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NEW RECORDS OF *HARMONIA AXYRIDIS* (PALLAS, 1773) (COLEOPTERA: COCCINELLIDAE) IN ROMANIA

Melania STAN*

Abstract. *The paper presents new records for Harmonia axyridis (Pallas), respectively from Buzău, Prahova, Giurgiu counties and Bucharest. The species was first recorded in Romania in 2009, but we consider the Asian ladybird beetle now more common than mentioned in previous publications. There is not a deliberate introduction of this species in Romania; probably the species expands the areal to the east of country.*
Keywords*: Asian lady beetle, non-native species, new faunistic data, variation of elytral and pronotal spot patterns.*

Rezumat. *Lucrarea prezintă noi semnalări ale speciei Harmonia axyridis (Pallas), respectiv din județele Buzău, Prahova, Giurgiu şi municipiul Bucureşti. Deşi semnalată în România din 2009, apreciem că buburuza asiatică este mult mai răspândită la noi decât o arată publicațiile anterioare. În România nu există o introducere controlată a acestei specii, probabil specia şi-a extins arealul către estul țării.*
Cuvinte cheie*: Buburuza asiatică, specie exotică, noi date faunistice, spectrul de variabilitate al desenului elitrelor şi pronotului*

Introduction

A lot of papers (Adriaens *et al*. 2003, Koch, 2003) deal with different aspects of the Asian lady beetle, *Harmonia axyridis* (Pallas): morphology, geographical variation, habitat preferences, phenology, distribution, use as a biological control agent. It is a non-native species to the Romanian fauna. *Harmonia axyridis* is native in southern Siberia, Manchuria, China, Formosa, Korea, Japan, Ryukyu Islands and the Bonin Islands (Chapin, Brou, 1991, 630). A chronology of the spreading of this species is given by Brown *et al.* (2008). In 1916 the Asian lady beetle was introduced in North America to be used as a classical control agent of aphids and coccids. In 2002 it has been recorded in South America (Koch *et al*. 2006). In Europe, it was deliberately introduced in Ukraine and Belarus. Other European countries introduced *Harmonia axyridis* as a biological control agent: Belgium, Czech Republic, France, Germany, Greece, Italy, The Netherlands, Portugal, Spain and Switzerland. In other European countries *Harmonia axyridis* has been found in the wild without evidence of deliberate introduction: Austria, Denmark, Great Britain, Liechtenstein, Luxembourg, Norway and Sweden.

The species is considered an invasive in Europe and North America (Brown *et al*. 2008, 5). For example, in Belgium, the species was used as a biological control agent from 1997. In autumn 2001 was first found in wild, the invasion probably originated from populations in the north of country. By 2003, *H. axyridis* was invading semi-natural ecosystems (Adriaens *et al*. 2003), being most commonly in garden, parks, road verges, forests and woodland fringes and also occurred in healthlands, meadows and wetlands. By 2006, the species was recorded in all regions of Belgium. (Adriaens *et al*. 2008).

In the next years the species was mentioned from Poland, Hungary, Serbia, Slovakia, Bosnia and Herzegovina (Kulijer, 2010, 141) illustrating further expansion.

Material and methods

The specimens were collected directly from the herbaceus vegetation of Buzău river bank and from walls of houses. These are some loose incidental observations.

Results and discussion

Harmonia axyridis was collected in Romania from Oradea (10.04.2009) and Gurani (02.08.2009), these being the first records of the Asian lady beetle for Romania (Markó, Pozsgai, 2009, 490). Other collecting sites where the Asian lady beetle was found are Băița (Hunedoara county) and Baia Mare (Maramureş county) (Ruicănescu, Alexandru, 2009, 155). *H. axyridis* was observed and collected from other four new collecting sites (Tab. 1). The distribution of this species in

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Romania based on the published records and examined material is given in Fig. 1.

The Romanian lady beetles fauna comprises two species of *Harmonia*, *H. quadripunctata* (Pontoppidan, 1763) and *H. axyridis* (Pallas).

A diagnosis of *Harmonia axyridis* is given by Chapin, Brou (1991). The species is highly polymorphic, showing a lot of variation in elytral and pronotal spot patterns. However, two external morphological characters are diagnostics. The transverse plica anterior to the elytron apex („keel") is usually present and a constant character, the presence of a carina on the intercoxal process of the prosternum. The carina is absent at the specimens of *Harmonia quadripunctata*. The pronotum shows up to five black spots shows lateral spots joined to form two curved lines, an M-shaped mark, or a solid trapezoid. Another diagnostic character is the typical black belly centre with clear orange border.

The collected specimens belong to *H. axyridis* f. *succinea*. Variation of elytral and pronotal spot patterns from unspotted to the typical one is presented in Fig. 2. The specimens present different colours, from light yellow to light brown, and one of them is melanic (Fig 2 f). The length of studied specimens: 5 – 7.5 mm.

In the literature this species is mentioned as semi-arboreal, it occupies many habitats: heathlands and riparian zones, reed beds and crop systems (Adriaens *et al*. 2008).

H. axyridis is a polyphagous species preying mainly on aphids but can also feed on eggs and larvae of other insects. It feeds not only on pests but also on beneficial insects such as immature stages of other coccinellids, lacewings, butterflies and hoverflies (Kulijer, 2010, 141).

The records give new data on the distribution of *H. axyridis* in Romania. The studies on *Harmonia axyridis* are at the beginning in Romania. It is clear that the species was not deliberate introduced. First record in wild was in 2009 in the west of the country. In only 1-2 years the species has expanded the areal to the central and east of Romania (taking into account previous articles and personal records). For example, *Coccinella septempunctata* was frecquently observed in Cluj, in 2009, while in 2010 the majority of the specimens belong to *Harmonia axyridis* (A. Ruicănescu, pers. com.). Also, in Mehedința (Prahova County) I have observed the adults and larvae of *Harmonia axyridis* in 2011. Here, the species has become more common than *C. septempunctata* or *Adalia bipunctata*, being a threat for native aphid predators.

Collected specimens are deposited in the Coleoptera collection of the „Grigore Antipa" Natural History Museum, and the species is new for this collection.

Acknowledgements

I am grateful to Dr. Tim Adriaens (Belgium) for his helpful and constructive comments on my manuscript and some stylistic suggestions to improve the manuscript. I wish to thank to George Năzăreanu for the *Harmonia axyridis* photos and to Dr. Alexandru Iftime for drawing the distribution map using Arc View GIS version 8.3. I also thank to Dr. György Makranczy who sent me the article describing the first *H. axyridis* for the Romanian fauna.

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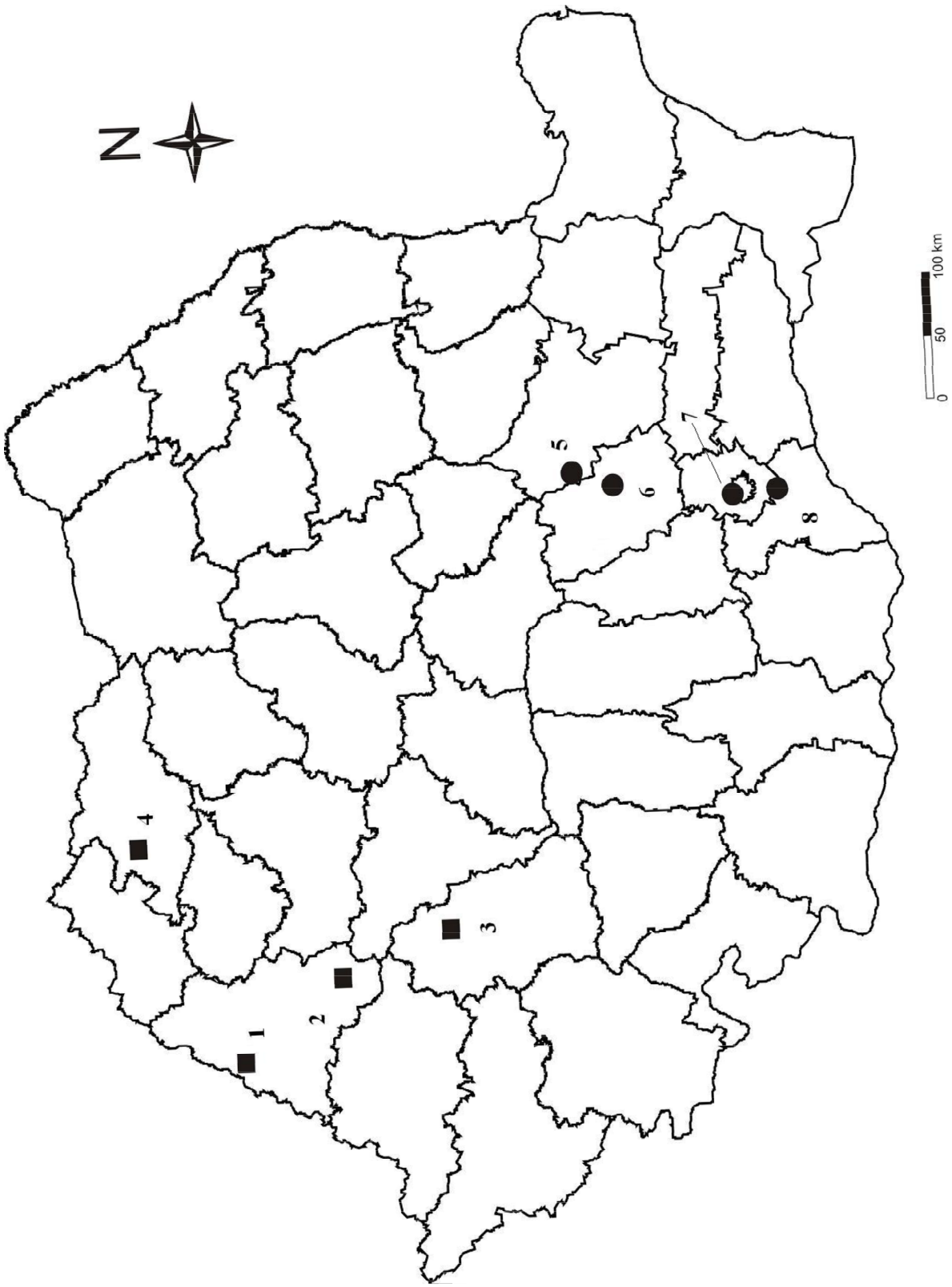

Fig.1. Distribution of *Harmonia axyridis* (Pallas) in Romania

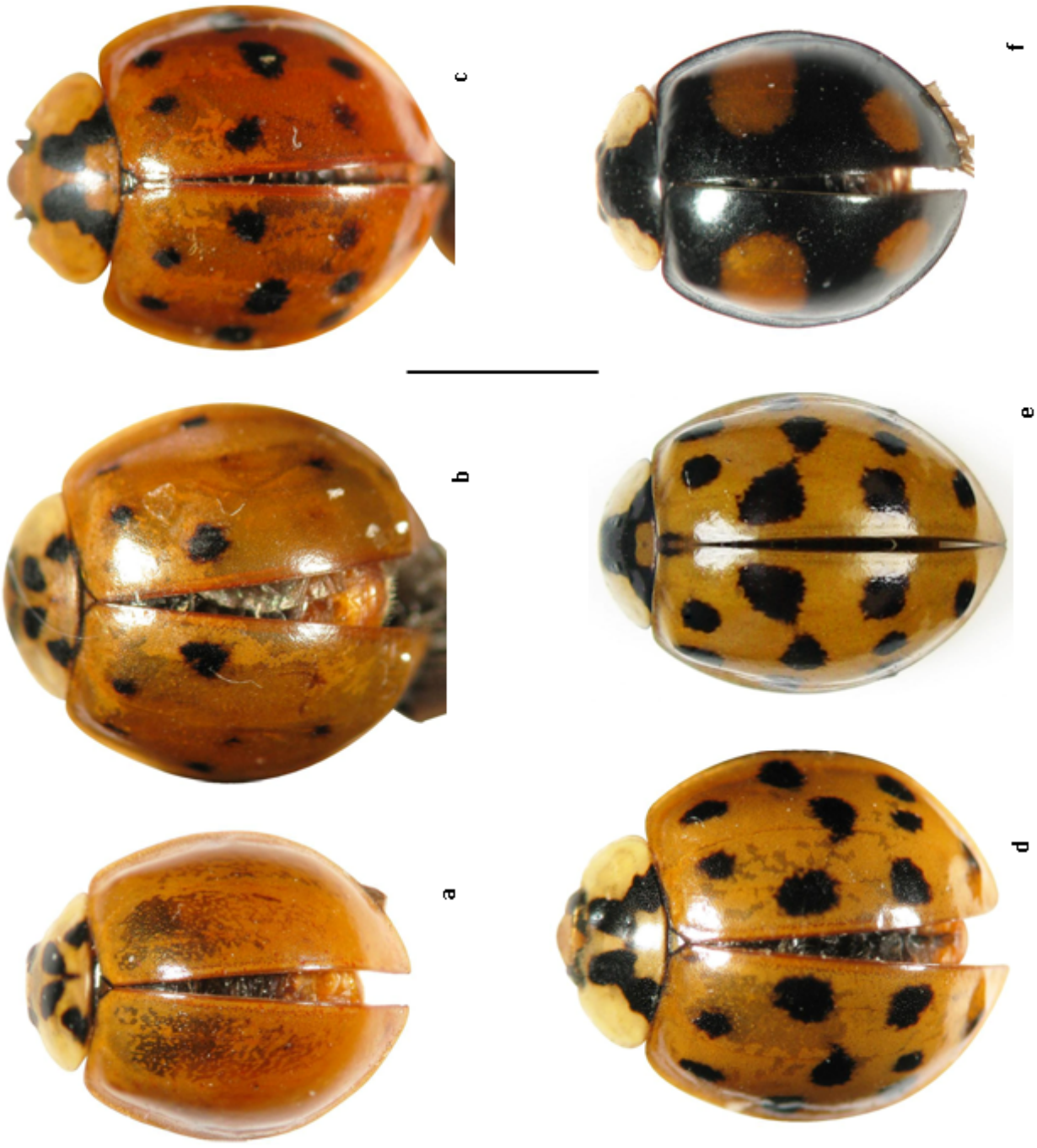

Fig. 2. a–f *Harmonia axyridis* (Pallas) – variation of elytral and pronotal spot patterns

Tab. 1. Collecting sites for *Harmonia axyridis* (Pallas).

Species	No. of Specs.	Collecting date	Coordinates	Description of finding	Habitat
Harmonia axyridis (Pallas)	1	Valea Seacă, Pătârlagele, Buzău county, 07.07. 2010	N: 45º16. 653´, E: 026º21.605´	specimen drew the attention through its size and the color of the elytra	herbaceous vegetation on the Buzău river bank, semi-natural habitat
Harmonia axyridis (Pallas)	1	Valea Seacă, Pătârlagele, Buzău county, 13.07. 2010	N: 45º16. 653´, E: 026º21.605´	visual search	herbaceous vegetation on the Buzău river bank, semi-natural habitat
Harmonia axyridis (Pallas)	16	Mehedința, Podenii Noi, Prahova county, 24.10.2010	N: 45º05.467´, E: 026º12.174´	drew attention the big number of specimens which climbed up the house wall searching for an overwintering site on a sunny autumn day	urbanised landscape (village)
Harmonia axyridis (Pallas)	1	Bucharest, 15.11.2010	N: 44º27.194´, E: 026º05.085´	opening windows	urbanised landscape (city)
Harmonia axyridis (Pallas)	6	Adunații Copăceni Giurgiu county, 30.10.2010	N: 44º15.885´, E: 026º02.472´	drew attention the specimens which climbed up the house wall on a sunny autumn day	urbanised landscape (village)
Adalia bipunctata (Linnaeus)	2	Valea Seacă, Pătârlagele, Buzău county, 13.07. 2010	N: 45º16. 653´, E: 026º21.605´	visual search	herbaceous vegetation on the Buzău river bank, semi-natural habitat
Adalia bipunctata (Linnaeus)	7	Mehedința, Podenii Noi, Prahova county, 24.10.2010	N: 45º05.467´, E: 026º12.174´	drew attention the number of specimens which climbed up the house wall on a sunny autumn day	urbanised landscape (village)
Coccinella septempunctata Linnaeus	1	Valea Seacă, Pătârlagele, Buzău county, 13.07. 2010	N: 45º16. 653´, E: 026º21.605´	visual search	herbaceous vegetation on the Buzău river bank, semi-natural habitat
Oenopia conglobata (Linnaeus)	1	Mehedința, Podenii Noi, Prahova county, 24.10.2010	N: 45º05.467´, E: 026º12.174´	drew attention the specimens which climbed up the house wall on a sunny autumn day	urbanised landscape (village)

* All the specimens are adults

BIOACOUSTICS IN BUSH-CRICKETS, CRICKETS AND GRASSHOPPERS (INSECTA: ORTHOPTERA) FROM CIUCAŞ MOUNTAINS (EASTERN CARPATHIANS, ROMANIA)

Ionuț Ștefan IORGU[*]
Elena Iulia IORGU[**]

Abstract. *An investigation on bush-crickets, crickets and grasshoppers (Orthoptera) ethology in Ciucaş Mountains took place during 2008-2011 and the results are presented in this paper. It is an already known fact that the majority of Orthoptera can be easily identified by listening to their particular calling songs, so the oscillographic and spectrographic sound analysis for 36 species is detailed: 19 bush-crickets, 3 crickets and 14 grasshoppers.*
Keywords*: Orthoptera, bioacoustics, Ciucaş Mountains*

Rezumat. *În lucrare sunt prezentate rezultatele studiului autorilor asupra etologiei cosaşilor, greierilor şi lăcustelor din Munții Ciucaş, în perioada 2008-2011. Este bine ştiut faptul că ortopterele pot fi identificate uşor ascultându-le stridulația specifică, aşadar detaliem analiza oscilografică şi spectrografică pentru 36 de specii: 19 cosaşi, 3 greieri şi 14 lăcuste.*
Cuvinte cheie*: Orthoptera, bioacoustică, Munții Ciucaş*

Introduction

Ciucaş Mountains, the southern part of the Eastern Carpathians, cover a relatively small area - but are very rich in natural beauty. To the south of the highest Peak, Ciucaş (1954 m) there are several notable cliffs: Tigăile Mari, Tigăile Mici, Babele la Sfat, Turnul lui Goliat, Mâna Dracului. A little farther to the South-east raises the sharp ridge Zăgan - Gropşoarele (alpinet.org, 2011). Despite the relatively low altitude, the Ciucaş Mountains impose themselves among the surrounding mountains, lower in altitude and completely different in aspect: Grohotiş Mountains towards West and Siriu Mountains towards East, both bald and grassed (Hera, 2007). It consists of Cretacic conglomerates made from crystalline, sedimentary (limestone) or eruptive-basaltic elements, linked by a limestone-gresous cement.

Ciucaş Mountain is listed as a special area of conservation in the Romanian „Nature 2000" network. The subalpine meadows are successively surrounded by relict spruce and larix forests, both pure and mixed, followed by mixed coniferous and deciduous forests, and pure beech forests. Ciucaş Mountains includes an important biological and ecological diversity that has an incomplete inventory.

Until the present study, no other faunistic data was available on the Orthoptera inhabiting these mountains. As an already known fact, most of the singing Orthoptera can be easily identified by simply listening to their particular calling songs. In many cases, an oscillographic and spectrographic sound analysis is required in order to separate sister-species and it proves to be very reliable in case of the morphological cryptic ones.

Material and methods

Since 2008, we performed systematic expeditions in Ciucaş Mountains, during which a new species of *Isophya* was discovered and described from this area (Iorgu, Iorgu, 2010).

Audio recordings were taken with the digital audio recorders SONY ICD SX56 and EDIROL R-09HR, the latter having a frequency response of 20-40.000 Hz. Due to those recording conditions and as most of the species have frequencies ranging above 40 kHz, we could not determine the maximum peak in all cases. Sound analysis was performed with the software Audacity 1.3 and Batsound 4. All recordings of Caelifera were taken from males with only one posterior leg, so that the oscillogram analysis could be better understood. Also the air temperature was registered during each recording.

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For the oscillogram analysis we used the terminology from Ragge, Reynolds (1998) and Heller *et al.* (2004): *calling song* - song produced by an isolated male; *syllable* - the sound produced by one to-and-fro movement of the stridulatory apparatus; *echeme* - a first-order assemblage of syllables; *impulse* - the highly damped sound impulse arising as the impact of one tooth of the stridulatory file; *after-click* - click produced with considerable delay after the main impulse group.

Results

In this study, 36 Orthoptera species were audio recorded: 19 bush-crickets, 3 crickets and 14 grasshoppers. A detailed oscillographic and spectrographic analysis was performed for each of them. Only frequencies in the interval 0.02-40 kHz were considered.

Suborder Ensifera
Family Phaneropteridae

***Phaneroptera falcata* (Poda, 1761)**
Audio recorded material: 2♂♂, Cheia, 05.09.2011 (19°C).
Bioacoustics. The species sings in the evening and at night during the summer; in autumn it can be heard also during daytime. Males sing isolated syllables or echemes formed of 11-14 syllables. Syllables usually last for about 79-96 ms and echemes for about 1200-1600 ms. Spectrographic analysis of the sound: maximum frequencies located between 15-33 kHz, with highest peak at 21 kHz (Figs. 1a, 2a, 7, 8, 9a).

***Leptophyes albovittata* (Kollar, 1833)**
Audio recorded material: 1♂, Cheia, 29.07.2011 (26°C).
Bioacoustics. This bush-cricket sings mainly in the afternoon and at night. 9 up to 18 impulses form a syllable that lasts for 23-45 ms, with the maximum frequencies in the range of 20 kHz and up to more than 40 kHz (Figs. 1b, 2b, 7, 8, 9b).

***Isophya camptoxypha* (Fieber, 1854)**
Audio recorded material: 3♂♂ 2♀♀, Muntele Roşu Peak, 27.06.2008 (24ºC); 5♂♂ 2♀♀, Muntele Roşu cabin, 18.07.2009 (27ºC); 7♂♂ 1♀, Muntele Roşu Peak, 21.08.2009 (25ºC); 5♂♂, Muntele Roşu cabin, 17.07.2010 (24ºC); 6♂♂ 4♀♀, Muntele Roşu Peak, 13.08.2010 (26ºC).
Bioacoustics. Males sing mainly in the afternoon and at night with a long series of short syllables. We also recorded short bursts of 9-27 syllables that lasted for 12-25 s. Each syllable is formed of 8-16 impulses and lasts for 16-42 ms. Sometimes after-clicks can be observed, following the syllable at 17-51 ms. Maximum sound frequency ranges located at 25 kHz (Figs. 1c, 2c, 7, 8, 9c). between 17 and more than 40 kHz. Highest peak

***Isophya ciucasi* Iorgu & Iorgu, 2010**
Audio recorded material: 2♂♂, Ciucaş cabin, 27.06.2008 (24ºC); 3♂♂ 3♀♀, Ciucaş cabin, 17.07.2009 (27ºC); 19♂♂ 6♀♀, Tigăile Mari Peak, 17.07.2010 (24ºC); 7♂♂, Ciucaş cabin, 14.08.2010 (26ºC), 3♂♂, Tigăile Mari Peak, 29.07.2011.
Bioacoustics. We observed the species singing in the afternoon and at dusk. The song consists of short or long series of syllables, sometimes lasting more than 3 minutes. The short syllable (7-26 impulses, 9-24 ms) is always followed by a number of 13-29 after-clicks. The interval between successive syllables is about 320-600 ms. Acoustic frequency: maximum between 15 and more than 40 kHz, highest peak at about 20 kHz (Figs. 1d, 2d, 7, 8, 9d).

***Poecilimon affinis* (Frivaldsky, 1867)**
Audio recorded material: 2♂♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 4♂♂, Muntele Roşu cabin, 18.07.2009 (25ºC); 3♂♂, Muntele Roşu cabin, 21.08.2009 (25ºC); 2♂♂, Berii springs, 18.07.2010 (24ºC); 4♂♂ 1♀, Muntele Roşu Peak, 13.08.2010 (26ºC).
Bioacoustics. The species sings in the afternoon and evening, sometimes in the morning. A single, loud syllable, lasting for 125-294 ms, is repeated at regular time intervals - about 1.9-3 s. The calling song frequency ranges from 5-35 kHz, with maximum peak at about 16 kHz (Figs. 1e, 2e, 7, 8, 9e).

***Poecilimon schmidtii* (Fieber, 1853)**
Audio recorded material: 1♂, Cheia, 14.08.2010 (26ºC).
Bioacoustics. The species is also crepuscular, singing a variable series of syllables, from 2 up to more than 30. Each syllable is very short - consisting of 2-3 impulses. In a series, the time interval between successive syllables is about 1.3-2 s. The stridulation maximum frequency ranges between 10 and more than 40 kHz (Figs. 1f, 2f, 7, 8, 9f).

***Polysarcus denticauda* (Charpentier, 1825)**
Audio recorded material: 3♂♂, Muntele Roşu Peak, 19.07.2009 (27ºC); 5♂♂, Ciucaş cabin, 18.07.2010 (24ºC).
Bioacoustics. The species stridulates during daytime, especially in warm sunny days. The long series of syllables (repeated at a rate of about 14-17/s) is interrupted by a short series of 8-11 clicks

after variable time periods. The syllable rate tends to increase before the series of clicks, reaching about 35-50/s. There are 3 different periods in the syllable series, each characterized by diverse syllable types. Syllables normally last for about 37-44 ms; before the click series syllables last 19-25 ms. Sound frequency: maximum between 8-35 kHz, with a peak at 14 kHz (Figs. 1g, 2g, 7, 8, 9g).

Family Conocephalidae

***Conocephalus fuscus* (Fabricius, 1793)**

Audio recorded material: 2♂♂, 17.07.2009 (27ºC).

Bioacoustics. The species stridulates a long series of echemes during daytime and rarely at dusk. Each echeme is formed of 3 syllables and each syllable consists of 2 different hemisyllables; the opening hemisyllables are much shorter than the closing ones. Maximum audio frequency: 10 up to more than 40 kHz, highest peak at about 30 kHz (Figs. 1h, 2h, 7, 8, 9h).

Family Tettigoniidae

***Tettigonia viridissima* (Linnaeus, 1758)**

Audio recorded material: 2♂♂, Muntele Roşu cabin, 18.07.2010 (24ºC).

