a bright green copper with the smell of musk, discovered in the scraps of an old willow. At the same time, the teacher revealed to his apprentice various methods of collecting insects, using the entomological net or Barber soil traps. With patience and talent, Constantin Tărăbuță inoculated in the young companion, unconscious, the love for Entomology.

The activity of organizing and guiding the cultural and scientific life of the Museum of Natural Sciences from Roman, carried out by Constantin Tărăbuță, would not have been possible without the contribution of his colleagues, who worked alongside the curator, to the completion of the museum as a recognized institution in the Neamț county cultural environment.

We mention here the curators: dr. Felicia Monah, Mihai Popa, Victor Apihtin, Mariana Bordeianu (Păltineanu), Margareta Bădoi (Titarev), Ileana Călărășanu, Cătălina Ivan, Filip Chirila, custodian Alexandrina Stegaru etc. Substantial help in the creation of the exhibitions also comes from the collaboration with other museum institutions such as: Piatra Neamț Museum of Natural Sciences, „Ion Borcea" Natural Science Museum Complex, Bacău, "Grigore Antipa" National Museum of Natural History, Bucharest.

A special place between the colleagues of the curator Constantin Tărăbuță is held by Professor Petruța Blidirișanu who, since her arrival in the museum, in the mid-80s, often takes over the institution's burden, contributing with devotion and significant efforts to the enrichment and conservation of the patrimony and to the unfolding of scientific, educational and cultural activities in proper conditions. The curator Petruța Blidirișanu together with her colleague Cătălina Ivan participates in the reorganization of the permanent exhibition in a new space, in the house of the family Morțun on Stefan cel Mare street no. 244, exhibition opened in 1999. Here the museum will operate until 2011.

Today, the legacy of the predecessors is managed by a new generation of curators, head of section Cătălina Ivan and Gabriela Vârgă in a new building located in the beautiful park of the Roman city.

During his more than 30 years of work, the curator Constantin Tărăbuță together with his colleagues carries out a fruitful museum activity constituting a valuable patrimony, which placed the Museum of Natural Sciences from Roman among the recognized cultural institutions in Romania.