Bioacoustics. The Great Green Bush-cricket sings at dusk and during the first few hours of night; in late summer and autumn it also stridulates in daytime. The song is formed of a long series of disyllabic echemes, repeated at a rate of about 14-16/s and lasting for a few minutes. Carrier wave frequency ranges between 5 and up to more than 40 kHz, maximum peak recorded at about 12 kHz (Figs. 1i, 2i, 7, 8, 9i).

***Decticus verrucivorus* (Linnaeus, 1758)**

Audio recorded material: 1♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 3♂♂, Cheia, 17.07.2009 (27ºC); 2♂♂, Muntele Roşu cabin, 18.07.2009 (27ºC); 2♂♂, Cheia, 14.08.2010 (26ºC).

Bioacoustics. The species sings a long series of tetrasyllabic echemes in warm sunny days. In cloudy days it only sings isolated echemes. Each echeme lasts for about 38-50 ms and time interval between successive echemes is 47-65 ms. Frequency of the sound ranges between 6 up to more than 40 kHz; maximum frequency recorded at 12 kHz (Figs. 1j, 2j, 7, 8, 9j).

***Metrioptera roeselii* (Hagenbach, 1822)**

Audio recorded material: 1♂, Cheia, 17.07.2009 (27ºC); 4♂♂, Muntele Roşu cabin, 18.07.2010 (24ºC).

Bioacoustics. The species stridulate mainly during sunny days. The song is a long series of syllables, repeated at a rate of about 81-94/s. Sound frequency: 7 up to more than 40 kHz, with peak at 17 kHz (Figs. 1k, 2k, 7, 8, 9k).

***Metrioptera bicolor* (Philippi, 1830)**

Audio recorded material: 1♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 2♂♂, Cheia, 17.07.2009 (27ºC); 5♂♂, Muntele Roşu Peak, 19.07.2009 (27ºC); 1♂, Muntele Roşu cabin, 20.08.2009 (25ºC); 6♂♂, Ciucaş cabin, 18.07.2010 (24ºC).

Bioacoustics. The song can be heard during daytime and consists of a variable series of trisyllabic echemes, lasting for about 20-27 ms. Successive echemes are repeated after 15-20 ms. Acoustic frequency: 8 up to more than 40 kHz, maximum at about 20 kHz (Figs. 1l, 2l, 7, 8, 9l).

***Metrioptera brachyptera* (Linnaeus, 1761)**

Audio recorded material: 1♂, Cheia, 17.07.2009 (27ºC); 3♂♂, Muntele Roşu Peak, 19.07.2009 (27ºC); 4♂♂, Tigăile Mari Peak, 17.07.2010 (24ºC).

Bioacoustics. The calling song is a long series of tetrasyllabic echemes. Each echeme lasts for about 82-98 ms and the interval between successive echemes is 70-90 ms. Maximum stridulation frequency ranges between 10-40 kHz, highest peak at about 22 kHz (Figs. 3a, 4a, 7, 8, 9m).

***Platycleis albopunctata grisea* (Fabricius, 1781)**

Audio recorded material: 1♂, Cheia, 17.07.2010 (28ºC).

Bioacoustics. The calling song consists of a variable series of tetra- or pentasyllabic echemes; an echeme lasts for 250-300 ms and the period between two successive echemes is 420-480 ms. Audio frequency: 10-39 kHz, with maximum at about 18 kHz (Figs. 3b, 4b, 7, 8, 9n).

***Pholidoptera griseoaptera* (De Geer, 1773)**

Audio recorded material: 2♂♂, Cheia, 17.07.2009 (28ºC); 1♂, Berii springs, 18.07.2010 (24ºC); 1♂, Cheia, 29.07.2011 (26ºC).

Bioacoustics. Males sing in the afternoon, at dusk and during the night. The song consists of very short echemes, repeated at irregular time intervals. Each echeme is composed of 3 syllables, lasting for about 80-110 ms. Calling song frequency ranges between 7 up to more than 40 kHz, with a peak at about 25 kHz (Figs. 3c, 4c, 7, 8, 9o).

***Pholidoptera fallax* (Fischer, 1853)**
Audio recorded material: 1♂, Muntele Roşu cabin, 17.07.2010 (24ºC).
Bioacoustics. The song is rarely produced during daytime, but mainly at dusk. The echeme structure is similar with *Pholidoptera griseoaptera*, each echeme being composed of 3 syllables. In a syllable, the sound amplitude constantly raises from beginning to the end. Echemes are short, of about 50-90ms. The frequency of sound ranges between 8 and more than 40 kHz, with the highest peak at 12 kHz (Figs. 3d, 4d, 7, 8, 9p).

***Pholidoptera littoralis similis* (Brunner von Wattenwyl, 1861)**
Audio recorded material: 3♂♂, Babarunca, 21.08.2009 (25ºC).
Bioacoustics. The species sings during daytime, at dusk and at night. The echeme is long, lasting for 1.1-1.9 s. It consists of 21-33 syllables, each syllable lasting for about 19-23 ms. Echemes are repeated at irregular time periods. Acoustic frequency is between 5 and more than 40 kHz; highest peak at about 8 kHz (Figs. 3e, 4e, 7, 8, 9q).

***Pholidoptera transsylvanica* (Fischer, 1853)**
Audio recorded material: 5♂♂, Muntele Roşu cabin, 29.07.2011 (25°C).
Bioacoustics. This endemic Carpathian bush-cricket sings mainly in the after-noon in mid-summer, but in late summer and autumn, when temperatures drop, it sings during daytime. The song consists of an echeme sequence, echemes being formed of 3 (rarely 4) syllables. The spectrum is very similar with the one in *Pholidoptera fallax* and *P. littoralis*, the frequencies ranging from 4 and up to more than 40 kHz, highest peak at about 7 kHz (Figs. 3f, 4f, 7, 8, 9r).

Family Bradyporidae
***Ephippiger ephippiger* (Fiebig, 1784)**
Audio recorded material: 1♂, Cheia, 17.07.2010 (25ºC).
Bioacoustics. The Saddle-backed Bush-cricket sings during time and at dusk a series of short syllables. Typically each syllable (100-190 ms) consists of 2 different hemisyllables, a short opening hemisyllable and a long closing hemisyllable. Sometimes 2 or 3 syllables are singed together in an echeme. Maximum sound frequency: from 8 up to 36 kHz (Figs. 3g, 4g, 7, 8, 10a).

Family Gryllidae
***Gryllus campestris* Linnaeus, 1758**
Audio recorded material: 1♂, Cheia, 17.07.2010 (25ºC).
Bioacoustics. Males typically sing in the evening and at night, but day songs have also been recorded - especially in the summer. Each short echeme consists of 4 syllables, each syllable lasting for about 19-27 ms. In a syllable, the sound reaches the maximum amplitude at midlength. Carrier wave frequency: 3-20 kHz, maximum at about 5 kHz (Figs. 3h, 4h, 7, 8, 10b).

***Pteronemobius heydenii* (Fischer, 1853)**
Audio recorded material: 3♂♂, Muntele Roşu cabin, 17.07.2010 (24ºC).
Bioacoustics. This cricket can be heard singing during daytime and in the dusk, usually in hygrophilous grasslands. The echeme lasts for about 1.9-3.4 s and consists of 80-110 syllables. From beginning to the end, the sound amplitude grows higher in each echeme. Audio frequency: 7 up to 26 kHz, with the highest peak at about 8.5 kHz (Figs. 3i, 4i, 7, 8, 10c).

***Oecanthus pellucens* (Scopoli, 1763)**
Audio recorded material: 2♂♂, Cheia, 05.09.2011 (19°C).
Bioacoustics. The Tree-cricket sings during the night in summer and sometimes during daytime in autumn. An echeme consists of 16-24 syllables and lasts for about 200-360 ms. The sound has a frequency of 2-18 kHz, highest peak at 3.5 kHz (Figs. 3j, 4j, 7, 8, 10d).

Suborder Caelifera
Family Acrididae
***Euthystira brachyptera* (Ocskay, 1826)**
Audio recorded material: 3♂♂, Muntele Roşu Peak, 19.07.2009 (27ºC); 6♂♂, Muntele Roşu cabin, 17.07.2010 (24ºC).
Bioacoustics. Males sing in summer sunny days. The short echemes (360-430 ms) are composed of 8-11 syllables. Each syllable lasts for 30-60 ms. Carrier wave frequency: 5 up to more than 40 kHz, maximum peak at about 10 kHz (Figs. 3k, 4k, 7, 8, 10e).

***Chrysochraon dispar* (Germar, 1831)**
Audio recorded material: 2♂♂, Babarunca, 21.08.2009 (25ºC).
Bioacoustics. The species sings during sunny days a series of echemes, each one lasting for 1.1-1.8 s. Echemes consist of 9-15 syllables (a syllable lasts for 110-137 ms). Maximum stridulation frequency

ranges between 6 and more than 40 kHz; peak at 12 kHz (Figs. 3l, 4l, 7, 8, 10f).

***Omocestus rufipes* (Zetterstedt, 1821)**
Audio recorded material: 1♂, Cheia, 05.09.2011 (19°C).
Bioacoustics. The Woodland Grasshopper sings especially in the warm sunny days, since June up to October. The song consists of long echemes, lasting for 4-10 s, composed of 69-170 syllables. Audio frequency: 3 up to more than 40 kHz, with maximum at about 16 kHz (Figs. 5a, 6a, 7, 8, 10g).

***Omocestus viridulus* (Linnaeus, 1758)**
Audio recorded material: 3♂♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 6♂♂, Muntele Roşu Peak, 18.07.2009 (27ºC); 1♂, Muntele Roşu cabin, 21.08.2009 (23ºC); 2♂♂, Muntele Roşu cabin, 17.07.2010 (24ºC); 3♂♂, Muntele Roşu Peak, 13.08.2010 (26ºC).
Bioacoustics. The Common Green Grasshopper sings mainly in sunny days and can be rarely heard in overcast days. The echeme is long and lasts up to 37 s, being formed of 250-520 syllables. Audio frequency: 4 up to more than 40 kHz, with maximum at about 20 kHz (Figs. 5b, 6b, 7, 8, 10h).

***Omocestus haemorrhoidalis* (Charpentier, 1825)**
Audio recorded material: 1♂, Muntele Roşu cabin, 17.07.2009 (27ºC).
Bioacoustics. The song consists of short echemes, lasting for 3.6-5.4 s, each having 49-107 syllables. Sound amplitude rises from beginning to end in each echeme and also in each syllable. Stridulation frequency ranges between 7 up to more than 40 kHz (Figs. 5c, 6c, 7, 8, 10i).

***Stenobothrus lineatus* (Panzer, 1796)**
Audio recorded material: 2♂♂, Muntele Roşu cabin, 29.07.2011 (25°C). It was the only grasshopper recorded while stridulating with both hind legs.
Bioacoustics. The Stripe-winged grasshopper has a particular way to sing, moving slowly and alternatively the hind legs. The echeme lasts for 24-37 s, composed of 19-25 syllables. Audio frequency: 6 and more than 40 kHz, with maximum at about 13 kHz (Figs. 5d, 6d, 7, 8, 10j).

***Stenobothrus stigmaticus* (Rambur, 1839)**
Audio recorded material: 1♂♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 2♂♂, Muntele Roşu cabin, 17.07.2009 (27ºC).
Bioacoustics. Males sing a low intensity echeme, lasting for about 2.4-4 s and composed of 27-50 syllables (each lasting for about 64-82 ms). Audio frequency: 5 up to more than 40 kHz (Figs. 5e, 6e, 7, 8, 10k).

***Gomphocerippus rufus* (Linnaeus, 1758)**
Audio recorded material: 2♂♂, Cheia, 17.07.2009 (28ºC); 2♂♂, Babarunca, 21.08.2009 (25ºC).
Bioacoustics. The species sings a short echeme sequence, lasting for about 5-10 s and consisting of 20-50 echemes. Two syllables with higher amplitude that are followed after a short pause by a dense group of 4-6 syllables with lower amplitude form an echeme. Audio frequency: 8 up to more than 40 kHz, with the highest peak at about 17 kHz (Figs. 5f, 6f, 7, 8, 10l).

***Chorthippus apricarius* (Linnaeus, 1758)**
Audio recorded material: 2♂♂, Cheia, 27.06.2005 (24ºC); 1♂, Cheia, 17.07.2009 (28ºC).
Bioacoustics. Male calling song is a long echeme sequence lasting for about 12-40 s. This echeme sequence is formed by 60-180 echemes. Each echeme consists of a group of 3 syllables, the first one being very short (12-16 ms) but with high amplitude and the following ones longer - each 65-100 ms - and lower in amplitude. Stridulation frequency ranges between 3 - more than 40 kHz. Maximum recorded at 8 kHz (Figs. 5g, 6g, 7, 8, 10m).

***Chorthippus biguttulus* (Linnaeus, 1758)**
Audio recorded material: 1♂, Cheia, 27.06.2008 (25ºC); 3♂♂, Cheia, 17.07.2009 (28ºC); 2♂♂, Cheia, 20.08.2009 (25ºC); 4♂♂, Babarunca, 21.08.2009 (25ºC); 1♂, Cheia, 17.07.2010 (25ºC).
Bioacoustics. Males sing during day time. Echeme sequences are repeated in a short series of 3, rarely 4-7. The first echeme sequence is longer, with about 45-70 echemes, the following ones being shorter, 20-35 echemes. A single echeme is very short (110-250 ms), consisting of 3-6 syllables. Acoustic frequency: 5 - more than 40 kHz, maximum at about 12 kHz (Figs. 5h, 6h, 7, 8, 10n).

***Chorthippus brunneus* (Thunberg, 1815)**
Audio recorded material: 1♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 2♂♂, Cheia, 17.07.2009 (27ºC); 1♂, Muntele Roşu cabin, 19.07.2009 (air temperature 27ºC).
Bioacoustics. Usually males sing during sunny days in very short echemes, lasting for about 0.2-0.3 s and consisting of 10-15 syllables. Carrier wave frequency ranges between 3 and more than

40 kHz. Maximum recorded at 12 kHz (Figs. 5i, 6i, 7, 8, 10o).

***Chorthippus albomarginatus* (De Geer, 1773)**
Audio recorded material: 1♂, Cheia, 29.07.2011 (26°C).
Bioacoustics. This grasshopper sings short echemes series, consisting of 3-5 echemes, each lasting for about 450-570 ms. Typically an echeme consists of 18-25 syllables, the ones in the middle having the lowest amplitude. Audio frequency: 6-35 kHz, with maximum at about 20 kHz (Figs. 5j, 6j, 7, 8, 10p).

***Chorthippus dorsatus* (Zetterstedt, 1821)**
Audio recorded material: 1♂, Cheia, 29.07.2011 (26°C).
Bioacoustics. This species sings during daytime an echeme series composed of 9-13 echemes, each one lasting for 1,9-2,6 s. In an echeme, the first 5-8 syllables are produced with the hind legs moving synchronously, while the last 4-6 syllables are "singed" with the hind legs moving asynchronously. Each syllable is composed of 2 distinct hemisyllable, more easily to be noticed in the echeme's first part. Sound frequency: from 4 up to more than 40 kHz, with maximum peak at 12 kHz (Figs. 5k, 6k, 7, 8, 10q).

***Chorthippus parallelus* (Zetterstedt, 1821)**
Audio recorded material: 2♂♂, Muntele Roşu cabin, 27.06.2008 (24ºC); 3♂♂, Muntele Roşu cabin, 19.07.2009 (27ºC); 2♂♂, Babarunca, 21.08.2009 (25ºC).
Bioacoustics. Males sing during daytime and very rare at dusk a short song, echemes composed of 10-15 syllables. Each echeme lasts for about 1-2 s at about 20-28ºC. Audio frequency: 5 and more than 40 kHz, with maximum at about 21 kHz (Figs. 5l, 6l, 7, 8, 10r).

Discussion

Only few papers deal with some Orthoptera species' acoustic analysis in the Romanian Carpathian Mountains (Orci, 2001; Orci *et al.* 2005; Iorgu, Pisică, 2007; Orci *et al.* 2010a; Orci *et al.* 2010b, Iorgu, Iorgu, 2010).

The present paper offers the first comprehensive analysis on the Orthoptera songs from Ciucaş Mountains, providing a mini acoustic guide - a very useful tool in identifying 36 Orthoptera species, many of those being commonly found in the Romanian Carpathians.

With few exceptions, the sound oscillogram and spectrogram analyses of the studied species revealed no major difference in the song structure of the Carpathian individuals from individuals from the rest of Europe. The song characteristics such as song structure and audio frequency of each studied individual were situated in the normal range of the species, comparing with several data from literature.

In *Isophya camptoxypha*, the syllables from some Central European individuals tend to have a higher number of impulses and length (11-25 impulses and 27-46 ms, in Heller et al. 2004), compared with Ciucaş individuals (8-16 impulses and 16-42 ms).

The studied Carpathian populations of *Poecilimon affinis* sing syllables located in the species' normal range for the Balkan populations analyzed in Chobanov, Heller (2010) and Ingrisch, Pavićević (2010).

In *Tettigonia viridissima*, one of the widespread bush-crickets in Europe, the Western populations have a normal syllable repetition of 10-15/s (Ragge, Reynolds, 1998), the same as in the Carpathians; however in some European populations the rate tends to reach 13-35 syllables/s (Heller, 1988).

Shorter echemes were noted in *Decticus verrucivorus* populations from Ciucaş (38-50 ms), comparing with Ragge, Reynolds, 1998 (45-80 ms), but considered in the species' normal range.

In *Platycleis albopunctata grisea* we observed longer echemes (250-300 ms) than in the nominotypical subspecies (100-200 ms) and faster repeating: 420-480 ms between successive echemes in *P. a. grisea* and 100-300 ms in *P. a. albopunctata* (data from Ragge, Reynolds, 1998).

Shorter echemes are produced in the Carpathian populations of *Pholidoptera griseoaptera* (80-110 ms), compared with the Western Europe populations (150-200 ms) (Ragge, Reynolds, 1998).

The oscillographic component of song analysis in *Pholidoptera transsylvanica* was discussed by Orci (2001); the only noticeable difference is that in Ciucaş the recorded individuals sing echemes formed of 3 syllables, but also echemes consisting of 4 syllables. The species' song spectrum is detailed for the first time in the present paper.

The studied Carpathian individuals of *Euthystira brachyptera* produce longer echemes (8-11 syllables, echemes lasting for 360-430 ms) compared with other Western European populations (4-7 syllables, echemes lasting for 140-300 ms) (Ragge, Reynolds, 1998).

Longer echemes, but with the relatively the same number of syllables, were noticed in the Ciucaş populations of *Stenobothrus lineatus*: 24-37 s against 10-25 s in Western European populations (Ragge, Reynolds, 1998). Also *Chorthippus dorsatus* populations from the Eastern Carpathians

produce longer echemes (1,9-2,6 s s) compared with the Western European populations (0.8-1.5 s) (Ragge, Reynolds, 1998).

All the recorded species, including from closely related groups, can be readily separated by temporal and frequency parameters of the calling songs through oscillogram and sonogram analyses.

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Fig. 1. Oscillographic analysis of the calling song in Orthoptera males recorded in Ciucaş Mountains (I): a. *Phaneroptera falcata*; b. *Leptophyes albovittata*; c. *Isophya camptoxypha*; d. *Isophya ciucasi*; e. *Poecilimon affinis*; f. *Pecilimon schmidtii*; g. *Polysarcus denticauda*; h. *Conocephalus fuscus*; i. *Tettigonia viridissima*; j. *Decticus verrucivorus*; k. *Metrioptera roeselii*; l. *Metrioptera bicolor*.

Fig. 2. Detailed calling song oscillograms of the Orthoptera males analyzed in Fig. 1: a. *Phaneroptera falcata*; b. *Leptophyes albovittata*; c. *Isophya camptoxypha*; d. *Isophya ciucasi*; e. *Poecilimon affinis*; f. *Pecilimon schmidtii*; g. *Polysarcus denticauda*; h. *Conocephalus fuscus*; i. *Tettigonia viridissima*; j. *Decticus verrucivorus*; k. *Metrioptera roeselii*; l. *Metrioptera bicolor*.

Fig. 3. Oscillographic analysis of the calling song in Orthoptera males recorded in Ciucaş Mountains (II) : a. *Metrioptera brachyptera*; b. *Platycleis albopunctata*; c. *Pholidoptera griseoaptera*; d. *Pholidoptera fallax*; e. *Pholidoptera littoralis*; f. *Pholidoptera transsylvanica*; g. *Ephippiger ephippiger*; h. *Gryllus campestris*; i. *Pteronemobius heydenii*; j. *Oecanthus pellucens*; k. *Euthystira brachyptera*; l. *Chrysochraon dispar*.

Fig. 4. Detailed calling song oscillograms of the Orthoptera males analyzed in Fig. 3: a. *Metrioptera brachyptera*; b. *Platycleis albopunctata*; c. *Pholidoptera griseoaptera*; d. *Pholidoptera fallax*; e. *Pholidoptera littoralis*; f. *Pholidoptera transsylvanica*; g. *Ephippiger ephippiger*; h. *Gryllus campestris*; i. *Pteronemobius heydenii*; j. *Oecanthus pellucens*; k. *Euthystira brachyptera*; l. *Chrysochraon dispar*.

Fig. 5. Oscillographic analysis of the calling song in Orthoptera males recorded in Ciucaş Mountains (III): a. *Omocestus rufipes*; b. *Omocestus viridulus*; c. *Omocestus haemmorhoidalis*; d. *Stenobothrus lineatus*; e. *Stenobothrus stigmaticus*; f. *Gomphocerippus rufus*; g. *Chorthippus apricarius*; h. *Chorthippus biguttulus*; i. *Chorthippus brunneus*; j. *Chorthippus albomarginatus*; k. *Chorthippus dorsatus*; l. *Chorthippus parallelus*.

Fig. 6. Detailed calling song oscillograms of the Orthoptera males analyzed in Fig. 5: a. *Omocestus rufipes*; b. *Omocestus viridulus*; c. *Omocestus haemmorhoidalis*; d. *Stenobothrus lineatus*; e. *Stenobothrus stigmaticus*; f. *Gomphocerippus rufus*; g. *Chorthippus apricarius*; h. *Chorthippus biguttulus*; i. *Chorthippus brunneus*; j. *Chorthippus albomarginatus*; k. *Chorthippus dorsatus*; l. *Chorthippus parallelus*.

Fig. 7. Sound spectrum in Orthoptera males recorded in Ciucaş Mountains: 1. *Phaneroptera falcata*; 2. *Leptophyes albovittata*; 3. *Isophya camptoxypha*; 4. *Isophya ciucasi*; 5. *Poecilimon affinis*; 6. *Pecilimon schmidtii*; 7. *Polysarcus denticauda*; 8. *Conocephalus fuscus*; 9. *Tettigonia viridissima*; 10. *Decticus verrucivorus*; 11. *Metrioptera roeselii*; 12. *Metrioptera bicolor*; 13. *Metrioptera brachyptera*; 14. *Platycleis albopunctata*; 15. *Pholidoptera griseoaptera*; 16. *Pholidoptera fallax*; 17. *Pholidoptera littoralis*; 18. *Pholidoptera transsylvanica*; 19. *Ephippiger ephippiger*; 20. *Gryllus campestris*; 21. *Pteronemobius heydenii*; 22. *Oecanthus pellucens*; 23. *Euthystira brachyptera*; 24. *Chrysochraon dispar*; 25. *Omocestus rufipes*; 26. *Omocestus viridulus*; 27. *Omocestus haemmorhoidalis*; 28. *Stenobothrus lineatus*; 29. *Stenobothrus stigmaticus*; 30. *Gomphocerippus rufus*; 31. *Chorthippus apricarius*; 32. *Chorthippus biguttulus*; 33. *Chorthippus brunneus*; 34. *Chorthippus albomarginatus*; 35. *Chorthippus dorsatus*; 36. *Chorthippus parallelus*.

Fig. 8. Sound spectrogram in Orthoptera males recorded in Ciucaş Mountains: 1. *Phaneroptera falcata*; 2. *Leptophyes albovittata*; 3. *Isophya camptoxypha*; 4. *Isophya ciucasi*; 5. *Poecilimon affinis*; 6. *Pecilimon schmidtii*; 7. *Polysarcus denticauda*; 8. *Conocephalus fuscus*; 9. *Tettigonia viridissima*; 10. *Decticus verrucivorus*; 11. *Metrioptera roeselii*; 12. *Metrioptera bicolor*; 13. *Metrioptera brachyptera*; 14. *Platycleis albopunctata*; 15. *Pholidoptera griseoaptera*; 16. *Pholidoptera fallax*; 17. *Pholidoptera littoralis*; 18. *Pholidoptera transsylvanica*; 19. *Ephippiger ephippiger*; 20. *Gryllus campestris*; 21. *Pteronemobius heydenii*; 22. *Oecanthus pellucens*; 23. *Euthystira brachyptera*; 24. *Chrysochraon dispar*; 25. *Omocestus rufipes*; 26. *Omocestus viridulus*; 27. *Omocestus haemmorhoidalis*; 28. *Stenobothrus lineatus*; 29. *Stenobothrus stigmaticus*; 30. *Gomphocerippus rufus*; 31. *Chorthippus apricarius*; 32. *Chorthippus biguttulus*; 33.

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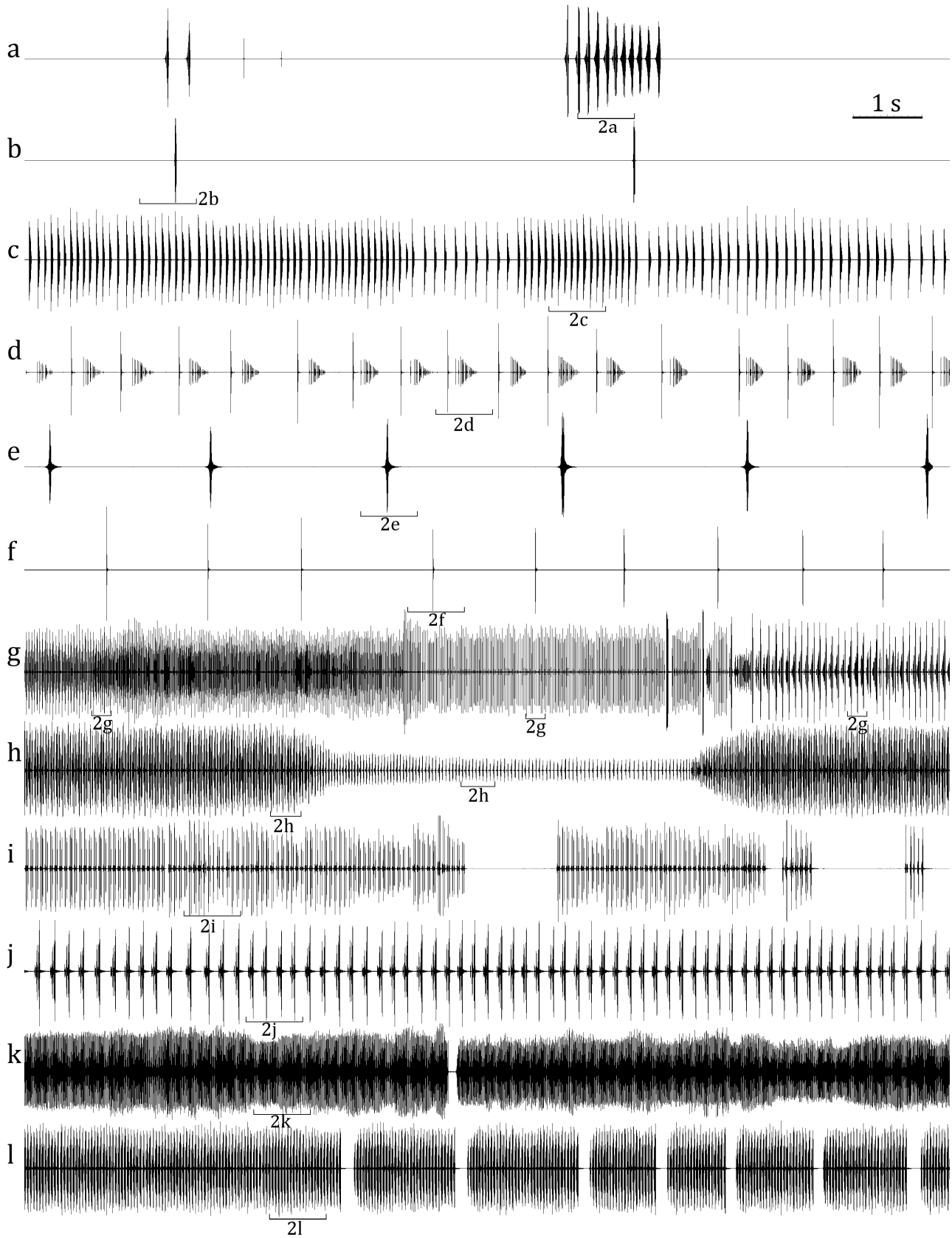


Fig. 1. Oscillographic analysis of the calling song in Orthoptera males recorded in Ciucaş Mountains (I)

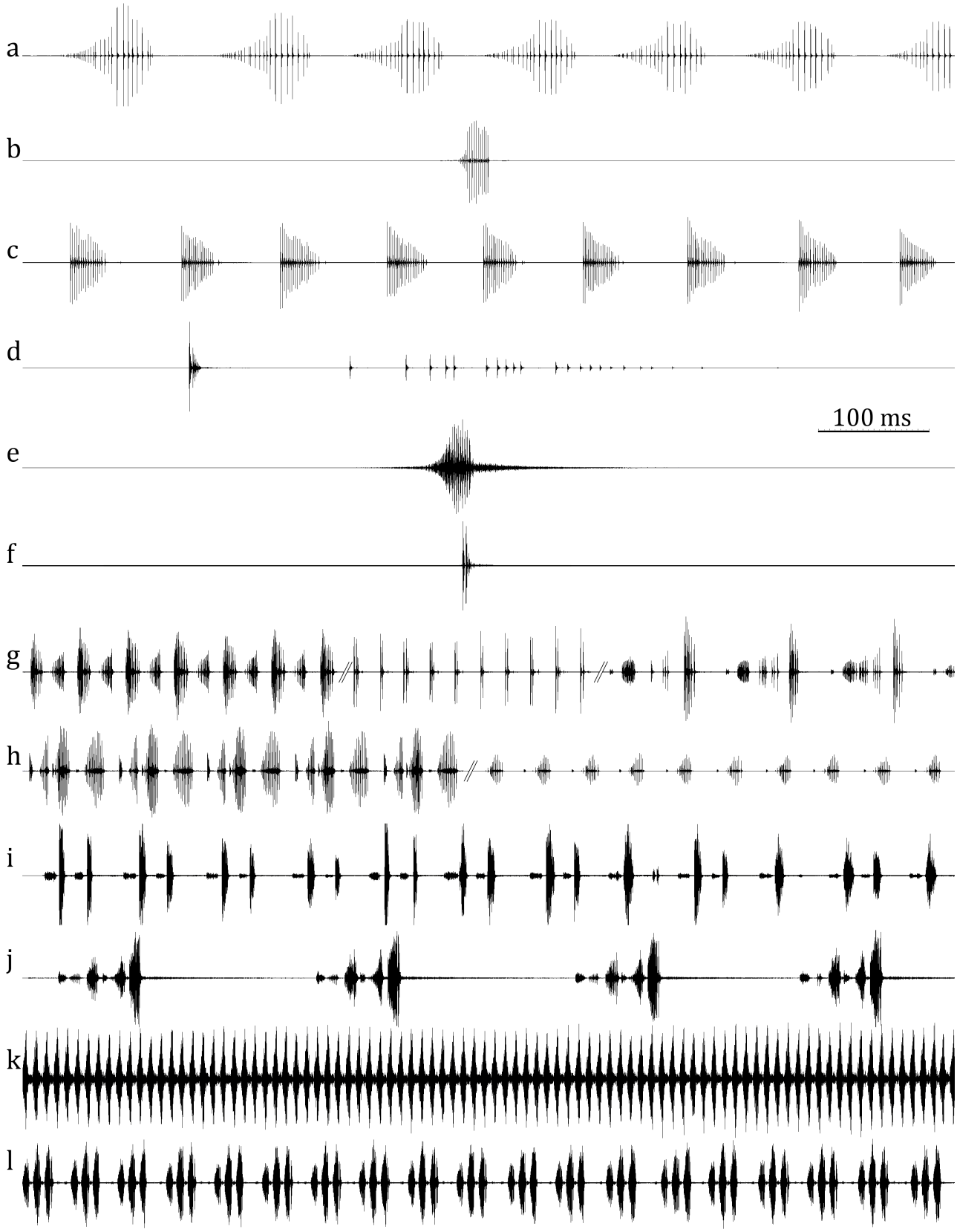
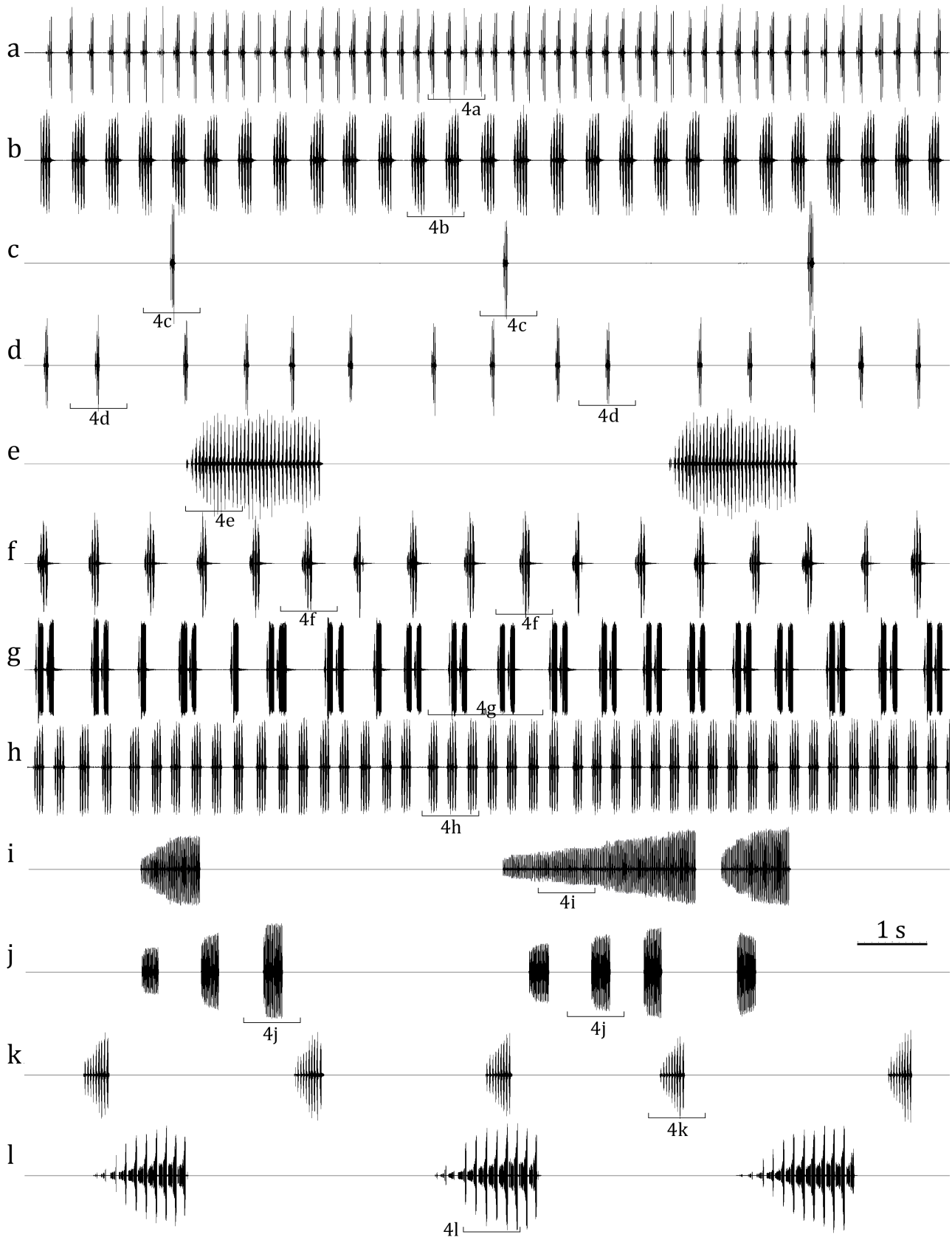


Fig. 2. Detailed calling song oscillograms of the Orthoptera males analyzed in Fig. 1



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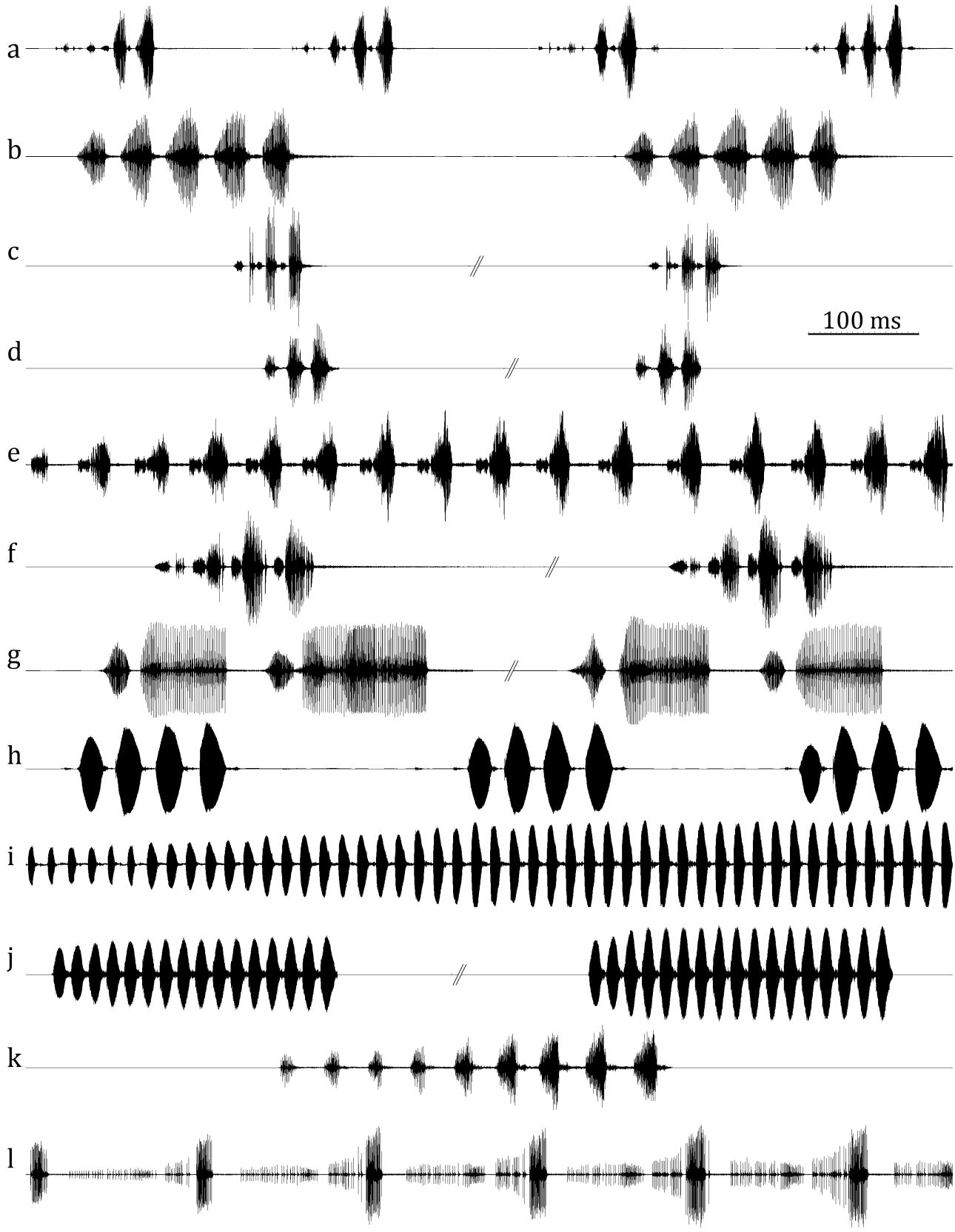

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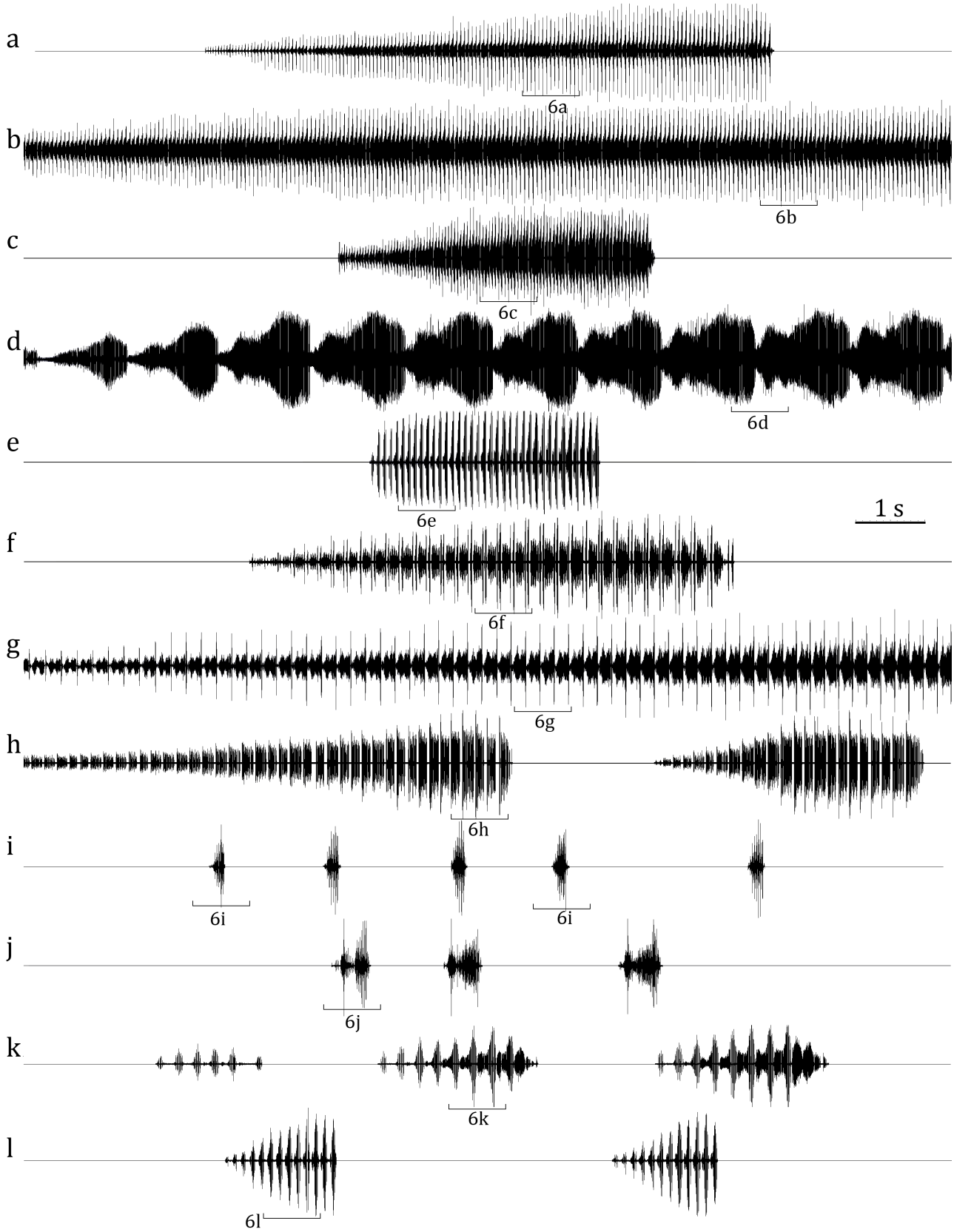

Fig. 4. Detailed calling song oscillograms of the Orthoptera males analyzed in Fig. 3

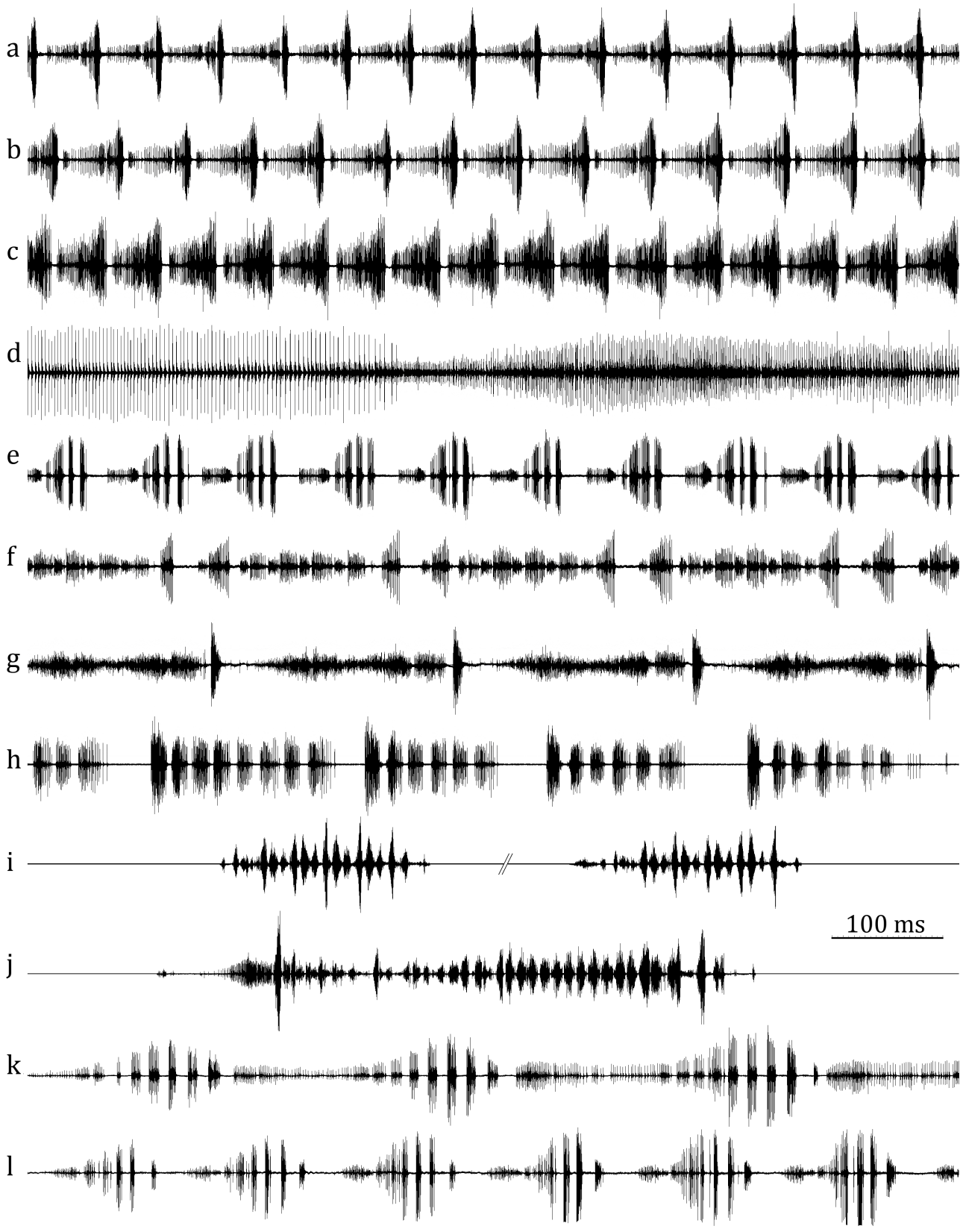

Fig. 6. Detailed calling song oscillograms of the Orthoptera males analyzed in Fig. 5

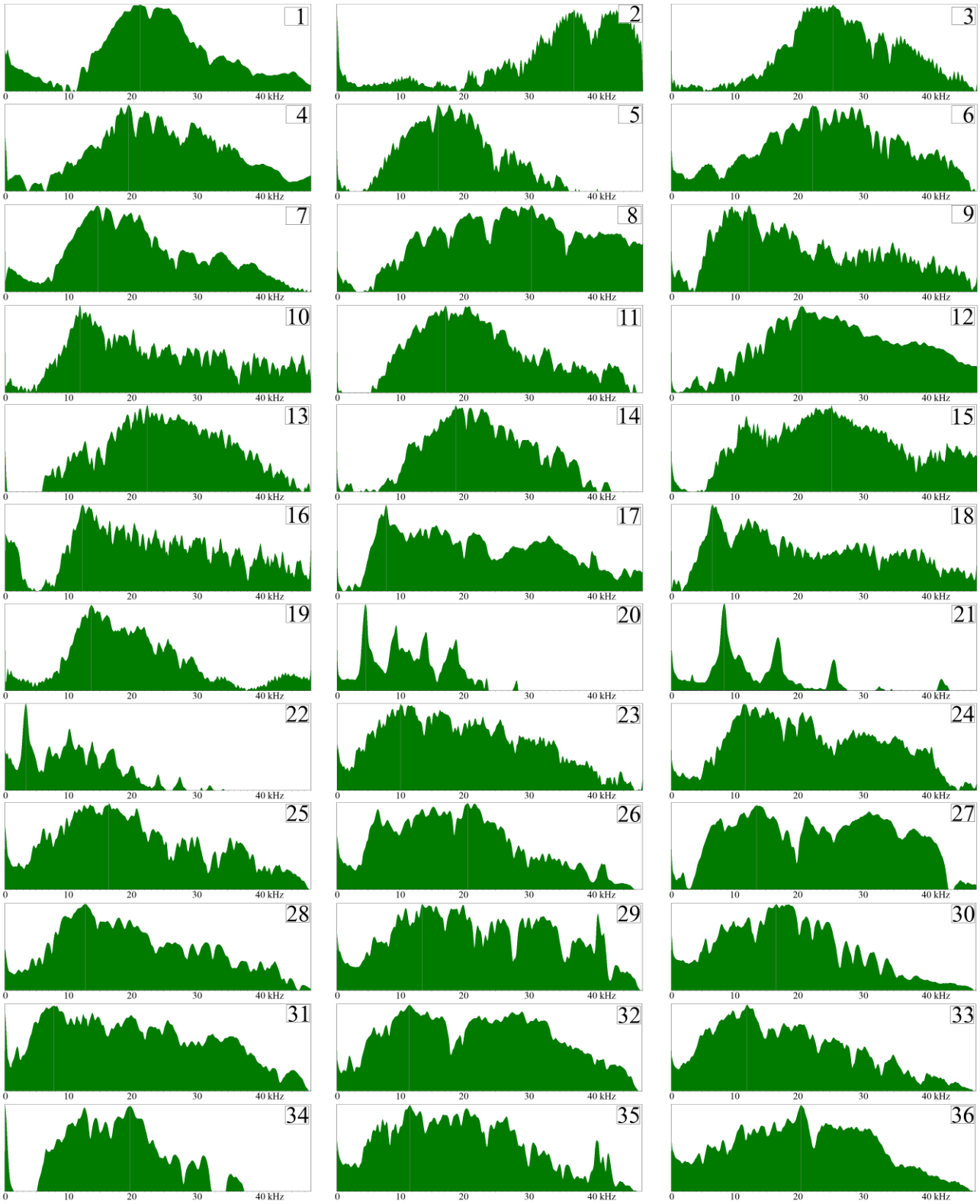

Fig. 7. Sound spectrum in Orthoptera males recorded in Ciucaş Mountains

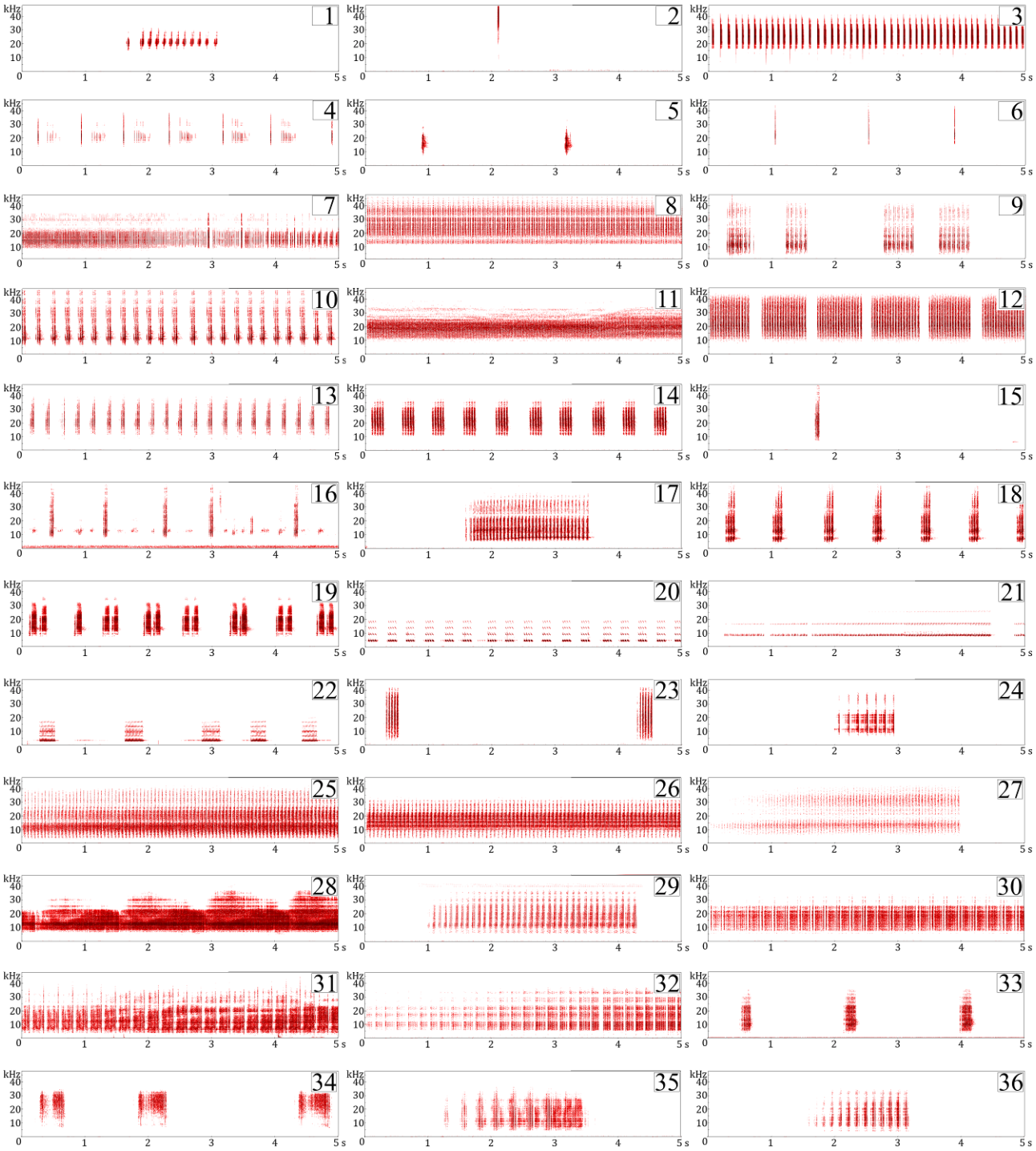

Fig. 8. Sound spectrogram in Orthoptera males recorded in Ciucaş Mountains:

Fig. 9. Photos of studied Orthoptera species (I)

Fig. 10. Photos of studied Orthoptera species (II)

STUDIES ON THE COREOID FAUNA (HEMIPTERA: HETEROPTERA: COREOIDEA) IN THE WETLANDS DISTRIBUTED IN THE LOWER BASIN OF THE SIRET RIVER

Cecilia ŞERBAN*

Abstract. *A number of 16 species was identified as a result of sundry investigations carried out between 2008 and 2009 in the habitats located in the wetlands situated in the lower basin of the Siret. The collection of the samples was made by the trimming method from the vegetation communities around the Potcoava, Lozova, Tălăbasca and Mălina lakes, all of these being located within the Galati County. The coreoid fauna in the investigated wetlands represents 51% of the coreoid fauna identified in the entire lower basin of the Siret (Serban, 2010). The paper also features an analysis of the distribution of the species and of the specimens within the respective habitats, as well as an analysis of how these species participate to the respective communities as a result of calculating certain ecological indices.*
Keywords*: Hemiptera, Heteroptera, Coreoidea, biodiversity, wetlands, Lower Siret Basin*

Rezumat. *În habitatele localizate în zonele umede aflate în bazinul inferior al Siretului au fost identificate un număr de 16 specii de coreoide în urma unor investigaţii realizate în anii 2008 şi 2009. Recoltarea probelor a fost făcută prin metoda cosirii de pe vegetaţia din jurul bălţilor Potcoava, Lozova, Tălăbasca şi Mălina, toate fiind situate în judeţul Galaţi. Fauna de coreoide din zonele umede investigate reprezintă 51% din fauna de coreoide identificată în tot bazinul inferior al Siretului (Şerban, 2010). În lucrare se prezintă o analiză a distribuţiei speciilor şi indivizilor în habitatele respective, precum şi o analiză a participării speciilor în asociaţiile respective în urma calculării unor indici ecologici.*
Cuvinte cheie*: Heteroptera, Coreoidea, biodiversitate, zone umede bazinul inferior Siret*

Introduction

The study on the coreoid fauna in the mezoxerophile meadows of the wetlands located on the Lower Siret was conducted by collecting heteropterologic material between 2008 and 2009 by means of the trimming method.. The investigated habitats are located around ponds and lakes formed along the lower Siret River. The specific plant communities are dry freshwater *Phragmites* beds, whereas the specificity of the riparian areas is yielded by a xerophyte vegetation dominated by Poaceae. The investigated sampling sites are as follows (Fig.1.):

B_1 – Lake Potcoava is an oxbow lake located in the Siret Meadow, 2 km south of Branistea (Galati County), at an altitude of 8 m. The eastern part of the region had been declared an avifaunal protected area since 1994. Coordinates: 45.41038° lat. N, 27.8318° long. E

B_2 - Lozova Pond is a facility where the industrial fishing used to be practiced, but since 2007 the pond has been included in the leisure circuit of recreational fishing. It is situated on a fluvial estuary on the lower stream of the Lozova valley, bordered to the west by the namesake village, and to the east by Branistea. It is situated at an altitude of 6-8 m. Coordinates: 45.45° lat. N, 27.816666° long. E.

B_3 – Lake Tălăbasca is located in the Siret meadow, near the village of Tudor Vladimirescu, at an altitude of 8-10 m. The Calmatui creek flows in this lake which keeps its connection to the Siret through a channel. It was declared a natural avifaunal protected area in 1994. Coordinates: 45,34 ° lat. N, 27,38 ° long. E.

B_4 - Malina Pond is a fluvial estuary located on the lower course of the namesake valley, at an altitude of 6-8 m, on the territory of the commune of Sendreni. On the south side it is bordered by the villages of Sendreni and Movileni. Coordinates: 45.43333° lat. N, 27.9333° long. E

Collections were made with entomological fillet through manual mowing method or directly from the plants.

The collected material was separated on samples, killed with ethyl ether and preserved dry by pierced with entomological needles and stored in insectariums boxes.

Determinations were performed in the laboratory using stereomicroscope with the help of

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different key for determination: Putshkov (1962), Wagner (1966), Moulet (1995) and Kis (2001).

Results and discussions

134 specimens have been collected from this type of habitat, specimens which belong to 16 species of coreoids and to three families: *Coreidae* with three species, *Alydidae* with two species and *Rhopalidae* with 11 species.

The data featured in Tab. 1 shows that, as far as the stations approached by the study are concerned, the differences are quite significant, the coreoid communities being distinct both in terms of structure and in regard to the number of the specimens which form the populations. In terms of the size of the population of species of coreoids identified in the investigated stations, it is ascertained these populations are quite small, except for the *Myrmus miriformis* identified in the Tălăbasca station, X = 2.14 specimens per sample, where the species developed a large population, being, in fact, present in all the other stations.

Another common species of the four stations, characterized by wetland habitats, is *Stictopleurus punctatonervosus*, though the Lozova station (X = 0.71 individuals per sample) features more favorable conditions when compared with Tălăbasca (X = 0.62), Malina (X = 0.21) or Potcoava (X = 0.07). In terms of zoogeography, 37.5% of the species found in this habitat are Palaearctic species, whereas the Euro-Mediterranean and the European elements amount to 12.5%, while the cosmopolitan and the Holomediterranean elements amount to 6.25% each.

The relative abundance values (numerical dominance) show that in the wet habitats located near the lower course of the Siret River there are two dominant or eudominant species common to all the investigated stations. They refer to *Stictopleurus punctatonervosus* and to *Myrmus miriformis*, both belonging to the Rhopalidae family. The two species find optimal ecological conditions in these habitats and develop populations larger than the rest of the species (Tab. 2.). On top of this aspect, for each station there is a number of species of coreoids featuring higher relative abundance values, but while for the Potcoava station, the Lozova station and, in particular, for the Malina station, these values are yielded by the small number of specimens collected from each of these stations, the case of the Tălăbasca station is different, since a relatively large number of specimens was collected from this particular station. As far as the Tălăbasca station is concerned, the two previously mentioned species of coreoids are accompanied by the *Brachycarenus tigrinus* (A = 13.40%) and by the *Stictopleurus abutilon* (A = 13.40%) which fall in the category of eudominants, *Stictopleurus pictus* (A = 6.18%) being the dominant species, whereas *Chorosoma schillingi* (A = 4.12%) is the subdominant species. The remaining species of coreoids which were identified here (six species) are, by calculating the relative abundance value, receding and subreceding species.

Regarding the constancy (frequency) of the species of coreoids in the studied stations, we can see a similarity between the relative abundance values and frequency values, especially for the Tălăbasca station, which is indicative of the large populations, uniformly spread in the investigated area. Thus, the constant and the euconstant species for the Tălăbasca station are, in descending order of the frequency index value, *Myrmus miriformis* (F = 100%), *Brachycarenus tigrinus* (F = 61.90%) and *Stictopleurus abutilon* (F = 61.90%) , while the remaining species are collateral (*Stictopleurus punctatonervosus*) or accidental (*Gonocerus acuteangulatus, Centrocoris spiniger, Alydus calcaratus, Camptopus lateralis, Corizus hyoscyami, Stictopleurus subtomentosus and Chorosoma schillingi*).

For the Potcoava, Malina and Lozova stations we ascertain deviations from this correspondence between the relative abundance and the frequency in samples (Tab. 2). Thus, despite the fact the species identified in these habitats feature high levels of relative abundance values, values which determine their categorization as eudominant and dominant species, their frequency in samples is very low, which is why they are ranked as collateral and accidental species. The exceptions refer to *Stictopleurus punctatonervosus* (F = 71.42%), *Stictopleurus abutilon* (F = 57.14%) and *Maccevethus caucasicus errans* (F = 57.14%) which occur in the Lozova station as constant species.

If we analyzed the influence of each of these species on the community they are part of, by means of the Dzuba index, we ascertain the following:

There is a single characteristic species around Potcoava Lake, namely, *Alydus calcaratus* (W = 11.9%), as well as two accompanying species, that is, *Camptopus lateralis* (W = 1.90%) and *Myrmus miriformis* (W = 4.28%), the rest of the species being deemed collateral ;

Of the seven species identified around the Lozova pond, three are characteristic, and they refer to *Stictopleurus punctatonervosus* (W = 21%), *Stictopleurus abutilon* (W = 13.44%) and *Myrmus*

miriformis (W = 13.44%), and the other four are collateral.

The highest values of the ecological significance index around the Tălăbasca pond were ascertained for the *Myrmus miriformis* (W = 46.39%), which is the only edifying species; the characteristic species occurring next to the one mentioned above refer to *Brachycarenus tigrinus* (W = 8 29%) and to *Stictopleurus abutilon* (W = 8.29%). *Stictopleurus punctatonervosus* (W = 3.97%) and *Stictopleurus pictus* (W = 1.76%) are two of the accompanying species.

Around the Malina pond, *Stictopleurus punctatonervosus* is the edifying species (W = 12.86%), whereas *Brachycarenus tigrinus* and *Myrmus miriformis* are accompanying species.
Making a general analysis of the ecological significance index values (W), we ascertain *Myrmus miriformis* is an edifying species only at the Tălăbasca station, whereas at the Lozova station it occurs as characteristic species, while for the Malina and the Potcoava stations it occurs as accompanying species. *Stictopleurus punctatonervosus* too occurs as edifying species at the Malina station exclusively, while at the Lozova station it occurs as characteristic species, at Tălăbasca it is an accompanying species, and at Potcoava it is a collateral species.

By analyzing Tab.2 we ascertain that the maximum diversity within this type of habitat was recorded at Potcoava lake (Hs = 2.683), followed by the Tălăbasca Pond (Hs = 2.503) and by the Lozova Pond (Hs = 2.463), while for lake Malina we obtained the lowest value (Hs = 1.371). Regarding the distribution of the specimens by species, it is ascertained this distribution is relatively uniform, ranging between 70% and 89% as compared with the ideal distribution.

Conclusions

In the habitats located in the wetlands near the lower course of the Siret we have identified 16 species of coreoids, which amounts to 29% of all the species identified in our country. From a zoogeographical perspective, most of the species of coreoids are Palaearctic elements. For the studied habitats, the characteristic and edifying species of coreoids are: *Myrmus miriformis, Brachycarenus tigrinus* and *Stictopleurus abutilon.*

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Tab.2. Ecological indices for the coreoid communities in the habitats located in the wetlands nearby the lower basin of the Siret River (A - relative abundance (%); F - frequency (%); W - ecological significance index (%)

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Tab.2. Indicii ecologici pentru comunitățile de coreoide în habitatele localizate în zonele umede din apropierea cursului inferior al Siretului: (A - abundență relativă (%); F - frecvență (%); W - indicele de semnificație ecologică (%)

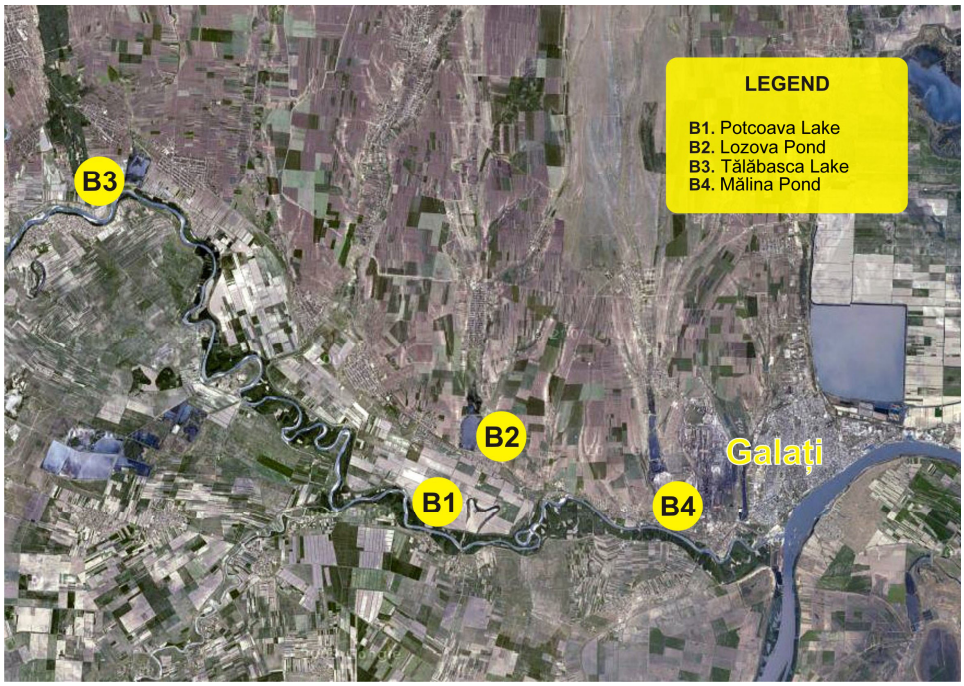

Fig. 1. Collection point map of heteropterologic material from in the habitats located in the wetlands situated in the lower basin of the Siret

Tab. 1. Faunal and ecological characterization of the coreoid communities in the habitats located in the wetlands nearby the lower course of the Siret River

No. crt	Taxon	Zoogeogr. category	B_1		B_2		B_3		B_4		**Total**
			N	X	N	X	N	X	N	X	
Coreidae Family											
1	*Gonocerus acuteangulatus*	Hm					1	0,05			1
2	*Coreus marginatus*	P	1	0,07							1
3	*Centrocoris spiniger*	EuM					1	0,05			1
Alydidae Family											
4	*Alydus calcaratus*	P	5	0,35			1	0,05			6
5	*Camptopus lateralis*	P	2	0,14	1	0,14	2	0,1			5
Rhopalidae Family											
6	*Corizus hyoscyami*	P					1	0,05			1
7	*Liorhyssus hyalinus*	C	1	0,07	1	0,14					2
8	*Rhopalus subrufus*	Eu	1	0,07							1
9	*Brachycarenus tigrinus*	P					13	0,62	1	0,07	14
10	*Stictopleurus punctatonervosus*	P	1	0,07	5	0,71	9	0,43	3	0,21	18
11	*Stictopleurus abutilon*	Eu			4	0,51	13	0,62			17
12	*Stictopleurus pictus*	M					6	0,28			6
13	*Stictopleurus subtomentosus*	M	1	0,07			1	0,05			2
14	*Maccevethus errans caucasicus*	EuM			1	0,14					1
15	*Myrmus miriformis*	Eu	3	0,21	4	0,51	45	2,14	1	0,07	53
16	*Chorosoma schillingi*	Eu			1	0,14	4	0,2			5
		Total	**15**		**17**		**97**		**5**		**134**

Tab. 2. Ecological indices for the coreoid communities in the habitats located in the wetlands nearby the lower basin of the Siret River (A - relative abundance (%); F - frequency (%); W - ecological significance index (%)

Crt. no	Taxon	B_1			B_2			B_3			B_4		
		A	**F**	**W**	**A**	**F**	**W**	**A**	**F**	**W**	**A**	**F**	**W**
Coreidae Family													
1	*Gonocerus acuteangulatus*							1,03	4,76	0,05			
2	*Coreus marginatus*	6,66	7,14	0,46									
3	*Centrocoris spiniger*							1,03	4,76	0,05			
Alydidae Family													
4	*Alydus calcaratus*	33,3	35,7	11,9				1,03	4,76	0,05			
5	*Camptopus lateralis*	13,3	14,3	1,90	5,88	14,28	0,84	2,06	9,52	0,19			
Rhopalidae Family													
6	*Corizus hyoscyami*							1,03	4,76	0,05			
7	*Liorhyssus hyalinus*	6,66	7,14	0,46	5,88	14,28	0,84						
8	*Rhopalus subrufus*	6,66	7,14	0,46									
9	*Brachycarenus tigrinus*							13,40	61,90	8,29	20	7,14	1,43
10	*Stictopleurus punctatonervosus*	6,66	7,14	0,46	29,41	71,42	21,0	9,27	42,86	3,97	60	21,43	12,86
11	*Stictopleurus abutilon*				23,52	57,14	13,44	13,40	61,90	8,29			
12	*Stictopleurus pictus*							6,18	28,57	1,76			
13	*Stictopleurus subtomentosus*	6,66	7,14	0,46				1,03	4,76	0,05			
14	*Maccevethus errans caucasicus*				5,88	14,28	0,84						
15	*Myrmus miriformis*	20	21,4	4,28	23,5	57,14	13,44	46,39	100	46,39	20	7,14	1,43
16	*Chorosoma schillingi*				5,88	14,28	0,84	4,12	19,04	0,78			
Total specimens		**15**			**17**			**97**			**5**		
Total species		**8**			**7**			**12**			**3**		
Shannon – Wiener diversity H_s		**2,683**			**2,463**			**2,503**			**1,371**		
Equitability E		**0,894**			**0,877**			**0,698**			**0,865**		

CORYTHUCHA CILIATA (SAY, 1832) (HEMIPTERA: TINGIDAE) – SECOND RECORD FOR THE LACE BUG FAUNA OF ROMANIA

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Ioan TĂUŞAN[**]

Abstract. *In the present study a new Romanian record is given for Corythucha ciliata (Say, 1832) a well-known alien pest species of Platanus spp. Although this species is very common in Europe, it has only once been recorded in Romania until now, in Craiova. Alongside the biology and economic importance of C. ciliata, the damage it produces and pest control methods are emphasized.*
Keywords*: alien species, lace bugs, Corythucha ciliata, Romania*

Rezumat. *În studiul de faţă se prezintă o nouă semnalare pentru specia Corythuca ciliata (Say, 1832) în România, dăunător al speciilor de Platanus spp. Deşi larg răspândită în Europa, în România specia a fost semnalată doar la Craiova. Sunt prezentate de asemenea date privind biologia, ecologia şi importanţa economică a speciei C. ciliata, precum şi impactul produs şi metodele de combatere.*
Cuvinte cheie*: specii invazive, Tingidae, Corythucha ciliata, România*

Introduction

Tingidae are members of a rather large family, comprising about 2100 species and 250 genera (Bisson *et al*. 2003; Henry, 2009). 171 of these species are native to Europe and only six of them are alien (Péricart, Golub, 1996; Streito *et al.* 2010). The adults, commonly known as lace bugs, due to the lace-like appearance of the dorsum, are small-sized (less than 8 mm in body size), phytophagous and host specific insects that can be identified by examining the head, pronotum and hemelytra (Bisson *et al.* 2003). One useful distinguishing character is often the host plant (Bisson *et al*. 2003).

The damage they cause resembles that of certain leafhoppers or mites but it can positively be identified by brown or black patches of excrements on the underside of leaves (Bisson *et al.* 2003; Rabitsch, 2010). This particular aspect and that of control measures will be discussed further in the article with more detailed information being provided on *Corythucha ciliata* (Say, 1832).

Corythucha ciliata is one of the six alien species and probably one of the most widespread of alien Heteroptera in Europe (Rabitsch, 2008). It was first described by Say and it is native to the North American Rocky Mountains. The species was introduced in Europe in the 1960s supposedly by ships (Őszi *et al.*, 2005),the first record dating back to 1964 when it was found in Padua (Northern Italy) (Rabitsch, 2008).

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Records of *Corythucha ciliata* in the world

The species quickly spread across Central and Southern Europe with records in Croatia (1970), Slovenia (1972), Serbia (1973), France (1974) - including Corsica, Switzerland (1975), Hungary (1976), Spain (1978), Austria (1982), and Germany (1983), Bulgaria (1987), Greece (1988), Southern Italy (Sicily), Sardinia (Rabitsch, 2008). *C. ciliata* has also been recorded in Portugal (Grosso-Silva, Aguiar, 2007; Kment, 2007), in the Czech Republic (1995), in Slovakia (1997) (Stehlík, 1997), in Russia (Voigt, 2001), Montenegro (Protić, 1998) and more recently in the United Kingdom (2005), (Malumphy *et al.* 2006), in Belgium (2006) (Aukema *et al.* 2007), in the Netherlands (Aukema, Hermes, 2009) and in Poland (Lis, 2009). Records of the species have also been mentioned from Turkey (Mutun, 2009), Eastern Asia, China (Ju *et al.* 2009), Japan (Tokihiro *et al.* 2003), Chile (Prado, 1990) and Australia (Dominiak *et al.* 2008).

The purpose of this study is of course to mention the new record and to provide detailed information based on the study of available literature regarding the biology and economic importance of *C. ciliata*, the damage it produces and pest control methods.

***Corythucha ciliata* in Romania**

Surprisingly or not, only one record of this lace bug is known so far in Romania. The first record dates to 1990 when Kis collected it in Craiova (Dolj County). It hasn't been recorded since.

On the 27th of November 2010, we found it in large numbers wintering under the bark of *Platanus sp.* and other trees in a park in Sibiu (Sibiu County). It was later collected and now deposited at the Natural History Museum Collections of Sibiu.

The species is expected to be widespread in Romania due its host preference for *Platanus s*pp., found in many city parks.

On the basis of our results, two localities are now known for the sycamore lace bug distribution in Romania (Fig. 1).

Biology and ecology

Corythucha ciliata (Fig. 2) feeds on the underside of leaves causing desiccation of tissue, first near the veins and subsequently affecting the entire leaf, which may drop prematurely. They produce droplets of liquid frass, which dry out as black spots on the lower surface of the leaves. Mating pairs of sycamore lace bugs initiate colonies by laying eggs along the leaf veins. A single female can lay up to 350 eggs. There are five immature instars. Nymphs stay close together at first, only moving to new leaves after they reach the fourth instar. First generation adults appear in June and second generation appears around July/August.

They overwinter as adults under loose bark, leaf litter and crevices, and tolerate extreme temperatures as low as -24ºC. As the average daily temperature rises above 8 °C in spring, the adults emerge and start wandering. The wandering can strictly be limited by wet weather. The first eggs are laid around the beginning of May; the number of eggs/female is 80–160. The swarming starts about at the end of May, the embryonic state of developing lasts three weeks, or so. Around three weeks after the larvae have developed the second egg-laying-period starts mainly in the second half of July with a number of 80–160 eggs/female. Approximately in the middle of September, the adults of the second generation emerge, and they start wintering at the end of October. The wings of the adults are very delicate, and they rarely fly very far; however, supported by wind they can be blown over many kilometers. Human activity is thought to be the main cause of its spread over long distances (Halbert, Meeker 1998; Őszi *et al*., 2005; Malumphy *et al.*, 2006).

Economic importance

The main host plant of *C. ciliata* is the American sycamore tree, *Platanus occidentalis* Linnaeus (family). Other *Platanus* spp. host species listed in literature are *P. orientalis* and the hybrid species *P. acerifolia*. Furthermore, *C. ciliata* has also been found on *Broussonetia papyrifera* (L.), Moraceae, *Carya ovata* (Mill.), Juglandaceae, *Chamaedaphne sp.*, Ericaceae and *Fraxinus sp.*, Oleaceae (Halbert, Meeker, 1998). Severe infestations are often associated with ornamental plane trees found in parks and gardens rather than with those of natural settings; they are also known to invade homes in large numbers (Malumphy *et al.* 2006) and to be passively spread by wind-drift or stuck to clothes, cars etc. (Rabitsch, 2008). It has been noted that they can spread on a distance of 100 km/year (Rabitsch, 2008).

The bug feeds on the underside of the plant's leaves sucking the cytoplasm, mainly the chloroplasts which may ultimately result in the death of the entire tree due to lack of nutrients (Őszi *et al.* 2005). On the other hand, Halbert, Meeker (1998) conclude that "despite the spectacular appearance of severe damage, the practical impact of occasional late-season defoliation on otherwise healthy sycamore trees is principally only aesthetic in nature". Its presence on the lower surface is confirmed by black spots which are actually dried out frass. However, the damage is more apparent on the upper surface, with the leaves exhibiting a white speckle which also leads to premature fall (Malumphy *et al.* 2006).

The same paper suggests that greater damage is associated with drier weather, that severe infestations may end up with trees defoliating in late summer and that "several consecutive years of severe lace bug damage combined with other stress factors, may kill the trees". Furthermore, certain types of fungi (e.g., *Apiognomonia platani*, Valsaceae, *Ceratocystis fimbriata* f. *platani* Ceratocystidaceae) and plant pathogens are associated with the presence of *C. ciliata* which provides the perfect support for infections (Neal, Schaefer, 2000; Rabitsch, 2008).

Pest Control

There is a wide variety of pest control methods listed in literature. Some studies mention the use of insecticides such as petroleum, potassium phosphate, products that contain bifenthrin, deltamethrin (both pyrethroids), plant extracts that coat the insects or just plain water, sprayed to dislodge the larvae as soon as they hatch

(Malumphy *et al.* 2006) as well as diverse ways of application: foliar sprays, trunk injections, soil treatments (Halbert, Meeker, 1998). However, *C. ciliata* is known to tolerate insecticides that contain phosphorus acid ester (Őszi *et al.* 2005). According to Őszi *et al.* (2005) a very appropriate method is the use of pyrethoids, which would prove both efficient and harmless for the plant and for the environment.

Other methods are using tree bindings made of jute treating the underside of the bark which is not a harmful process but is hardly efficient or injecting the insecticide straight into the conducting tissue for it to be later sucked by the insect (Őszi *et al.* 2005). However, this has proven inappropriate for the trees because it facilitates the infection with other pests (Tremblay, 1985).

Methods of biocontrol are not to be ignored. *Corythucha ciliata* has several known natural enemies: certain types of true bugs, spiders, crickets and locusts, viruses, nematodes and spore plants (Sidor, 1985) and deuteromycete fungi species (e.g., *Beauveria bassiana,* Clavicipitaceae, *Verticilium lecanii* Cordycipitaceae, *Paecilomyces farinosus*, Trichocomaceae) that ravage the populations of wintering adults (Balarin, Maceljski, 1986).

However, some studies have pointed out (Tavella, Arzone, 1987) that although the predation of *C. ciliata* is effective in laboratory conditions, it does not inhibit its reproduction in natural circumstances (Őszi *et al.* 2005).

Conclusions

In conclusion, one can only suppose that this potentially dangerous alien lace bug is actually widespread in Romania.

Acknowledgments

The authors are grateful for the useful comments of Petr Kment PhD, and Cecilia Şerban PhD that seriously improved the first version of the manuscript. Also, special thanks goes to Stanislav Krejcik for the kind permission of using one of his photographs of the species.

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Fig.1. Currently known distribution of *Corythucha ciliata* in Romania
Fig. 2. Corythuca ciliata (Say, 1832) (Photo by kind permission of © Stanislav Krejcik, www.meloidae.com)

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Fig. 1. Distribuția cunoscută a speciei *Corythucha ciliata* în Romania
Fig. 2. *Corythuca ciliata* (Say, 1832) (Fotografia cu permisiunea © Stanislav Krejcik, www.meloidae.com)

Fig.1. Currently known distribution of *Corythucha ciliata* in Romania

Fig. 2. *Corythuca ciliata* (Say, 1832) (Photo by kind permission of © Stanislav Krejcik, www.meloidae.com)

APHAENOGASTER SUBTERRANEA (LATREILLE, 1798) (HYMENOPTERA: FORMICIDAE) IN ROMANIA: NEW RECORDS, DISTRIBUTION AND HABITAT PREFERENCES

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Abstract. *Aphaenogaster subterranea (Latreille, 1798) is a widely distributed Mediterranean species, whose northern part of the range extends to the south of Central Europe. From Romania it's known only from the Southern part. We present the first records of this species from Transylvania and Dobrogea. The current distribution and habitat preference of the species are given also.*
Key words*: new records, Aphaenogaster subterranea, habitats, distribution, ants*

Rezumat. *Aphaenogaster subterranea (Latreille, 1798) are o distribuţie predominant mediteraneană, iar limita nordică a specie se intinde până la sudul Europei Centrale. În România specia este cunoscută în special din partea sudică. În prezenta lucrare, două noi semnalări sunt date pentru specie, primele din Transilvania şi Dobrogea. De asemenea distrubuţia actuală şi cerinţe ale habitatelor sunt discutate.*
Cuvinte cheie*: semnalări noi, Aphaenogaster subterranea, habitate, distribuţie, furnici*

Introduction

Aphaenogaster Mayr, 1853 is a large genus of ants within the subfamily Myrmicinae with species distributed in/over all of the zoogeographic regions, except for the Ethiopian. From the Palaearctic Region, 108 species and 24 subspecies are known, (Bolton *et al*. 2007; Kiran *et al*. 2008).

Aphaenogaster subterranea (Latreille, 1798) is a widely distributed Mediterranean species, whose northern part of the range extends to the south of Central Europe. It is oligotopic species, associated with warm deciduous forests (Czechowski *et al*. 2002; Seifert, 2007).

This species mainly inhabits moderately wet and warm deciduous forests, nesting in the ground, under stones, in rotten wood, rarely in litter. In Germany, where it is recorded only in the south, *A. subterranea* is found only in warm river valleys, in particular on forest edges and in warm deciduous forests, but also amongst shrubs in dry grasslands. It forms fairly numerous colonies (from several hundred to several thousand individuals). The species is active at night (Czechowski *et al*. 2002).

The species was recorded from several sites from Romania, mostly from the southern part, but it has not been reported from Transylvania, although the ant fauna of this region is well studied (Markó, Csősz, 2002; Csősz, Markó, 2005; Markó *et al*. 2006; Kiss, Fetykó, 2008; Tăuşan 2009; Tăuşan, Markó 2009; Tăuşan, 2010).

This study offers the first record of *Aphaenogaster subterranea* from Transylvania and Dobrogea. Additionally we discuss the species habitat preference and the present distribution in Romania.

Material and methods

During a field trip in the summer 2011, a population of *Aphaenogaster subterranea* was discovered in a Natura 2000 site in Dumbrăveni (Transylvania, Romania) in a forest with *Quercus pubescens* (500 m a.s.l.) The species was captured both in pitfall traps and within bait observations (Fig. 1).

Investigating nine other forest sites in the same area, all of them having a northern exposition, two additional specimens were collected from a clear-cut site. In addition to our collected material, *A. subterranea* was also found in the ant collections from the Natural History Museum of Sibiu. Three workers were collected in Dobrogea (leg. Eckbert

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Schneider, 5.05.1971), from where no published records of this species are known.

Discussion

The current known localities of the species are Comana - Vlasca, Oraviţa, Corneşti, Cloşani, Poaiana Stampei, Motrului Valley, Eşelniţa, Oltenia (Knechtel, Paraschivescu, 1962; Cîrdei, Bulimar 1965; Paraschiescu, 1967; Cîrdei *et al*. 1969; Fromunda *et al.* 1967; Paraschivescu 1974, 1975, 1976, 1978a, 1978b; Markó *et al.* 2006). So far, all of the known records are from outside the Carpathian arch, except one record. The presence of *A. subterranea* in Poiana Stampei (Suceva County) is quite questionable due to the fact that the climate is not favourable for the species. Most probably the species was misidentified with *Stenamma debille* (Förster, 1850) (Bálint Markó pers. comm.). Based on our records the northern point for *A. subterranea*, in Romania, is Dumbrăveni (Fig. 2).

A. subterranea mainly inhabits moderately wet and warm deciduous forests, nesting in the ground, under stones, in rotten wood, rarely in litter. In our research we collected the specimens from thermophilic *Quercus pubescens* forests. None the less based on our observations, the species can occur also in sites with colder climate, but with high sun exposure (Fig. 3) and can be also highly active in the day time showing aggressive behaviour towards common forest species such as *Myrmica ruginodis* Nylander 1846 (Fig. 4).

Comments

Despite that the ant fauna from Transylvania was rather well studied new species can be recorded. The species is expected to be widespread mainly in *Quercus pubescens* forests. Although the species is known from thermophilic habitats, our records show that it can occur in sites with colder climate, but with high exposure to the sun (clear-cuts, etc.).

The species range can be extended in the northern part of Romania due to its presence in Hungary (Csősz *et al.* 2011), and in Ukraine in the Transcarpathian province (Alexander Radchenko pers. comm.).

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Fig. 1. *Aphaenogaster subterranea* on bait (photo: I. Tăuşan)

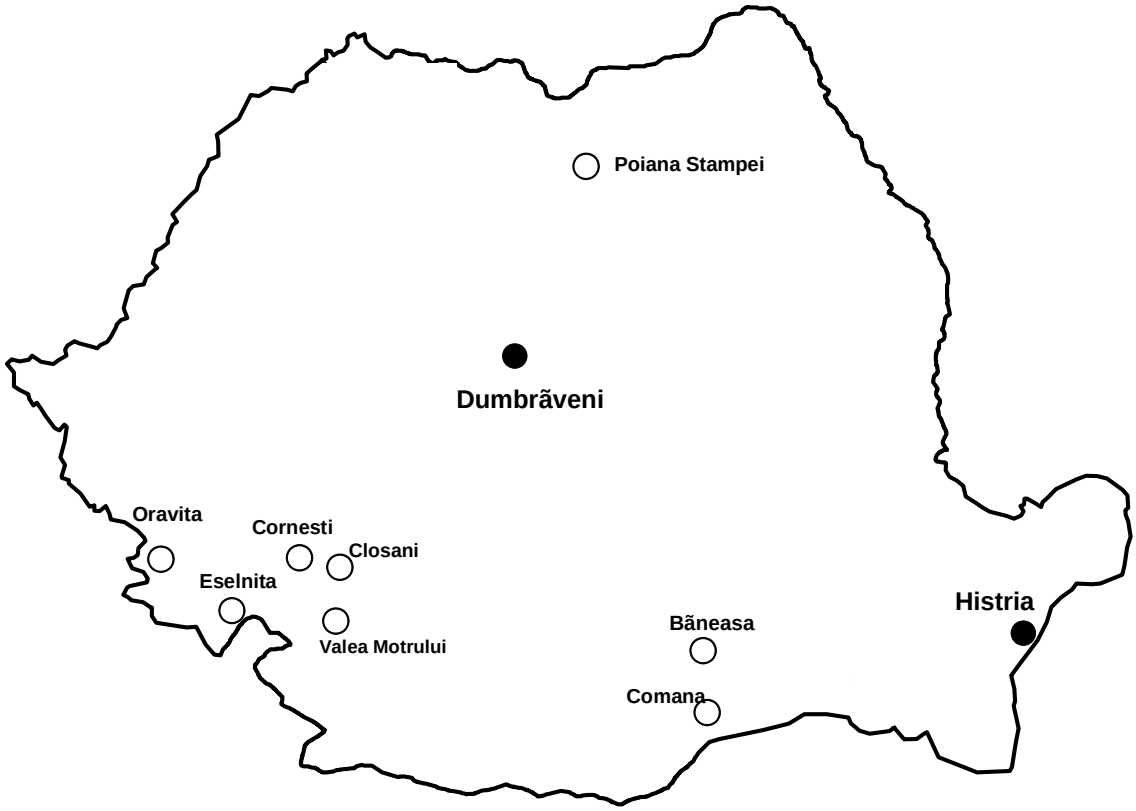
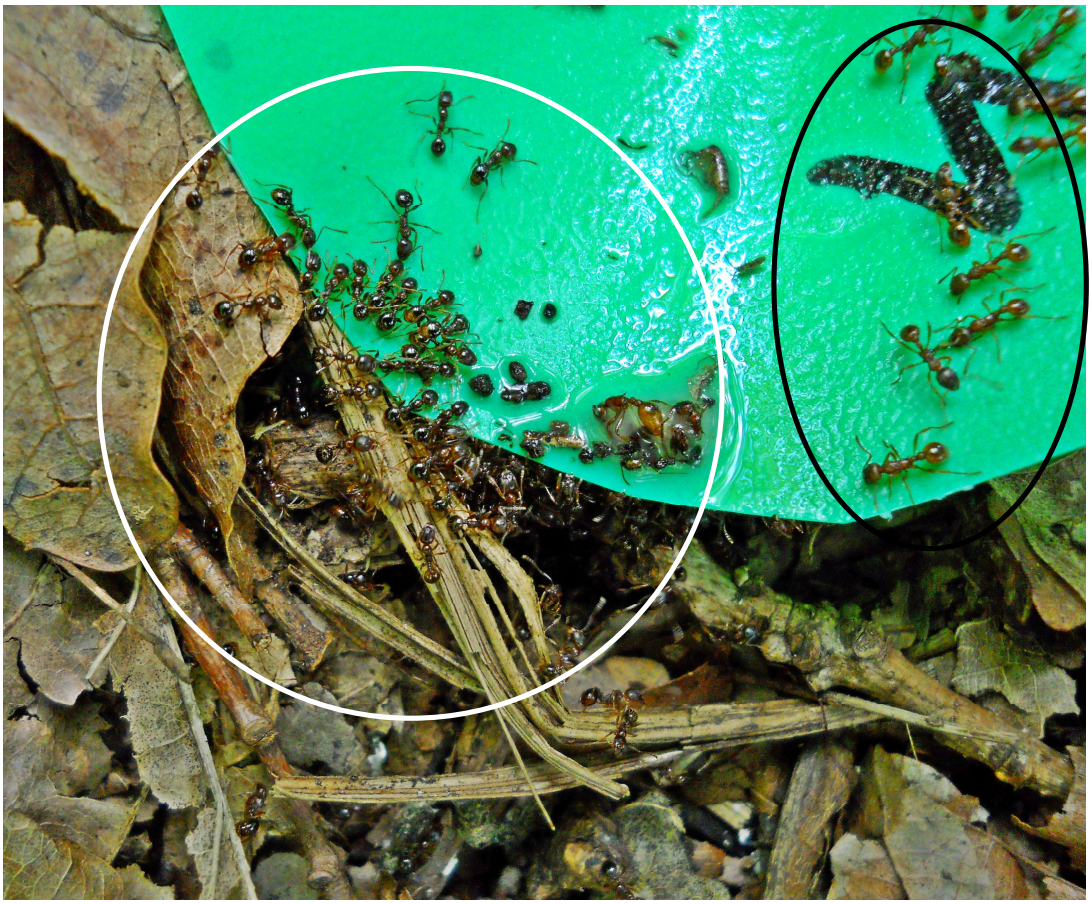


Fig. 2. Known distribution of *Aphaenogaster subterranaea* in Romania (black circles – new records; blank circles– published records)

Fig. 3. Clear-cut habitat on a northern exposition in Dumbrăveni (photo: I. Tăuşan)



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AQUATIC COLEOPTERA (INSECTA: COLEOPTERA) IN HANNENHEIM ENTOMOLOGICAL COLLECTION FROM NATURAL HISTORY MUSEUM SIBIU

Gabriela CUZEPAN*

Abstract. *The paper presents data regarding the presence of the species belonging to Gyrindae, Dytiscidae and Hydrophilidae families from the Heinrich Hann von Hannenheim entomological collection. A total of 76 specimens are present in the collection, which were collected during 1954 and 1957, mostly from Sibiu and its surroundings. Family Gyrinidae is present in the collection with 2 species belonging to one genus, the family Dytiscidae is present with 10 species belonging to 9 genera, the water scavenger beetles (family Hydrophilidae) are represented in collection by 10 species belonging to 9 genera. The aquatic coleopteran species list of Heinrich Hann von Hannenheim entomological collection represents a small contribution in filling a gap regarding the knowledge of this group in Romania.*
Keywords*: new records, Romania, Gyrinidae, Dytiscidae, Hydrophilidae*

Rezumat. *Lucrarea prezintă date despre speciile din familiile Gyrinidae, Dytiscidae şi Hydrophilidae din colecția entomologică a lui Heinrich Hann von Hannenheim. 76 de specimene sunt prezente în colecție, acestea au fost colectate în perioada 1954 – 1957, majoritatea din Sibiu şi împrejurimile acetuia. Familia Gyrinidae este reprezentată în colecție de 2 specii încadrate ce aparțin unui gen, familia Dytiscidae este reprezentată prin 10 specii ce aparțin la 9 genuri, gândaci gunoieri de apă (familia Hydrophilidae) sunt reprezentați în colecție de 10 specii aparținând la 9 genuri. Lista speciilor de coleoptere acvatice din colecția entomologică Heinrich Hann von Hannenheim reprezintă o contribuție minoră în completarea unui gol legat de cunoaşterea acestui grup pentru fauna entomologică din România.*
Cuvinte cheie: *date noi, România, Gyrinidae, Dytiscidae, Hydrophilidae*

Introduction

Entomological collections are valuable databases which are providing knowledge regarding the different species distribution, presence and absence, richness and other important data. Recently the museums collection value became more and more emphasized (Ponder *et. al.* 2001).

The Natural History Museum from Sibiu is one of the holders of these important databases of biological information. Since the museum inauguration (in 1949), its collections had grown in species and specimens. One of these collections is represented by the entomological collection, that have an important historical and scientifically value at national and international level, it is dated since 1827 (Pascu, Schneider 1998). The museum entomological collection reflects over a long period of time the entomofauna of the Transylvania Region, but also the entomofauna of other parts of Romania. The entire entomological collection comprise of 264.777 specimens that were collected by numerous members of the Transylvania Society (*Sibenbürgische Verein für Naturwissenschaften zu Hermannstadt*), collaborators of the Society's members, amateurs and famous entomological researchers. Several publications appeared along the time comprising some of the insect groups of: Lepidoptera, Orthoptera, Diptera, Hymenoptera, Coleoptera etc. (Pascu, Schneider 1998), but most of the entomological material remains still unpublished.

The Heinrich Hann von Hannenheim Entomological Collection is part of the museum entomological collection and comprises 5623 specimens from different insects groups. His collection was acquired in 1964 by the Museum (Schneider, 2003). The entomological material had been sampled during 15 years (1950-1964) by Hannenheim from Transylvania and Sibiu surroundings (Schneider, 2003). In 2003 a list comprising the Lepidoptera species, from Hannenheim collection, was published by Schneider in 2003.

The biggest part of Hannenheim collection is represented by the coleopterans specimens (1986 specimens), in which a small number is represented by the specimens of aquatic beetles.

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The aquatic beetles are considered to be secondary adapted for life in various standing and running freshwater habitats and they constitute one of the main groups of aquatic macroinvertebrates which plays important role in aquatic ecosystems (Temunović *et.al.* 2007).

The objective of this study was to comprise a list of the aquatic beetle species from Hannenheim Entomological Collection, and fulfilling gaps regarding this group of insect's distribution in Romania and especially in Transylvania Region.

Material and methods

The aquatic coleopteran specimens in Hanneheim collection belong to the Gyrinideae, Dytiscidae and Hydrophilidae families. The material had been collected during the years 1954 - 1957. The majority of samples were maid in 1955, followed by several samples in 1956, 3 samples in 1957 and only one sample in 1954. The aquatic coleopterans were sampled from February, to November.

The systematic update of the species list was compiled after the classification presented in the Catalogue of Palaearctic Coleoptera (Löbl, Smetana, 2003), Volume 1 by Mazzoldi (2003), for family Gyrinidae; Nilsson (2003), for family Dytiscidae; Ribera *et.al.* (2004), for family Hydrophiloidea. In addition, Hájek (2009) and online update version compiled by Nilsson (2011) and J. Hájek (2007) were consulted for Gyrinidae family.

Each species is presented according to the actual taxonomy, the name with which appears on the collection label mentioned in square brackets (synonymy), followed by the number of the specimens (spec./s), the place from which the specimens were collected with the actual name and the present geographical range in square brackets, followed by the period of samples. All specimens were collected by Heinrich Hann von Hannenheim. *Abbreviations:* spec. = specimen/s**;** Mt/Mts. = mountain/s**;** RO = Romania; GE= Germany;

Results

The aquatic coleopteran updated list of species from the Hannenheim Entomological Collection is systematically presented as follow:

Order Coleoptera
Suborder **Adephaga**- Schellenberg, 1806
Family **Gyrinidae** Latreille, 1810
Subfamily **Gyrininae** Latreille, 1810
Tribe **Gyrinini** Macleay, 1825
Genus ***Gyrinus*** O.F.Müller, 1764
Subgenus ***Gyrinus*** O.F.Müller, 1764

Gyrinus natator (Linné, 1758)
3 specs., Zakelsberg [Zakel Hill, Slimnic, Sibiu County, RO], 8.VII.1956; 4 specs., Jungen Wald [Pădurea Dumbrava, Sibiu County, RO], 29.VII.1956.

Gyrinus substriatus Stephens, 1828
[= Gyrinus natator (Linné, 1758)]: 2 specs. Zakelsberg [Zakel Hill, Slimnic, Sibiu County, RO], 8.VII.1956 – M.A. Ieniştea revid.

Family **Dytiscidae** Leach, 1815
Subfamily **Hydroporinae** Aubé, 1836
Tribe **Bidessini** Sharp, 1882
Genus ***Hydroglyphus*** Motschulsky, 1853

Hydroglyphus geminus (Fabricius, 1792)
[= *Bidessus pusillus* (Fabricius, 1781)] : 8 specs. Hmst. [Hermanstadt = Sibiu, Sibiu County, RO], 13.X.1955; 1 spec. Talmesch [Tălmaciu, Sibiu County, RO], 4.IX.1955.

Tribe **Hydroporini** Aubé, 1836
Genus ***Hydroporus*** Clairville, 1806

Hydroporus pubescens **(**Gyllenhal, 1808) : 4 specs. Poplaker Hlide [Poplaca, Sibiu County, RO], 6.XI.1955.

Subfamily **Agabinae** C.G.Thomson, 1867
Tribe **Agabini** C.G.Thomson, 1867
Genus ***Agabus*** Leach, 1817
Subgenus ***Gaurodytes*** C.G.Thomson, 1859

Agabus affinis (Paykull, 1798)
1 spec. Gr Zibin seser [Cibin river - Cindrel Mts., RO], 2200m, 25.VIII.1955.

Agabus bipustulatus (Linné, 1767)
4 specs. Poplaker Hlide [Poplaca, Sibiu County, RO], 6.XI.1955; 4 spec. Zibin seser [Cibin river - Cindrel Mts., RO], 15.VIII.1956 ; 1 spec. Jungen Wald [Pădurea Dumbrava, Sibiu County, RO], 29.VII.1956.

Subfamily **Colymbetinae** Erichson, 1837
Tribe **Colymbetin**i Erichson, 1837
Genus ***Rhantus*** Dejean, 1833
Subgenus ***Rhantus*** Dejean, 1833

Rhantus suturalis (MacLeay, 1825)
[= *Rhantus punctatus* (Geoffroy, 1785)]
5 specs. Poplaker Hlide [Poplaca, Sibiu County, RO], 6.XI.1955 ; 2 specs. Hmst [Hermanstadt = Sibiu, Sibiu County, RO], 5.III.1955; 2 specs. Hmst [Hermanstadt = Sibiu, Sibiu County, RO], 13.VIII.1955.
[= *Rhantus notatus* Fabricius (1781)]; 1 spec. Hmst [Hermanstadt = Sibiu, Sibiu County, RO], 13.VIII.1955; 1 spec. Poplaker Hlide [Poplaca, Sibiu County, RO], 6.XI.1955.

Genus ***Colymbetes*** Clairville, 1806

Colymbetes fuscus (Linné, 1758)
2 specs. Poplaker Hlide [Poplaca, Sibiu County, RO], 6.XI.1955.

Subfamily **Laccophilinae** Gistel, 1856
Tribe **Laccophilini** Gistel, 1856
Genus ***Laccophilus*** Leach, 1815

Laccophilus minutus (Linné, 1758)
[= *Laccophilus obscurus* (Panzer, 1795)]
3 specs. Poplaker Hlide [Poplaca, Sibiu County, Ro], 6.XI.1955; 1 spec. Hmst [Hermanstadt = Sibiu, Sibiu County, RO], 13.X.1955; 2 specs., Hmst [Hermanstadt = Sibiu, Sibiu County, RO], 5.III.1955.

Subfamily **Dytiscinae** Leach, 1815
Tribe **Aciliini** C.G.Thomson, 1867
Genus ***Graphoderus*** Dejean, 1833

Graphoderus cinereus (Linné, 1758)
1 spec., Salzburg [Ocna Sibiului, Sibiu County, RO], 1.III.1956.

Genus ***Acilius*** Leach, 1817
Subgenus ***Acilius*** Leach, 1817

Acilius sulcatus (Linné, 1758)
1 spec., Hmst [Hermanstadt = Sibiu, Sibiu County, RO], 5.III.1955.

Tribe ***Cybistrini*** Sharp, 1882
Genus ***Cybister*** Curtis, 1827
Subgenus ***Scaphinectes*** Adám, 1993

Cybister (Cybister) laterlimarginalis lateralimarginalis (DeGeer, 1774)
4 specs. Fischteich [pond, RO], 28.X.1954; 2 specs. Istrea Giolulsee [Histria, Ghiolul Mare Lake, Constanta County, RO], 14.VII.1955.

Suborder **Polyphaga**
Family **Hydrophilidae** Latreille, 1802
Subfamily **Helophorinae** Leach, 1815
Genus ***Helophorus*** Fabricius, 1775
Subgenus ***Helophorus*** Fabricius, 1775

Helophorus aquaticus (Linnaeus, 1758)
1 spec., Poplaker Hlide [= Poplaca, Sibiu County, RO], 6.XI.1955.

Subfamily Hydrophilinae Leach, 1815
Tribe Anacaeini M.Hansen, 1991
Genus *Anacaena* Thomson, 1859

Anacaena limbata (Fabricius, 1792)
2 specs., Jungen Wald [= Pădurea Dumbrava, Sibiu County, RO], 26.V.1957.

Tribe **Acidocerini** Zaitzev, 1908
Genus ***Enochrus*** Thomson, 1859
Subgenus ***Lumetus*** Zaitzev, 1908

Enochrus bicolor (Fabricius, 1792)
1 spec., Salzburg [= Ocna Sibiului, Sibiu County, RO], 1.VII.1956.

Tribe **Hydrobiusini** Mulsant, 1844
Genus ***Hydrobius*** Leach, 1815

Hydrobius fuscipes (Linnaeus, 1758)
1 spec., Hmst [= Hermanstadt = Sibiu, Sibiu County, RO], 3.III.1957.

Tribe **Hydrophilini** Latreille, 1802
Genus ***Hydrochara*** Berthold, 1827

Hydrochara flavipes (Steven 1808)
[= *Hydrous flavipes* (Steven 1808)]
1 spec., Poplaker Hlide [= Poplaca, Sibiu County, RO], 6.XI.1955.

Genus ***Hydrophilus*** Geoffroy, 1762
Subgenus ***Hydrophilus*** Geoffroy, 1762

Hydrophilus piceus Linnaeus,1758
1 spec., Hmst [= Hermanstadt = Sibiu, Sibiu County, RO], 25.VII.1956.

Subfamily **Sphaeridiinae** Latreille, 1802
Tribe **Coelostomatini** Heyden, 1891
Genus ***Coelostoma*** Brullé, 1835
Subgenus ***Coelostoma*** Brullé, 1835

Coelostoma orbiculare (Fabricius, 1775)
4 specs., unknown location, 20.V.1956.

Tribe **Megasternini** Mulsant, 1844
Genus ***Cercyon*** Leach, 1817
Subgenus ***Dicyrtocercyon*** Ganglbauer, 1904

Cercyon ustulatus (Preyssler, 1790)
1 spec., Hohe Rinne [= Păltiniş, Cindrel Mts., RO], 15.VIII.1955.

Tribe **Sphaeridiini** Latreille, 1802
Genus ***Sphaeridium*** Fabricius, 1775

Sphaeridium bipustulatum Fabricius, 1781
1 spec. Schewis [= Sebeş river, RO], 16.II.1957.

Sphaeridium scarabaeoides (Linnaeus, 1758)
1 spec., Crinz [= Crinț, Cindrel Mts., RO], 25.V.1955 ; 2 specs, unknown location, 19.VI.1955 ;1 spec., Hohe Rinne [Păltiniş, Cindrel Mts., RO], 15.VIII.1955.

Discussions

In the Heinrich Hann von Hannenheim Entomological Collection from the Natural History Museum from Sibiu, the aquatic coleopterans are represented by 2 families of the Suborder Adephaga (family Gyrinidae Latreille, 1810 and Dytiscidae Leach, 1815) and one family of the Suborder Polyphaga (family Hydrophilidae Latreille, 1802).

Family Gyrinidae is present in the collection with 2 species belonging to one genus, the family Dytiscidae is present with 10 species belonging to 9 genera. The water scavenger bettles (family Hydrophilidae) are represented in collection by 10 species belonging to 9 genera.

All of the aquatic coleopteran species are represented in the collection by few specimens; the collector had made only several samples during the period of the years 1954 and 1957. The family with the most number of specimens samples is Dytiscidae (with 50 specimens), followed by the family Hydrophilidae (with 17 specimens) and by the family Gyrinidae (with only 7 specimens). In comparison with other insects groups, the aquatic coleopteran appears poorly represented in his collection, this is a fact also found in the other entomological collection of the museum.

In regard with the distribution of the samples sites of the aquatic coleopterans, most of the specimens were collected from Sibiu and especially from Sibiu County (Figure 1). Many specimens collected from Sibiu County come from mountainous areas. Some specimens are collected outside of Transylvania region (from Ghiolul Mare Lake, Constanța County).

After consulting literature data and online databases of aquatic coleopteran (Šťastný, Trávnĺček 2000; Ruicănescu 1997; Ruicănescu, Mathé, 1999; Cojocaru 2005, 2006, 2008; Nicoară *et al*. 2009; Catalogue of Palaearctic Coleoptera edited by Löbl, Smetana (2003, 2004) and Fauna Europaea (2011) together with the lists compiled by: Audisio and Mazzoldi for family Gyrinidae; Audisio, Nilsson and Anders for family Dytiscidae and Alonso-Zarazaga, Hansen, Ribera *et al.*, (2004) for family Hydrophilidae), the following species have been already listed as present in Romania fauna: *Hydroglyphus geminus, Gaurodytes bipustulatus, Cybister (Schaphinectes) latermarginalis, Anacaena limbata, Enochrus (Lumetes) bicolor, Hydrobius fuscipes, Hydrochara flavipes, Hydrophilus piceus, Helophorus aquaticus, Coleostoma orbiculare, Cercyon ustulatus, Sphaeridium scarabaeoides Gyrinus substriatus, Gaurodytes affinis, Rhantus frontalis, Colymbetes fuscus, Laccophilus minutus, Graphoderus cinereus, Acilius sulcatus.*

For the follow species: *Gyrinus natator*, *Hydroporus pubescens*, *Sphaeridium bipustulatum*, their presence in Romania remains to be discussed, no data regarding their presence in Romania were found according to literature data consulted below, catalogue (Löbl, Smetana 2003, 2004), nor in Fauna Europea lists. For this it is necessary to deepen future investigation in order to establish their presence in Romania fauna.

Conclusions

The aquatic coleopteran species list of Heinrich Hann von Hannenheim entomological collection represent a small contribution in filling data regarding the aquatic coleopteran species distribution in Romania and in filling a gap regarding the knowledge of this group for the entomological fauna of this country. New data could be sampled to compare them with the present data from the collection, and in regards

with this a better knowledge about the aquatic coleopteran fauna will be made in order to estimate the species diversity and distribution.

This paper is also a recall for the passionate members of the Transylvania Society that brought their contribution to the knowledge of the numerous insect groups' diversity and distribution in Romania, and especially in Transylvania region

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Fig. 1. Samples site of the aquatic coleopteran from Sibiu and its surroundings according with the specimens from the Heinrich Hann von Hannenheim Entomological collection

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Fig. 1 Locurile de colectare a coleopterelor acvtice din Sibiu şi împrejurimile acestuia conform cu exemplare din colecția entomologică Heinrich Hann von Hannenheim

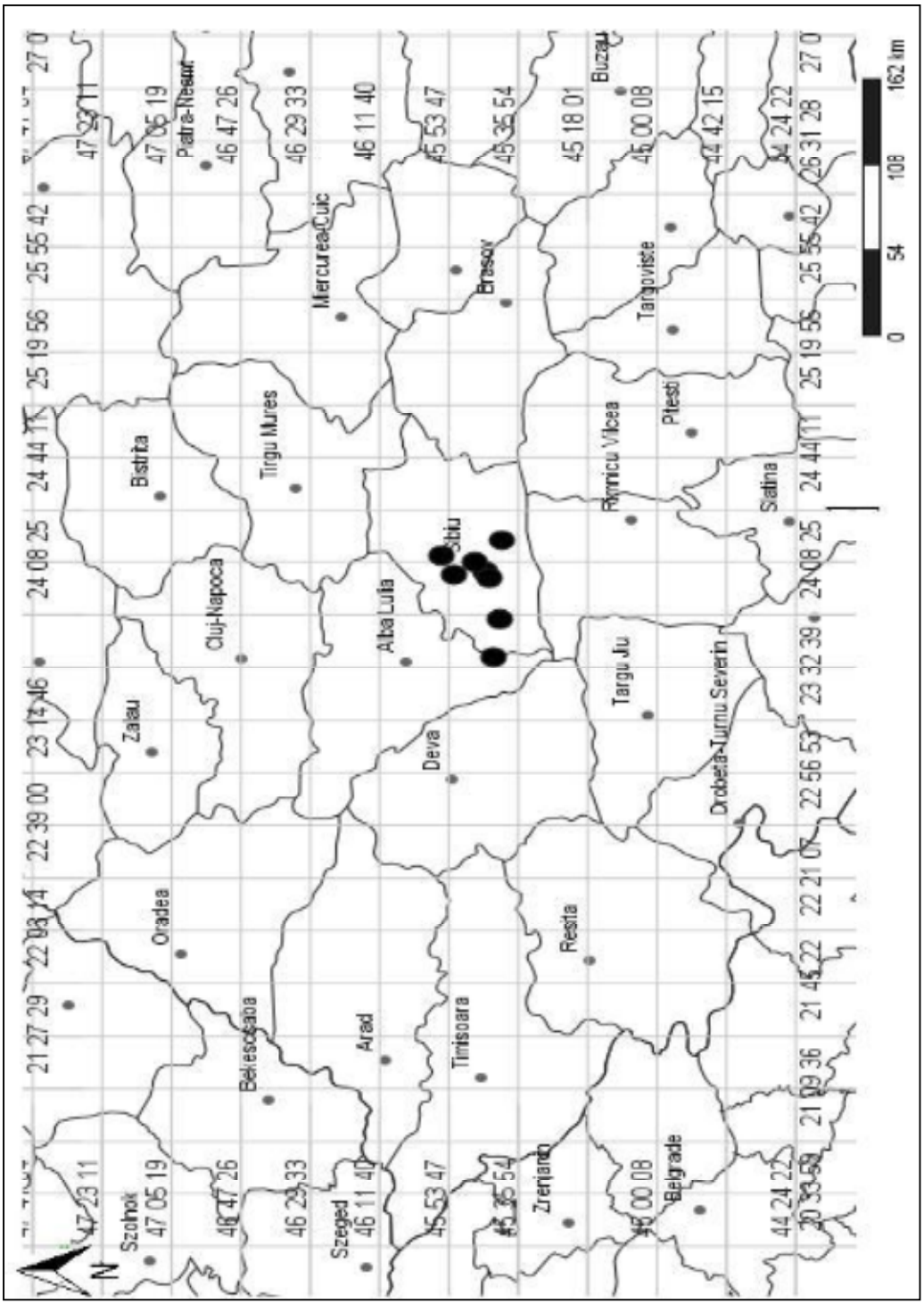

Fig. 1. Samples site of the aquatic coleopteran from Sibiu and its surroundings according with the specimens from the Heinrich Hann von Hannenheim Entomological collection

SPECIES DIVERSITY AND COMMUNITIES STRUCTURE OF SPRINGTAILS (HEXAPODA: COLLEMBOLA) UNDER ALFALFA CROP

Galina BUŞMACHIU*

Abstract. *The density and species diversity of Collembola from the eight alfalfa fields in the Republic of Moldova were investigated. The nitrogen fixation properties and the presence of a high diversity of food resources in the alfalfa fields are very attractive for a large spectrum of Collembola species. Total number of individuals, density and species richness of Collembola showed a peaked relationship with the location of alfalfa crop near the water sources and forest. In the fields situated near the natural forest the typical silvicolous species were recorded.*
Keywords*: agro-ecosystems, Collembola, Medicago sativa, Republic of Moldova.*

Rezumat. *În lucrare se prezintă diversitatea specifică şi densitatea colembolelor colectate în cultura de lucernă din Republica Moldova. Capacitatea de a acumula azotul şi diversitatea resurselor de hrană face lucerna extrem de atractivă pentru un spectru larg de specii de colembole. Cercetările au demonstrat că numărul de indivizi, densitatea şi diversitatea speciilor de colembole este maximă în lucerna amplasată între bazinele acvatice şi pădure. Diversitatea specifică în lucerna de lângă pădure este mai înaltă datorită speciilor caracteristice ecosistemelor forestiere.*
Cuvinte cheie*: agroecosisteme, colembole, Medicago sativa, Republica Moldova.*

Introduction

Human activities impose the spatial and temporal changes of habitats, which converts the natural ecosystems into a patch of crop fields of various types, perhaps interspersed with remnant forest, grassland, and/or wetland Fahrig, Jonsen (1998). In agricultural landscapes species richness of animals and plants has declined drastically. However the presence of certain plant species like legumes *Medicago sativa* and *Trifolium repens* in experimental grassland ecosystems has a strong influence on the structure of soil fauna, including collembolan communities Salamon *et al.* (2011)

Collembola is one of the commonly dominant groups of mesofauna in soil, playing an important role in organic matter decomposition. They are among the most abundant microarthropodes in the rhizosphere of plants mobilize nutrients by grazing on fungi and bacteria Endlweber, Scheu (2006). Also, different vegetation communities host different species assemblages of Collembola.

Many causal connections have been established between Collembola, the cropping systems and environmental factors Allan *et al.* (1975), Kováč (1994), Kováč, Miklisová (1995), Fahrig, Jonsen (1998), Hulugale *et al.* (1999), Dambos (2001), Frampton, Brink (2002), Sousa *et al.* (2002), Kanal (2004), Larsen *et al.* (2004), Vanbergen *et al.* (2007), while the influence of single plant species on the structure of the soil fauna community has generated little attention Salmon *et al.* (2011).

Alfalfa is an ideal crop for growing, having capacity to obtain most of the N needed for growth by developing root nodules and fixing atmospheric N_2 in symbiosis with compatible rhizobia (Amarger, 2001). This ability is the most renowned and is widely exploited for improving the soil fertility through the plant's nitrogen fixation properties Ceotto, Spallaci (2006). According to Salmon *et al.* (2011) the high N availability increase potential food sources through its diversification like fungi, algae, bacteria, pollen, leaves and decaying organic matter.

The main goal of this research was to study the species diversity and density of Collembola under alfalfa fields and to detect influence of neighborhood forest and water sources on their communities. Collembola diversity patterns were evaluated along a range of fields situated near natural oak forest, sources of water to monoculture of alfalfa located between other crops.

Material and Methods

The samples of soil were taken from 22 July to 10 December 2010 in eight alfalfa (*Medicago sativa*) fields situated in different localities of the

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Republic of Moldova. The fields varied in size, frequency of disturbance by cutting (1-2 times per growing season), age and location (Tab.1). Herbicides were not use and other kinds of plants, such as grasses, were present in the alfalfa also.

The study was conducted in the following three groups of alfalfa fields as described below:
i) patches located among others crops near the localities - Ivancea (Iv), Lozova (Lz), Mirnoe (Mr) and Rezina (Rz);
ii) patches located near the natural forest and far from water - Rădenii Vechi (RV) and Călăraş (Cl);
iii) patches located between forests and lake or bank of river - Lozova (Lzl) and Leuntea (Ln).

An identical number of soil samples with surfaces of 25 cm^2 and 5 cm depth from each alfalfa fields were taken using steel quadrant, put in plastic bags and transported in the laboratory. Specimens were extracted using flotation method, and then fixed in 80% ethyl alcohol, sorted and identified.

Results

As a result of investigation a total of 1042 individuals of Collembola were identified over all alfalfa fields, which fell into 55 species, 33 genera and 13 families: Entomobryidae with 14 species, followed by Isotomidae with 11 species, Tullbergiidae – 10, Hypogastruridae – 5, Onychiuridae – 4, Neanuridae – 3, Katiannidae – 2, Odontellidae, Tomoceridae, Cypoderidae, Sminturidae, Neelidae and Snimthurididae with one species each (Tab.2). The highest number of individuals were registered from the family Entomobryidae – 471 (45.2%), followed by Isotomidae – 226 (21.6%), Onychiuridae – 163 (15.5%), Tullbergiidae – 109 (10.4%) and Hypogastruridae – 43 (4.1%). These five families presented the majority of collembolan individuals - 1012 (96.8 %) living in the alfalfa fields with the highest abundance and number of recorded species.

The average density over all alfalfa fields are 14.362 ex.m^{-2}, varying between 25.700 ex.m^{-2} and 5.333 ex.m^{-2} per field. The fields from the localities Ln and Lzl situated between forest and sources of water (lake and river) were registered the maximum values of density (25.700 ex.m^{-2} and 20.800 ex.m^{-2}), number of individuals (257 and 208) and species (21 and 22) (Tab.2). The third highest density 24.666 ex.m^{-2} (number of individuals 185) were registered in locality Cl situated near the forest.

All found species were aggregated into three different functional groups according to their vertical distributions (epedaphic, hemiedaphic and euedaphic). These groups differ in dispersal ability and other life traits such as reproduction, mobility, metabolic activity and feeding behavior Hopkin (1997).

Epedaphic species (living above ground, feeding partly with decomposing plant organic matter and detritus): *Isotoma viridis*, *Desoria trispinata*, *Desoria* sp., *Orchesella cincta*, *O. multifasciata*, *Entomobrya marginata*, *E. multifasciata*, *Lepidocyrtus cyaneus*, *L. lanuginosus*, *L. lignorum*, *L. paradoxus*, *Sminthurus viridis*, *Sminthurinus* sp., *Sminthurinus elegans* and *Sphaeridia pumilis* (15 species with a total of 230 individuals).

Hemiedaphic species (living in superficial soil layers and feeding often on fungi and detritus): *Hypogastura vernalis*, *H. viatica*, *Ceratopysella denticulata*, *C. engadinensis*, *Pseudachorutes pratensis*, *P. subcrassus*, *Neanura muscorum*, *Hemisotoma thermophila*, *Folsomia quadrioculala*, *Parisotoma notabilis*, *Proisotoma minuta*, *Heteromurus major*, *Pseudosinella alba*, *P. moldavica*, *P. horaki*, *P. imparipuncata*, *P. octopunctata* and *Tomocerus vulgaris* (18 species with a total of 495 individuals).

Euedaphic species (feeding on fungi, bacteria and probably protozoa): *Willemia scandinavica*, *Axenyllodes bayeri*, *Doutnacia xerophila*, *Mesaphorura critica*, *M. italica*, *M. hylophila*, *M. krausbaueri*, *M. macrochaeta*, *M. yosii*, *Mesaphorura* sp., *Metaphorura affinis*, *Stenaphorura denisi*, *Protaphorura sakatoi*, *P. armata*, *Deuteraphorura silvaria*, *Micraphorura uralica*, *Folsomia candida*, *Folsomides parvulus*, *Isotomodes productus*, *Isotomiella minor*, *Cyphoderus albinus* and *Neelus murinus* (22 species with a total of 317 individuals).

The most abundant and frequent Collembola species dominating in alfalfa were: epedaphic *Heteromurus major* (312 individuals, present in all fields), hemiedphic *Parisotoma notabilis* (73 individuals in all fields also) and euedaphic *Protaphorura sakatoi* (138 individuals in six fields) (Tab.2). These species were followed by *Isotoma viridis*, *Isotomiella minor* and *Metaphorura affinis* with lower number of individuals (between 34 and 17), appearing from seven to six fields. All these species are widespread except *P. sakatoi*, having an ubiquist distribution and being abundant in various biotopes.

The alfalfa fields situated near the natural forest show peculiarities in species composition. Some typical silvicolous species such as *Neanura muscorum*, *Tomocerus vulgaris*, *Micraphorura uralica* and *Deuteraphorura silvaria* have been found there.

Discussions

Our study shows the high density and diversity of Collembola associated with alfalfa crop. The ability of this legume to increase the potential of food sources through the plant's nitrogen fixation property, minimum disturbance during the year, led to the observed high species diversity of all three functional groups. Total number of individuals, density and species richness of Collembola showed a positive relationship with the location of alfalfa fields near the sources of water and forest. Only in the patches situated near the natural forest the typical silvicolous species have been found.

According to Wu *et al.* (2008) the planting of alfalfa could improve soil properties and substantially increase density and diversity of Collembola in moderately degraded grassland. Also the presence of legumes in the grassland increased the density of euedaphic Collembola species Sabias *et al.* (2011).

The higher collembolan abundance and species richness in legume (*Trifolium repens*) were confirmed by the study of Kováč, Miklisová (1995).

However Sousa *et al*. (2002) have investigated collembolan diversity patterns in five land-use units of the Iberian Peninsula and revealed lower abundance and diversity of Collembola in the alfalfa field. As the most abundant and frequent species were cited *Folsomides parvulus* and *Hemisotoma thermophila*. As possible causes of significant decrease were reported several factors, especially intensive management. The similar results were obtained by Fahrig, Jonsen (1998) which suggest that alfalfa fields with higher disturbance frequency have lower overall insect richness.

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Tab. 1. Characteristics of the eight investigated fields

Localities*	Iv	Lzl	Lz	Ln	Rz	Mr	Cl	RV
GPS position	N 47^0 16' E 28^0 49'	N 47^0 06' E 28^0 21'		N 47^0 42' E 28^0 60'	N 46^0 40' E 29^0 36'	N 46^0 48' E 29^0 15'	N 47^0 13' E 28^0 22'	N 47^{0}18' E 28^{0}04'
Sampling dates	22.07.10	13.10.10	13.10.10	18.11.10	15.10.10	26.11.10	10.12.10	10.12.10
Age of lucerne (in yrs)	1	5	3	4	1	3	2	1
Number of cutting	2	1	2	1	1	2	1	2
Size of field (ha)	0,7	1,1	0,25	6	0,7	4	4	2

*abbreviations of localities as in "Material and Methods**"***

Tab. 2. List of Collembola species identified in studied alfalfa fields

№	Collembola families and species	Localities*								
		Iv	**Lzl**	**Lz**	**Ln**	**Rz**	**Mr**	**Cl**	**RV**	**Total**
	Hypogasturidae									
1.	*Hypogastura vernalis* (Carl, 1901)	-	-	-	13	3	-	-	-	16
2.	*Hypogastrura viatica* (Tullberg, 1872)	8	-	-	-	-	-	-	-	8
3.	*Ceratopysella denticulata* (Bagnall, 1941)	1	5	-	-	-	-	-	-	6
4.	*Ceratophysella engadinensis* (Gisin, 1949)	-	-	-	4	-	-	7	-	11
5.	*Willemia scandinavica* Stach, 1949	-	-	-	2	-	-	-	-	2
	Neanuridae									
6.	*Pseudachorutes subcrassus* Tullberg, 1871	-	1	-	-	2	-	-	-	3
7.	*Pseudachorutes pratensis* Rusek, 1973	-	-	-	-	-	1	2	1	4
8.	*Neanura muscorum* (Templeton, 1835)	-	-	-	-	-	-	-	1	1
	Odontellidae									
9.	*Axenyllodes bayeri* (Kseneman, 1935)	-	-	-	1	-	-	2	-	3
	Tullbergiidae									
10.	*Doutnacia xerophila* Rusek, 1974	-	1	-	-	-	-	-	2	3
11.	*Mesaphorura critica* Ellis, 1976	5	-	-	-	29	4	1	7	46
12.	*Mesaphorura italica* (Rusek, 1971)	-	-	-	-	-	-	1	-	1
13.	*Mesaphorura hylophila* Rusek, 1982	-	3	-	1	-	-	2	-	6
14.	*Mesaphorura krausbaueri* Börner, 1901	-	-	-	2	-	2	-	-	4
15.	*Mesaphorura macrochaeta* Rusek, 1976	-	-	-	-	-	-	-	6	6
16.	*Mesaphorura yosii* (Rusek, 1967)	-	9	9	-	-	-	-	-	18
17.	*Mesaphorura* sp.	-	-	-	-	-	2	-	-	2
18.	*Metaphorura affinis* (Börner, 1902)	6	1	2	-	2	-	5	5	21
19.	*Stenaphorura denisi* (Bagnall, 1935)	-	-	-	-	-	-	-	2	2
	Onychiuridae									
20.	*Protaphorura sakatoi* (Yosii, 1966)	3	-	-	96	5	4	4	26	138
21.	*Protaphorura armata* (Tullberg, 1869)	-	-	-	-	-	-	-	1	1
22.	*Deuteraphorura silvaria* (Gisin, 1952)	-	10	-	-	-	-	-	-	10
23.	*Micraphorura uralica* (Khanislamova, 1986)	-	-	-	-	-	-	-	14	14
	Isotomidae									

24.	*Cryptopygus thermophilus* (Axelson, 1900)	-	-	-	13	5	-	6	-	24
25.	*Folsomia quadrioculala* (Tullberg, 1871)	1	-	-	-	4	-	-	-	5
26.	*Folsomia candida* (Willem, 1902)	-	5	-	-	-	-	-	-	5
27.	*Folsomides parvulus* Stach, 1922	1	-	2	3	-	-	1	8	15
28.	*Isotoma viridis* Bourlet, 1839	7	-	2	5	2	6	7	4	33
29.	*Isotomodes productus* (Axelson, 1906)	1	-	-	-	-	-	-	3	4
30.	*Isotomiella minor* (Schäffer, 1896)	-	6	1	-	2	3	1	4	17
31.	*Parisotoma notabilis* (Schaffer, 1896)	2	14	4	25	3	7	11	7	73
32.	*Proisotoma minuta* (Tullberg, 1871)	-	1	-	-	1	-	-	-	2
33.	*Desoria trispinata* (Mac Gillivray, 1896)	-	2	-	-	4	-	-	-	6
34.	*Desoria* sp.	-	-	-	3	-	26	13	-	42
	Entomobryidae									
35.	*Orchesella cincta* (Linnaeus, 1758)	-	-	-	42	-	-	-	-	42
36.	*Orchesella multifasciata* Stscherbakow, 1898	2	-	-	2	-	1	2	-	7
37.	*Entomobrya marginata* (Tullberg, 1871)	-	6	1	21	4	2	-	-	34
38.	*Entomobrya multifasciata* (Tullberg, 1871)	-	-	-	-	-	1	-	-	1
39.	*Heteromurus major* (Moniez, 1889)	36	106	14	12	11	18	113	2	312
40.	*Lepidocyrtus cyaneus* Tullberg, 1871	9	12	1	-	-	-	-	-	22
41.	*Lepidocyrtus lanuginosus* (Gmelin, 1788)	1	-	-	-	-	-	-	-	1
42.	*Lepidocyrtus lignorum* (Fabricius, 1775)	-	1	-	-	-	-	-	-	1
43.	*Lepidocyrtus paradoxus* Uzel, 1890	3	15	-	6	2	-	-	1	27
44.	*Pseudosinella alba* (Packard, 1873)	-	-	-	-	-	-	1	-	1
45.	*Pseudosinella moldavica* Gama & Buşmachiu, 2002	1	-	-	1	1	-	-	-	3
46.	*Pseudosinella horaki* Rusek, 1985	-	3	2	-	1	-	4	2	12
47.	*Pseudisinella imparipuncata* Gisin, 1953	-	-	-	1	-	-	-	-	1
48.	*Pseudosinella octopunctata* Börner, 1901	2	-	-	1	-	3	1	-	7
	Cyphoderidae									
49.	*Cyphoderus albinus* Nicolet, 1842	-	-	2	-	-	-	-	-	2
	Tomoceridae									
50.	*Tomocerus vulgaris* (Tullberg, 1871)	-	1	-	-	-	-	-	-	1
	Neelidae									
51.	*Neelus murinus* Folsom, 1896	-	-	-	2	-	-	-	-	2
	Sminthuridae									
52.	*Sminthurus viridis* (Linnaeus, 1758)	2	2	-	1	-	-	1	-	6
	Katiannidae									
53.	*Sminthurinus* sp.	3	3	-	-	-	-	-	-	6
54.	*Sminthurinus elegans* (Fitch,1863)	-	1	-	-	-	-	-	-	1
	Sminthurididae									
55.	*Sphaeridia pumilis* (Krausbauer, 1898)	1	-	-	-	-	-	-	-	1
	Abundance ex.m^{-2}	9.500	20.800	5.333	25.700	8.100	8.000	24.666	12.800	14.362
	Number of individuals	95	208	40	257	81	80	185	96	Σ 1042
	Number of species	20	22	11	21	17	14	18	16	55
	Number of genera	17	18	11	18	16	12	14	14	33
	Numbar of families	7	8	4	6	5	4	7	4	13

DATA REGARDING THE PAST AND PRESENT DISTRIBUTION OF *ISOGNOMOSTOMA ISOGNOMOSTOMOS* (SCHRÖTER 1784) (HELICIDAE: ARIANTINAE) IN ROMANIA

Ana-Maria MESAROŞ*

Abstract. *The Malacological Collections of the Transylvanian Society for Natural Sciences of Sibiu (Siebenbürgischer Verein für Naturwissenschaften zu Hermannstadt) include 169 specimens identified as Isognomostoma isognomostomos (Schröter 1784), a land snail indicator species collected from Romania. The Kimakowicz Collection possesses 152 specimens of I. isognomostomos (Schröter 1784) from which 113 gathered from Romania and 39 from other European countries. The specimens were listed during the inventory done in the Natural History Museum from Sibiu Malacological Collections from 2009 to 2011. The aim of this paper is to establish the past collecting sites, especially the ones from Romania, in comparison to the present distribution of the species according to today's references. The distribution maps generated support future distribution studies of the species.*
Keywords*: museum collections, I. isognomostomos, present day distribution*

Rezumat. *Colecţiile malacologice ale Societăţii Ardelene pentru Ştiinţele Naturii din Sibiu (Siebenbürgischer Verein für Naturwissenschaften zu Hermannstadt) includ 169 specimene aparţinând speciei Isognomostoma isognomostomos (Schröter 1784), melc terestru considerat specie indicatoare. Colecţia Kimakowicz numără 152 specimene aparţinând aceleaşi specii, dintre care 113 colectate din România şi 39 din alte zone ale Europei. Specimenele au fost identificate în urma inventarului realizat în colecţiile malacologice aparţinând Muzeului de Istorie Naturală din Sibiu din 2009 până în 2011. Scopul acestei lucrări este de a stabili zonele de colectare din trecut ale speciei, mai ales a celor de pe teritoriul ţării noastre, comparativ cu distribuţia actuală a acesteia, în funcţie de datele bibliografice din present. Hărţile de distribuţie rezultate sprijină studiile viitoare ale distribuţiei speciei.*
Cuvinte cheie*: colecţii muzeale, I. isognomostomos, distribuţia actuală*

Introduction

Biodiversity distribution at different spatial and temporal scales has long been the focus of ecology and biogeography. Reliable descriptions of species distributions are fundamental for conservation and research purposes. Raw data on the presence of species gathered from museums and/or recorded from field surveys are increasingly used to build species distribution maps.

Isognomostoma isognomostomos (Schröter, 1784) or the mask snail is a terrestrial helicid snail with a distribution in Europe extending over the mountainous regions of central Europe, from the Harz, Sauerland and the Eitel region in the north, to the Carpathians in the east and the Alps, Jura and Vosges in the south and southwest (Ant, 1963, 1-121; Kerney *et al.* 1983, 384). The species is considered to be of Alpine-Carpathian origin and probably dispersed northward during inter- and postglacial periods (Ant, 1963, 1-121).

The shell brown, height 4-7 mm, width 7-11 mm, smooth with long and slightly curved hairs (can be eroded in old shells), 4-5 convex whorls, rounded at periphery, aperture inside narrow, margin pale brownish and thick, reflected, with a basal and a palatal tooth, parietal side with a prominent white lamella running along the parietal margin of the aperture, but not or only weakly connecting at both ends at the apertural lip, umbilicus in a flattened area and almost entirely covered except a tiny crescentic opening.

The hairs are semi-rigid structures part of the periostracum, a thin protein layer (conchiolin) secreted by the snail to cover the calcareous shell. *I. isognomostomos*, like other hairy snails, presents specialized glandular tissue and complex strategies so that it can form the hair. There are different hypothesis why the snail has hairs: defense against predators, sexual selection, climate selection, adaptation to move in humid environments. One of them is that the hairs facilitate the adherence of the snail to its herbaceous food plants during foraging when humidity levels are high (Pfenninger *et al.* 2005, 5-59).

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The species is encountered under dead wood logs and rock rubble in humid mountain forests, abundant in gorges covered by forests, at 300-1800 m altitude, in Romania 400-1500 m. Dvořák (2005 a, 97-103) established that at suitable stands in the Bohemian Forest, *I. isognomostomos* lives togheter with *Vestia turgida* (Rossmässler, 1836), *Vertigo alpestris* Alder, 1838, *Semilimax kotulae* (Westerlund, 1883), *Deroceras rodnae* Grossu et Lupu, 1965 or *Causa holosericea* (Studer, 1820). A similar assemblage with *V. turgida* is known from the Bavarian Forest (Hässlein, 1966, 1-176).

The mask snail was also encountered in winter time in subterranean shelters like military bunkers, karst or pseudokarst caves, cellars of different types, mining galleries, due to a possible immigration of the species from a cold outer environment (Dvořák, 2005 b, 10-16).

Ideally, mollusc biogeography should include data from systematic, ecology, paleontology, paleo-climatology and changes in distributions over time. The data accumulated from all of these studies should be correlated with data from the study of other elements in the biota (Grossu, 1984, 93-106). In the initial stage of the documentation, necessary for this study, papers from all of the domains mentioned above that include data regarding *Isognomostoma isognomostomos* were mentioned so that a more complete biogeographical analysis of this species can be attempted.

Between 1995 and 1997, Piläte (2003, 216-220) investigated terrestrial mollusks as indicator species of natural forests in Latvia. As indicator species were chosen species that require specific conditions in a prolonged time period (forest continuity, stabile microclimate, large diameter logs and old trees) as well as endangered by certain forest management practices (clear-cuttings, soil tillage, establishment of plantations and artificial regeneration, land drainage, removal of dead wood and injured trees). From the 85 terrestrial mollusk species found in Latvia inhabiting forests, one of the identified species was *Isognomostoma isognomostomos*, species considered to be a mollusc indicator, inhabiting broadleaved forests. The author concluded that *Isognomostoma isognomostomos*, *Ena montana* and *Spermodea lammelata* have particularly high indicative value.

In Romania the achievement of a responsible forest management is in progress. Studying the *I. isognomostomos* populations from the Romanian forests we can obtain valuable information that can contribute to the conservation of the local forests. Land snail indicator species like *Isognomostoma isognomostomos* can provide a point in the evolution and development of these endeavors for a sustainable management and conservation of the forest biodiversity.

In 2001, Riel *et al*. (2001, 1-11) investigated the genetic and phenotypic variation in 13 populations of *Isognomostoma isognomostomos* from Belgium, Germany, Czech Republic, Austria, Liechtenstein and Switzerland. The reason of this study was to determine to what degree the peripheral Belgian populations of *Isognomostoma isognomostomos* are differentiated from population elsewhere in Europe.

In Romania the genetic variations of the *Isognomostoma isognomostomos* was not investigated and the danger of genetic drift and inbreeding is possible. Generally, small and isolated populations are prone to effects of genetic drift and inbreeding, resulting in two possible, though not mutually exclusive, outcomes. Usually, genetic drift and inbreeding will lead to loss of alleles and decreased heterozygosis, resulting in reduced evolutionary flexibility and a higher risk of extinction (Riel *et al.*2001, 1-11).

Ŝteffek *et al*. (2008, 168-188) has studied the succesional processes on travertines on the basis of the Mollusc fauna from the Hornádska kotlina Valley (Slovak Republic). The valley includes several different aged travertine sites. By sampling the travertine and manually picking the shells, the author identified 88 recent molluscs species, a very high diversity of species. *Isognomostoma isognomostomos* was noted in the north exposure of the valley, castle rock-hills and debris. Mollusc communities of travertine sites are very specific, often conservative and relict, with a mixture of xerothermophilous and mountainous elements. *Isognomostoma isognomostomos* is an indicator of these communities.

The mask snail was subject of stratigraphical studies, in the frame work of detailed geological mapping during the study from Augustów Plain from NE Poland where interglacial sediments of the Lower Middle Pleistocene were determinated (Ber, 2005, 61-76). In the rich faunistic assemblage discovered were included numerous shells of *I. isognomostomos*, *Soosia diodonta* and *Drobacia banatica*. *Isognomostoma isognomostomos*, together with other faunistic and paleobotany elements, are indicators of the stratigraphical scheme of a region.

In 2002, Žák *et al.* (2002, 137-152) studied the climate-induced changes in Holocene calcareous tufa formations from the Bohemian Karst (Czech Republic). Molluscan shells are present in all layers of the studied section. In the lower horizon, characterized by maximum species richness was

identified *Isognomostoma isognomostomos*. Geochronological dating and the assemblages of Mollusca species are methods in the study of climate-induced changes at a geological level.

As part of the soil community *Isognomostoma isognomostomos* has been studied in relationship to its influence in litter decomposition in deciduous forests (Fahrenholz *et al.*2009, 45-70), in soil biodiversity assessments (Sólymos *et al*. 2007) and to analyze the response of the soil macrofauna communities to increasing tree species diversity in a temperate deciduous forest (Fahrenholz *et al*.2009, 45-70).

The present paper is based on a revision accomplished by the author in 2009-2011, with the purpose to update the inventory and to ascribe the former chorology in terms of modern toponymes. The aim of the revision was to recover the data related to the former distribution of the species in Romania, highlighting the outstanding documentary value of these collections.

Material and methods

Information regarding the past and present collecting sites was obtained from five sources: (a) a re-examination of the Natural History Museum from Sibiu Malacological Collections (b) catalogues of museum specimens, (c) literature cheek, (d) internet database, (e) internet data, base maps.

The collections inventory books were used for comparison and to locate the boxes holding the species belonging to the Ariantinae Subfamily in the deposit. The Transylvanian Society inventory books did not include the collecting sites of the specimens which were noted from the original labels written by Michael Bielz and Edward Albert Bielz. The Kimakowicz inventory books include the partial collecting sites, not the dates, but the original labels are complete and easy to read. For some species the localities are accurately known, but a few of the identifications are hard to read because the writing on the original label has partially faded.

The original collecting sites are given in German or in Hungarian, seldom in Romanian, because in the XIXth and the beginning of the XXth centuries, Transylvania was enclosed in the Austro-Hungarian Empire. The links between the past- and present-day names was restored using Stielers Hand – Atlas (1913) and Atlas von Siebenbürgen - Ortsnamenbuch (Heller *et al*. 1992).

The specimens belonging to *Isognomostoma isognomostomos* (Schröter 1784) present in the Museum Malacological Collections were collected not only from Romania, the subject of this paper, but also from Germany, Austria, Czech Republic and Croatia.

In the lists included in this paper each species is noted following today's taxonomy, the name with which it appears on the original collector's note (Syn.), the number of specimens collected from that specific location, the collecting site and the inventory number (Inv. No.).

The inventory numbers are essential for future studies, as all the researchers interested in analyzing a particular specimen could find it easier in the collections or the initial results of this paper can be confirmed.

Some labels, especially the ones belonging to the Kimakowicz Collection, have written the year when the specimen was collected, name of the collector or the person who identified the species.

The collecting sites are grouped considering the counties in which are found or mountainous area for two reasons: firstly because it is easier for the reader to single out a location and secondly, many of the present studies are related to a specific region or area.

The systematic catalogue is given according to Grossu (1993, 334), "Fauna Europaea", the lists compiled by Bank (2009) and Mollbase – Database of Mollusks of Central Europe.

Results and discussions

Taxonomy

Classis Gastropoda Cuvier 1798,
Order Pulmonata Cuvier 1814,
Superfamily Helicoidea,
Family Helicidae Rafinesque 1815,
Subfamily Ariantinae,
Genus Isognomostoma Fitzinger 1833,
Subgenus Isognomostoma Fitzinger 1833.
Isognomostoma isognomostomos (Schröter 1784)

Past distribution according to the museum collections

The collecting sites identified in the Malacological Collections of the Transylvanian Society for Natural Sciences of Sibiu are:

Syn. *Helix personata* Lamarck, 1792 – 157 specimens collected from:

4 Moldavia Inv. No. 21858 – 21861; 6 Cluj County (Inv. No. 4656-4658 Cojocna, Inv. No. 122557-122559 Cara); 39 Sibiu County (Inv. No. 4652-4655 Avrig, Inv. No. 13558 – 13560 Prejba Mountains, Inv. No. 21697 – 21698 Sadu River, Inv. No. 21836 – 21839 Mediaş, Inv. No. 22010 – 22011 Brateiu Inv. No. 22017 – 22018 Cârţişoara,

Inv. No. 22119-22121 Bradu, Inv. No. 21603-21609 Seviş Valley – Cisnădie, Inv. No. 21869 – 21873 Păltiniş, Inv. No. 177111 Olt River bank at Turnu Roşu, Inv. No. 198078-198079 Turnu Roşu); 9 Braşov County (Inv. No. 21533-21534 Tâmpa, Inv. No. 21802 Măgura Summit – Zărneşti, Inv. No. 21867 – 21868 Bran, Inv. No. 21974 – 21976 Bacifalău – Săcele, Inv. No. 122540 Şoarş); 5 Covasna County (Inv. No. 21862 – 21866 Vâlcele); 1 Suceava County (Inv. No. 21751 Apa Ciobanului – Drăgoiasa); 1 Vîlcea County (Inv. No. 122530 Runcu, Babii Valley); 10 Alba County (Inv. No. 21620 – 21625 Lungă Valley, Inv. No. 21941 – 21944 Sebeş Valley – Bistra); 20 Harghita County (Inv. No. 21595 – 21599 Gheorgheni, Inv. No. 21691 – 21694 Tuşnad Baths, Inv. No. 21935 – 21936 Curmătura Penticului – Tulgheş, Inv. No. 21971 – 21973 Red Lake (Gheorghieni); 22 Mureş County (Inv. No. 21689 – 21690 Mureşului Valley – Răstolnița, Inv. No. 22004 – 22009, 22113 – 22115, 21967 – 21970, 122532-122539 Sighişoara); 5 Sălaj County (Inv. No. 21800 – 21801 Crasna, Inv. No. 21980 – 21982 Var); 1 Argeş County (Inv. No. 21753 Dîmbovicioara); 12 Piatra Craiului Mountains (Inv. No. 21537 – 21539 Piatra Mică, Inv. No. 21940 Moara Dracului, Inv. No. 21977 – 21979 Zărneşti – Crăpăturii Valley – Colțul Chiliilor, Inv. No. 22012 – 22016 Piatra Mare); 2 Bucegi Mountains (Inv. No. 21532 Rütthl Gorge, Inv. No. 122529 Hotarului Valley); 1 Apuseni Mountains (Inv. No. 122517 Gheţarul Scărişoara); 8 Ciucaş Mountains (Inv. No. 21937 – 21939 Dungu Mountains, Inv. No. 22116 Ciucaş Mountains, Inv. No. 22117-22119 Bârsei Mountains, Cheile Tamina, Inv. No. 122531 Colțul Telejan); 10 Outer Eastern Carpathians (Inv. No. 21524 – 21531 Uz Valley, Nemira Mountains, Inv. No. 21601-21602 Cracul Geamăna Summit, Gosman Mountains); 2 Bucşoiul Mountains (Inv. No. 21695 – 21696 Vâlcelul Grohotişului, Bucşoiului Valley, the Eastern slope of the mountain); 5 Cibin Mountains (Inv. No. 21803 – 21805 Prejba, Inv. No. 21869 – 21870 Duş); 5 Rodna Mountains (Inv. No. 21799 Piatra Roşie or Piatra Rândunelelor, Inv. No. 22019 – 22021, 22122 Rodna Mountains); 1 Negoiu Mountains (Inv. No. 22018 at Negoiu lodge); 1 Harghita Mountains (Inv. No. 21752 Almaş Cave).

The collecting sites identified in the Kimakowicz Collection are:

- Syn. *Isognomostoma personata* Lamarck, 1792 – 113 specimens collected from:

35 Cibin Mountains (Inv. No. 4850/8447 Prejba, 1887, Inv. No. 4867/230 Ursului Hill, 1883, Inv. No. 4868/8444 Foltea Hill, 1884, Inv. No. 4870/229 Duş, 1883, Inv. No. 4871/226, Inv. No. 4872/8445 Duş, 1891, Inv. No. 4873/224 Easter parts 1883, Inv. No. 4874/8446 Măgura Cisnădiei, 1887, Inv. No. 4875/227 Plaiul Moşilor, 1883, Inv. No. 4876/228 Şanta, Păltiniş, 1883, Inv. No. 4881/225 Cibin Mountains, 1883), 1 Sibiu County (Inv. No. 4869/8443 Apoldu de Sus, 1880), 9 Alba County (Inv. No. 4857/235 Aiud, 1883, Inv. No. 4859/8432 Detunata, Bucium District, Inv. No. 4858/8433 Scărişoara Cave, Gârba de Sus Village, Inv. No. 4865/8434 Valea Lungă, 1906, leg. Barth), 1 Scocul Mare (Inv. No. 4860/234 Jiului Valley), 1 Piatra Barului Mountains (Inv. No. 4861/231 Retezat Mountains, 1883), 1 Zănoagei Hills (Inv. No. 4862/233, Retezat Mountains, 1883), 1 Piatra Şipotului (Inv. No. 4863/232, next to Petrosu, Jiului Valley), 11 Mureş County (Inv. No. 4864/8435, Sighişoara, 1900, Inv. No. 4866/8437 Sighişoara forest, 1900, Inv. No. 4891/8436 Sighişoara, 1900), 10 Lotrioara Valley at Turnu Roşu (Inv. No. 4877/223, 1883), 1 Tîmpa, Nordthern parts, Braşov (Inv. No. 4878/8453, 1900), 3 Orlat, Cernei Valley (Inv. No. 4879/12414), 2 Văcăraia, Făgăraş Mountains (Inv. No. 4880/8448, 1896), 1 Poiana Braşov (Inv. No. 4882/8454, 1900), 1 Comăna de Sus, Perşani Mountains (Inv. No. 4883/8449, 1892, leg. Deubel), 1 Heldenburg, Perşani Mountains (Inv. No. 4884/222, 1879, leg. Riess.), 1 Hoghiz, Braşov County (Inv. No. 4885/8442, 1906, leg. Barth.), 2 Măgura Codlei, Perşani Mountains (Inv.No. 4886/8450, 1895, Deubl.), 3 Piatra Mare until Piatra Mică, Piatra Craiului Mountains (Inv. No. 4887/8456, 1888, Deubl.), 1 Piatra Mică, Piatra Craiului Mountains (Inv. No. 4888/8457, 1886, Deubl.), 1 Piatra Mare, Piatra Craiului Mountains (Inv. No. 4889/220, 1879, Riess), 1 Cracul Mare Mountains, Cristian, Braşov County (Inv. No. 4890/8455, 1900), 1 Piatra Craiului Mountains (Inv. No. 4892/221, 1884, leg. Daubel.), 1 Colțul Chiliilor, Piatra Craiului Mountains (Inv. No. 4893/8451, 1886, leg. Deubl.), 1 Cheile Dâmbovicioarei (Inv. No. 4894/8452, 1886, Deubl.), 1 Tesla, Ciucaş Mountains (Inv. No. 4895/7979, 1900), 1 Piatra de Pază, Hăşmaş Mountains (Inv. No. 4896/8440, 1891, Deubl.), 3 Miercurea-Ciuc, Harghita County (Inv. No. 4897/8441, 1891, Deubl.), 1 Harghita, without other data (Inv. No. 4898/8439), 1 Tesla, Northern slops, at the base, Ciucaş Mountains (Inv. No. 4899/4476, 1900), 1 Miercurea-Ciuc, with no other data (Inv. No. 4900/8430), 1 Hidiş, Bihor County (Inv. No. 4901/8429, 1891, Deubl.), 9 Borsec (Inv. No. 4902/8427, 5.08.1891, leg. Deubl.), 2 Northern Transilvania (Inv. No. 4903/8431, 1891, Deubl.), 2 Moldavia (Inv. No. 4904/8428, 1891, Deubl.),

Piatra Roşie, Northern Transilvania (Inv. No. 4905/8430, Deubl.).

Data extracted from literature

Bielz (1863, 53-54) mentioned the species in *Fauna der Land und Süsswasser – Mollusken Siebenbürgens* collected from the following sites that are not included in the Society Collection: Sibiu County (Gura Râului, Cisnădioara, Tălmaciu, Porumbacu, Cârţişoara), Alba County (Piatra Corbului, Aiud), Braşov County (Drăguş), Postăvarul Mountains, Ciomatu Mountains (St. Ana Lake), Hargita County (Odorheiu Secuiesc), Gurghiu Mountains, Harghita County (Topliţa, Borsec), Sălaj County (Gîrbou), Apuseni Mountains (Detunata, Scărişoara Cave), Hunedoara County (Vărmaga village, Metaliferi Mountains, at the base of the Auriferi Mountains, under the Gurguiota Summit).

Grossu (1983, 483-509) possessed in his collection over 250 specimens collected from 40 places starting from the Danube to Herculane Baths, and especially in the mountains areas (Rodna Mountains and Apuseni Mountains). In his previous work Fauna Republicii Populare Române, Mollusca (1955), the third edition he mentioned that in our country the species can be found in Bucegi, Făgăraş, Parâng, Ceahlău, Apuseni, Piatra Mare, Piatra Craiului mountains. The catalogue of the mollusks from Romania (Grossu, 1993, 334) includes the species *I. isognomostomos* as being distributed in mountain forests, on stumps and among the stones, in all Carpathian Chain.

Nagrea (1994, 10, 14) identified the species in 1957, 1962 and 1970 in Dobrogea, collecting site Dobrogei Mouth – Gura Dobrogei (at Liliecilor Cave, Râpele Apţiene, Găurii Valley, Bujori Hill – Dealul cu Bujori, Seacă Valley) and Border Canaraua.

Domokos, Lennert (2007, 67-95) initiated a standard faunistical study on the mollusks of Codru-Moma Mountains. The authors consulted also the Malacological collections from the Hungarian Natural History Museum (Budapest and Munkácsy Mihály Museum (Békéscsaba). Previous malacofaunistical data from the area that included *Isognomostoma isognomostomos* came from Csiki (1906) that found the species in Beliu, Finiş and Vaşcău, and from Soós (1943) who collected specimens from Beiuş, Moneasa and Vaşcău. Domokos, Lennert (2007, 67-95) original data, obtain in different periods of field work, includes the following locations: from 1990 – Borz, cliff above the spring and broken fragments; from September 2004 – Hăşmaş, stony bank of the brook Hăşmaş, humid dead leaves (*Fagus* sp.) left and right side of the brook, stones of the brook bed; from 2004 – Urvişu de Beliu, stony bank of the brook covered with great burdock.

Sólymos *et al.* (2007, 6-7) sampled an unusually rich land snail fauna in the coniferous forest from Slătioara (Suceava, Romania) counting 20 species, among them *I. isognomostomos*. According to the authors land mollusc species richness varies between 2 and 15 in northern coniferous forests and it is somewhat lower in central European conifer plantations. At the time of their study the authors could not find published literature on the fauna of Carpathian coniferous forest.

Fehér *et al.* (2008, 163-164) from the Hungarian Natural History Museum undertook a study in the Maramureş area between 2006 and 2008. The results of these studies were correlated with the data all ready present in the museum Malacological collections especially the Wagner Collection. In the museum collection the species was collected from Gutâi Mountains (Staţiunea Izvoare at 1000 m, beech forest), Borşa Baths, Pietrosu Summit (1200 – 1900 m). The new data brought by the authors: Rodna Mountains limestone rocks over the ski course, N47°35’13.9” E24°48’05.1”, 1521m, Cimpoieş Stream under the ski course, N47°36’17.1” E24°46’47.9”, 946m, Oaş Mountains, Kövesláz Stone, beech forest and brook beneath the Huţa Pass, N47°58.151’ E23°31.184’, 430m, Maramureş Mountains, Vişeu de Sus, Suligu de Sus Stream and pine forest at the mineral water spring, N47°48.310’ E24°41.143’, 862m, Rodnei Mountains, Săcel, Iza Gorge, Iza River and the shore vegetation, limestone rocks, N47°36.058’ E24°31.812’, 946m.

Gheoca *et al.* (2008, 55) collected the species from the Maramureş Mountains Nature Park, at Bardău, Vaser Valley collecting site.

The species was also identified by Lengyel, Pàll-Gergely (2009, 97-98) during 2007 campaign in the Bihor and Vlădeasa Mountains in the following locations: Cluj County, Vlădeasa Mountains, Răchiţele, Valea Seacă, 1150 m; Bihor County, Bihor Mountains, Padiş plateau, NW of Padiş Lodge, beech forest, 1300 m; Bihor County, Bihor Mountains, Bazarul (Cetăţile), Someşul Cald, Cetăţile Rădesei, at 1250 m; Bihor County, Bihor Mountains, Boghii Summit, beech forest, at 1340 m; Bihor County, Bihor Mountains, Valea Boghii, at 580 m; Alba County, Bihor Mountains, Caput Cave, 1060 m; Alba County, Bihor Mountains, Urşilor Valley, South-facing cliffs, 1200 m; Alba

County, Bihor Mountains, Urşilor Valley, North-facing cliffs, 1200 m.

Sîrbu *et al.* (2009, 26) identified the species and noted its presents in the Retezat National Park, collecting specimens from: Cheile Scorota, Câmpuşel II, Piatra Iorgovanului, Cheile Buții, mixed forest in Buta Valley, northern slope of Piule, Soarbele.

The investigation results obtained after re-examining the museum collections and the current studies regarding the past and present collecting sites are presented in Table 1, which includes the collecting sites in geographic areas like counties and mountainous areas. The indefinite collecting points like Transylvania or Moldavia are written for future records. Also the map generated with the help of SimpleMappr, online mapping program, helps create a general image of the species distribution (Fig. 1).

Conclusions

The Natural History Museum from Sibiu shelters an outstanding valuable Malacological Collection of a great documentary significance. Comparing the former fauna distribution of *Isognomostoma isognomostomos* (Schröter 1784) with those documented in the last years we can assess the effects of environmental quality on the species. By mentioning the collecting sites for *I. isognomostomos* especially the areas where reserves do not exist we can increase the awareness of the both scientific and general community, because terrestrial mollusks are among the most threatened group of animals (Lydeard *et al.* 2004, 321-330; Rundell, 2007, 1-2). Also for a preserved area manager or policymaker an estimate of the number of species and the "highlight" species (e.g. those that are known to be rare elsewhere, or that are particularly compelling for another reason, scientific or otherwise) may be more than sufficient to guide a decision to protect an area or include it in future management efforts.

IUCN Red List of Treathened Species 2011.1 includes the masked snail to the Least Concern category as the species is relatively widespread been native, according to the same data base, to: Austria; Belgium; Bosnia and Herzegovina; Croatia; Czech Republic; France (France (mainland)); Germany; Hungary; Italy (Italy (mainland)); Latvia; Liechtenstein; Lithuania; Luxembourg; Poland; Romania; Russian Federation (Kaliningrad); Slovakia; Slovenia; Switzerland; Ukraine (Neubert, 2011).

According to AnimalBase (2010) the species is endangered in Niedersachsen (Germany), vulnerable in Rheinland-Pfalz (Germany). Also the species is included in the Ötscher-Dürrenstein (Austria) Natura 2000 network, as endangered species in the region. The mask snail is endangered (EN) in Lower Saxony, where its distribution area has its northern limits with the Süntel and Teutoburg mountains.

Limited dispersal abilities of land snails make them very suitable model organisms for studying phylogeographical and evolutionary processes. Research of dispersal patterns of these organisms can help us discover the ice age refuge on the European continent. *Isogonomostoma isognomostomos* together with other land-snail species as *Helicodonta obvoluta, Faustina faustina, Cochlodina laminate* and *Cochlodina dubiosa corontica* can be used as model species to investigate the existence of a glacial refuge in Central Europe (Szalontayová, 2010, 22).

Making a comparison between the past collecting sites and the present ones we can find some similarities, differences or even studies that complete the past distributions. Grossu (1983, 483-509) mentioned the species in over 40 collecting sites in our country starting from the Danube to Herculane Baths and especially in the mountain areas from the Apuseni Mountains. Negrea studied from 1957 until 1994 the gastropod population from Banat Mountains, collecting specimens from 97 stations located in Semenic Mountains, Anina Mountains, Locva Mountains and Almăj Mountains, the lower basin of the Cerna River between Herculane Baths and Orşova. The author does not mention the species *Isogonomostoma isognomostomos* (Negrea, 1995a, 141-156). Also collected between 1957 and 1993 terrestrial gastropods from the Southern Carpathians; more specific the Olt-Cerna Rivers sector, one of the collecting areas was Galbenului Basin from Parâng Mountains. Negrea (1995a, 141-156; 1995b, 3-14) did not list the species, but sightings of *Isogonomostoma isognomostomos* were reported by Grossu in 1955 (466) in the Parâng Mountains and in 1993 (334), when he generalized that the species is distributed in all the Carpathian Chain.

Isognomostoma isognomostomos (Schröter 1784) presents strong variations in the size of the shells. Grossu (1983, 483-509) considered that because of the condition inside the ecological niche the size of the shells were different from one niche to another. The subject of a future paper will be the based on the analysis of the shell measurements for each specimen, a work in progress.

In general, in the past field efforts by naturalists were largely based to classical localities of particular natural beauty, localities of high

species richness in the past, and to areas near the experts' residences and/or research centers (Dennis, Thomas,. 2000, 73-77; Lobo 2008a, 873-881; 2008b, 14-19).

While older collections made by amateur naturalists or taxonomists are concentrated in a few easily accessible areas surveyed in the past, more recent surveys conducted with a modern ecological focus provide a broader coverage of the environmental and geographical variability (Lobo *et al*. 2007, 772-780). Hortal *et al*. (2007, 853-863) considered that the spatial coverage provided by the collection data stored in museums and herbaria is generally limited and spatially and environmentally biased.

The collecting sites identified in the Natural History Museum from Sibiu are an exception to this opinion because it includes a wider range of collecting sites then the recent surveys regarding *Isognomostoma isognomostomos* (Schröter 1784). Distribution maps can not be generated as a result of the fact that some data from museum collections have an associated positional error because the only available information on the location is the name of the place, locality or area where the species was recorded, and so making the final distribution map inaccurate. The solution would be to confirm the museum data with the help of present day studies and pinpoint specific regions areas were the species was identified both in the past and present.

Mapped species distributions coming from range maps, atlas data or species distribution models are widely used, and the increasing availability of data through the Global Biodiversity Information Facility (GBIF) or other biodiversity databases, but unfortunately as it is the case of *I. isognomostomos* (Schröter 1784) when searched on the GBIF there is data that confirms the presence of the species in Austria, Germany, Slovakia and other European countries, but there is no occurrence records for Romania.

Another issue that appeared during and after literature check is that although biologists may know the places in which a species is unlikely to be observed (e.g., species not detected at a locality after intense sampling), such data are not usually published (Rocchini *et al.* 2011, 211-226). Thus, despite the potential usefulness of relatively reliable absence data, such information is generally not available. By researching museum collections we can point out possible collecting sites and the absence or presence of the species in that area will confirm or infirm the past distribution areas and thus starting a more complete time and space distribution of the species.

Museum collections, such as the Malacological Collections belonging to the Natural History Museum from Sibiu, are source of biological data and a starting point in the study of species distribution.

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Tab. 1. Past and present collecting sites of *I. isognomostomos* (Schröter 1784) in Romania according to museum collections and current studies.

Geographic region	*Collecting sites*	*Data source*
Northern Transylvania	-	Kimakowicz Collection
Maramureş County	Vişeu de Sus	Fehér *et al.* (2008, 163-164)
	Suligu de Sus Stream	Fehér *et al.* (2008, 163-164)
Maramureş Mountains	-	Fehér *et al.* (2008, 163-164)
	Bardău	Gheoca *et al.* (2008, 55)
	Vaser Valley	Gheoca *et al.* (2008, 55)
Gutâi Mountains	Staţiunea Izvoare	Fehér *et al.* (2008, 163-164)
Maramureş County – Bistriţa Năsăud County, *Rodna Mountains*	Rodna Mountains	Society Collection, Fehér *et al.* (2008, 163-164)
	Piatra Roşie (Piatra Rândunelelor)	Society Collection, Kimakowicz Collection
	Pietrosu Summit	Fehér *et al.* (2008, 163-164)
	Borşa Baths	Fehér *et al.* (2008, 163-164)
	Cimpoieş Stream	Fehér *et al.* (2008, 163-164)
	Săcel	Fehér *et al.* (2008, 163-164)
	Iza Gorge	Fehér *et al.* (2008, 163-164)
	Iza River	Fehér *et al.* (2008, 163-164)
Satu Mare County, *Oaş Mountains*	Huţa Pass	Fehér *et al.* (2008, 163-164)
Sălaj County	Crasna	Society Collection
	Var	Society Collection
	Gîrbou	Bielz (1863, 53-54)
Bihor County	Hidiş	Kimakowicz Collection
Bihor Mountains	Padiş Plateau	Lengyel, Pàll-Gergely (2009, 97-98)
	NW of Padiş Lodge	Lengyel, Pàll-Gergely (2009, 97-98)
	Cetăţile Rădesei	Lengyel, Pàll-Gergely (2009, 97-98)
	Someşul Cald	Lengyel, Pàll-Gergely (2009, 97-98)
	Boghii Summit	Lengyel, Pàll-Gergely (2009, 97-98)
	Valea Boghii	Lengyel, Pàll-Gergely (2009, 97-98)
	Caput Cave	Lengyel, Pàll-Gergely (2009, 97-98))
	Urşilor Valley	Lengyel, Pàll-Gergely (2009, 97-98)
Arad County, *Codru-Moma Mountains*	Beliu	Domokos, Lennert (2007, 67-95)
	Finiş	Domokos, Lennert (2007, 67-95)
	Vaşcău	Domokos, Lennert (2007, 67-95)
	Beiuş	Domokos, Lennert (2007, 67-95)
	Moneasa	Domokos, Lennert (2007, 67-95)
	Borz	Domokos, Lennert (2007, 67-95)
	Hăşmaş Brook	Domokos, Lennert (2007, 67-95)
Cluj County	Cojocna	Society Collection
	Cara	Society Collection

Vlădeasa Mountains	Răchițele	Lengyel, Pàll-Gergely (2009, 97-98)
	Valea Seacă	Lengyel, Pàll-Gergely (2009, 97-98)
Alba County	Lungă Valley	Society Collection, Kimakowicz Collection
	Sebeș Valley, Bistra	Society Collection
	Aiud	Kimakowicz Collection, Bielz (1863, 53-54)
	Detunata, Bucium District	Kimakowicz Collection
	Gârba de Sus Village	Kimakowicz Collection
	Piatra Corbului	Bielz (1863, 53-54)
	Scărișoara Cave (Gârda de Sus)	Bielz (1863, 53-54)
	Detunata (Bucium Sasa)	Bielz (1863, 53-54)
Hunedoara County	Jiului Valley, Scocul Mare	Kimakowicz Collection
	Jiului Valley, Piatra Șipotului next to Petrosu	Kimakowicz Collection
	Vărmaga Village, Metaliferi Mountains, under Gurguiota Summit	Bielz (1863, 53-54)
Retezat Mountains	Piatra Barului Mountains	Kimakowicz Collection
	Zănoagei Hills	Kimakowicz Collection
	Cheile Scorota	Sîrbu *et al.* (2009, 26)
	Câmpușel II	Sîrbu *et al.* (2009, 26)
	Piatra Iorgovanului	Sîrbu *et al.* (2009, 26)
	Cheile Buții	Sîrbu *et al.* (2009, 26)
	Buta Valley	Sîrbu *et al.* (2009, 26)
	Piule northern slope	Sîrbu *et al.* (2009, 26)
	Soarbele	Sîrbu *et al.* (2009, 26)
Sibiu County	Avrig	Society Collection
	Sadu River	Society Collection
	Mediaș	Society Collection
	Brateiu	Society Collection
	Cârțișoara	Society Collection, Bielz (1863, 53-54)
	Bradu	Society Collection
	Seviș Vally (Cisnădie)	Society Collection
	Păltiniș	Society Collection
	Olt River Bank at Trunu Roșu	Society Collection
	Lotrioara Valley at Turnu Roșu	Kimakowicz Collection
	Turnu Roșu	Society Collection
	Apoldu de Sus	Kimakowicz Collection
	Gura Râului	Bielz (1863, 53-54)
	Cisnădioara	Bielz (1863, 53-54)
	Tălmaciu	Bielz (1863, 53-54)
	Porumbacu	Bielz (1863, 53-54)
	Orlat	Kimakowicz Collection
Cindrel Mountains	Cibin Mountains, Eastern parts	Kimakowicz Collection
	Prejba	Society Collection, Kimakowicz Collection
	Duș	Society Collection, Kimakowicz Collection
	Ursului Hill	Kimakowicz Collection
	Foltea Hill	Kimakowicz Collection
	Măgura Cisnădiei, Cindrel	Kimakowicz Collection

	Mountains	
	Plaiul Moşilor	Kimakowicz Collection
	Şanța, Păltiniş	Kimakowicz Collection
Negoiu Mountains	Negoiu lodge	Society Collection
Braşov County	Tâmpa, northern parts	Society Collection, Kimakowicz Collection
	Zărneşti, Măgura Summit	Society Collection
	Bran	Society Collection
	Bacifalău, Săcele	Society Collection
	Şoarş	Society Collection
	Poiana Braşov	Kimakowicz Collection
	Hoghiz	Kimakowicz Collection
	Cracul Mare Mountains, Cristian	Kimakowicz Collection
	Drăguş	Bielz (1863, 53-54)
	Măgura Codlei	Kimakowicz Collection
Postăvarul Mountains	-	Bielz (1863, 53-54)
Bucşoiul Mountain (Bucegi Mountains)	Vâlcelul Grohotişului	Society Collection
	Bucşoiul Valley	Society Collection
Covasna County	Vâlcele	Society Collection
Nemira Mountains	Uz Valley-	Society Collection
Harghita County	Gheorghieni	Society Collection
	Tuşnad Baths	Society Collection
	Curmătura Peticului – Tulgheş	Society Collection
	Red Lake, Gheorghieni	Society Collection
	Miercurea-Ciuc	Kimakowicz Collection
	Harghita, no other data	Kimakowicz Collection
Harghita Mountains	Almaş Cave	Society Collection
	Ohorheiul Secuiesc	Bielz (1863, 53-54)
	Toplița	Bielz (1863, 53-54)
	Borsec	Bielz (1863, 53-54)
Hăşmaş Mountains	Piatra de Pază	Kimakowicz Collection
Ciomatu Mountains	St. Ana Lake	Bielz (1863, 53-54)
Mureş County	Mureşului Valley Răstolița	Society Collection
	Sighişoara	Society Collection, Kimakowicz Collection
Gurghiu Mountains	-	Bielz (1863, 53-54)
Argeş County	Dâmbovicioara	Society Collection
Făgăraş Mountains	Făgăraş Mountains	Grossu (1983, 483-509)
	Văcăria	Kimakowicz Collection
Perşani Mountains	Comăna de Sus	Kimakowicz Collection
	-	Kimakowicz Collection
Braşov County – Argeş County, *Piatra Craiului Mountains*	Piatra Craiului Mountains	Kimakowicz Collection, Grossu (1983, 483-509)
	Piatra Mică	Kimakowicz Collection
	Piatra Mare	Kimakowicz Collection, Grossu (1983, 483-509)
	Colțul Chiliilor	Kimakowicz Collection
	Cheile Dâmbovicioarei	Kimakowicz Collection
Gorj County, *Parâng Mountains*	-	Grossu (1983, 483-509)
Vîlcea County	Runcu, Babii Vally	Society Collection

Prahova County, *Bucegi Mountains*	Bucegi Mountains	Grossu (1983, 483-509)
	Rütthl Gorge	Society Collection
	Hotarului Valley	Society Collection
Ciucaş Mountains	Ciucaş Mountains	Society Collection
	Dungu Mountains	Society Collection
	Bărsei Mountains, Cheile Tamina	Society Collection
	Colţul Telejan	Society Collection
	Tesla	Kimakowicz Collection
Suceava County	Apa Ciobanului, Drăgoiasa	Society Collection
	Slătioara	Sólymos *et al*. (2007, 6-7)
	Moara Dracului	Society Collection
	Zărneşti – Crăpăturii Valley – Colţul Chiliilor	Society Collection
	Piatra Mare	Society Collection
Neamţ County, *Gosman Mountains*	Cracul Geamăna Summit	Society Collection
Ceahlău Mountains	-	Grossu (1983, 483-509)
Moldavia	-	Society Collection, Kimakowicz Collection
Gura Dobrogei	Liliecilor Cave	Negrea (1994, 1-14)
	Râpele Apaţiene	Negrea (1994, 1-14)
	Valea Găurii	Negrea (1994, 1-14)
	Dealul cu Bujori	Negrea (1994, 1-14)
	Valea Seacă	Negrea (1994, 1-14)
Dobrogea	Canaraua de la Graniţă	Negrea (1994, 1-14)

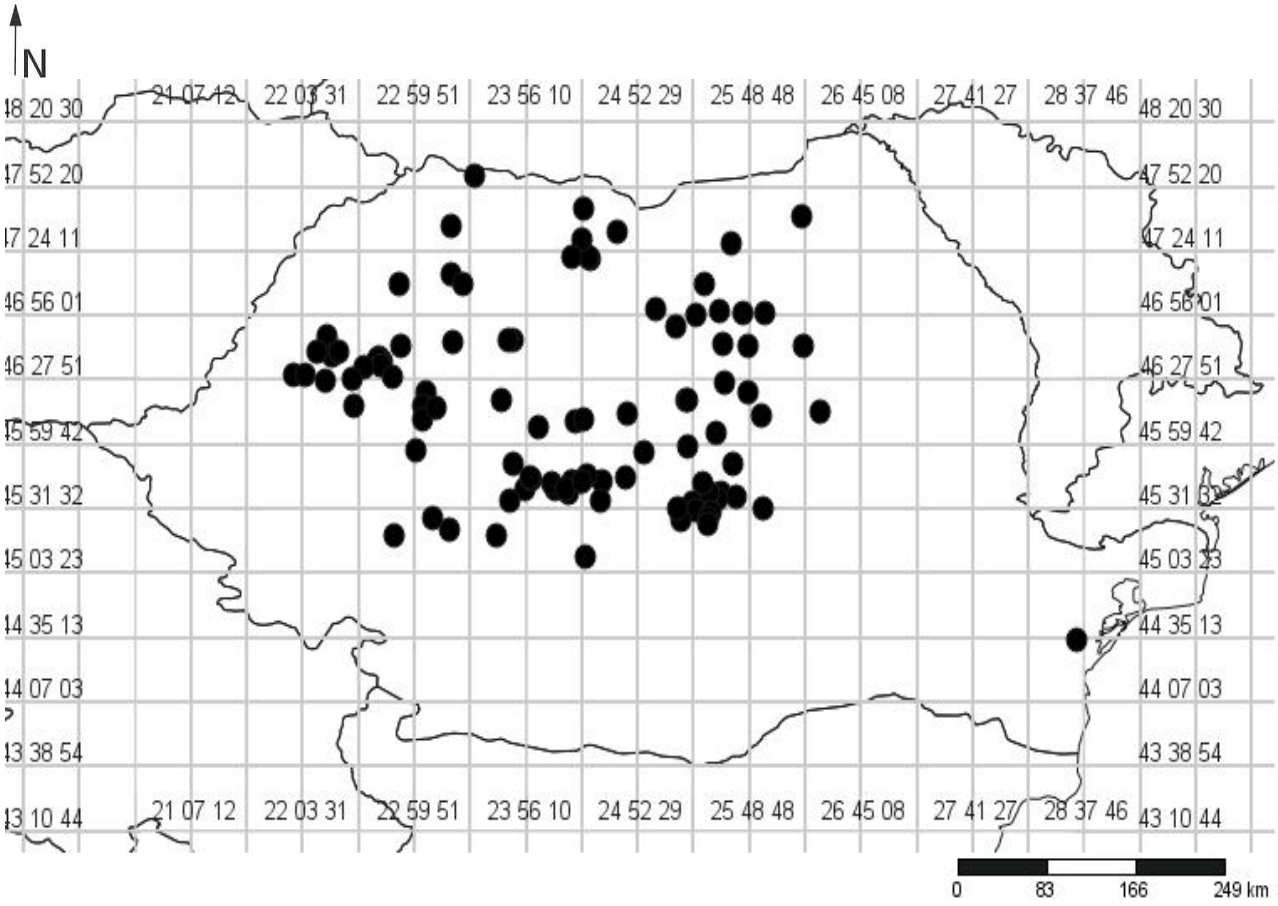

Fig. 1. Past and present distribution map according to the museum collections

BAILLON'S CRAKE (*PORZANA PUSILLA INTERMEDIA*, HERMANN, 1804) GEOGRAPHICAL AND HISTORICAL DISTRIBUTION IN ROMANIA

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Abstract. *In this paper we try to review the geographical and historical distribution of Baillon's crake (Porzana pusilla intermedia) in Romania. For our aim we used four sources: natural history museum collections, literature, "Natura 2000" database and personal observations. We investigated 16 museum collection, literature from 1871 until 2009 and used 2008-2010 own field observation. From all data we assume that Baillon's crake is pointed spread in specific habitats from Transylvania and in the south-eastern Romania, being a very rare species.*
Keywords*: museum collections, identification criteria, little crake, map, specimens*

Rezumat. *Prin studiul nostru am încercat să stabilim distribuţia geografică şi istorică a crestețului cenuşiu (Porzana pusilla intermedia) în România. În acest scop am folosit patru surse: colecţiile muzeale, date din literatură, baza de date „Natura 2000" şi observaţii personale. Am cercetat 16 colecţii muzeale, literatura de specialitate din 1871 până în 2009 şi observaţii personale dintre 2008 şi 2010. Analizând toate datele am ajuns la concluzia că în România crestețul cenuşiu are o distribuţie punctiformă în habitate specifice din Transilvania şi partea de sud-est a ţării.*
Cuvinte cheie*: colecţii muzeale, criterii de identificare, crestеț cenuşiu, hartă, specimene*

Introduction

Baillon's crake (*Porzana pusilla*) is one of the least known and studied birds in Europe. Its distribution covers Europe E through C and S Russia and S Siberia to N China and Japan, and S to Indonesia, New Guinea, Australia, Tasmania and New Zealand. Palearctic race are migratory, wintering in Africa, Middle East, Indian subcontinent, SE Asia, SE China and S Japan to the Greater Sundas, Borneo, the Philippines and Seram (Taylor, 1998). Baillon's crake is a polytypic species; based on color and body size, there were nominated seven subspecies.

In Europe, *P.p. intermedia* is widespread with an indistinct boundary (Hermann, 1804) (Cramp *et al.*, Simmons, 1980). The possible race obscura, of sub-Saharan Africa and Madagascar, is said to differ from *intermedia* in being generally darker, especially dark-grey below, and in having a shorter bill and wings (Mackworth-Praed, Grant, 1957, 1962; Ripley, 1977). However, Benson (1964) found no difference between European and African birds, in the colour of the upperparts and bill length. Although, on average European birds have longer wings, there is considerable overlap in wing length and Benson considered the race *obscura* not distinct; it was recognized by Cramp *et al.* (1980) on the basis of wing length, but not by Urban *et al.* (1986), (Taylor, 1998).

P.p. intermedia (includes *obscura*) is distributed along Continental Europe (Portugal, Spain, France, Belgium, Netherland, Germany, Switzerland, N Italy, Sardinia, Austria, Hungary, former Yugoslavia, Romania, Moldova, Bulgaria and Greece); Africa, locally in N Morocco, Tunisia, Egypt, possibly N Algeria and Ethiopia, and from NE Zaire, Rwanda, W Uganda, Kenya, C and S Tanzania, Zanzibar, S and SE Angola, Zambia, Malawi, Mozambique, Zimbabwe, N Namibia, Botswana and E and S South Africa; also Madagascar. European birds winter in Africa, including Senegal and possibly S to equator; also in Egypt and Iraq; occurs on migration in Mauritania, Sudan, S Iran and Arabia (Taylor, 1998)

P.p. intermedia is now regarded as a rare and very local species, having declined considerably since 19th century. In Europe its numbers are difficult to estimate because of the erratic nature of its occurrence in response to large annual variations in flooding and thus availability of suitable breeding habitat and because of the difficulty involved in birds census (Taylor, 1998).

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According to BirdLife International (2004) (for the period 1990 - 2002), in Romania only 10-20 breeding pairs were estimated.

Being a rare and very local species our aim is to create a map of the geographical and historical distribution of Baillon's crake in Romania, based on data available from museum collections, literature and other databases.

Methods

For the Baillon's crake Romanian distribution map we used four data sources: natural history museum collections (naturalized specimens, nests and eggs), literature, "Natura 2000" database and our observations.

These four sources allowed us not only the species distribution analysis in terms of a geographical perspective but from a historical one too. This was possible because the majority of the samples were accompanied by geographical coordinates and the collecting or observation time.

Regarding the data from the Natural History Museums we studied collections of 16 museums from Romania and abroad. For each museum, ornithological collection catalogs were analyzed and if they were not available data and photos about each Baillon's crake specimen was requested.

Thus we analyzed collections from: "Grigore Antipa" National Museum of Natural History from Bucharest, "Danube Delta" Natural History from Tulcea, Natural Sciences Museum complex from Galati, Natural Science Museum from Aiud, Natural History Museum from Sibiu, Cluj Zoological Museum, "The Museum of Dacian and Roman Civilization" from Deva, Natural History Museum from Iaşi, Natural Science Museum from Focsani, ornithological collection of the Faculty of Silviculture and Forst Engineering from Braşov, ornithological collection of "Andrei Şaguna" National College from Braşov, "Criş River region" Museum from Oradea, "Banat" Museum from Timisoara, ornithological collection of the Institute for Forest Research and Management from Timisoara, Muzeal Complex from Arad and Natural History Museum from Vienna.

Specimens from museum's collections, which had been directly observed by us, were evaluated for species re-determination based on the characters described in Tab.1.

Results

Baillon's crakes in museum collections

In "Gr. Antipa" National Museum of Natural History from Bucharest we found one specimen of Baillon's crake, collected in April 1905, from Colentina, Ilfov County.

In ornithological collection of Natural History Museum from Sibiu we found three specimens of *P. pusilla intermedia*; one male was collected in October 1857 from Cunța (Alba county), another male was collected in 20 August 1862 from Mercurea (today probably Miercurea) (is located in Hunedoara region, today probably in Alba or Sidiu County). Both specimens are part of the Adam Buda Collection. The third specimen from the collection is not accompanied by any date, time or place in which it was collected. Being unable to examine directly these birds we do not have the certainty of their correct determination. We do so because in the same collection we discovered, in our own examination of material, a Spotted crake (*P. porzana*) which was wrong determined being in fact a Little crake (*P. parva*).

There are four Baillon's crake specimens in the Natural History Museum of Aiud (Bethlen College). Three were collected in 1886 and one in 1890. Three of them were labeled as *Porzana pygmea* (sin. *P. pusilla*) and one as *P. pusilla*. After our examination, all of them proved to be Little crake.

In Dombrowsky's collection (Linția, 1955) five Baillon's crakes are mentioned. From this five three are juveniles: two collected in September 1900 from Cernavodă and another one collected in 13 September 1909 from Pietrile (today Pietrele, Giurgiu county) and two are adult males: one collected in 15 May 1900 from Sinteşti (Ilfov county) and one in 17 may 1903 from Potcoava lake (Galați county).

In the ornithological collection from the Zoology Museum of Cluj-Napoca three specimens of Baillon's crake exist, but all three are incorrectly identified, being in fact Little crake, *Porzana parva*.

In the ornithological collection of the Faculty of Silviculture and Forest Engineering from Braşov there are three specimens of Bailon's crake. From the received photos of two specimens, we consider that they are identified incorrectly, one being male and one female of Little crake. We do not have photos with the other specimen and also in the "Catalog of Birds collection" (Ionescu, 2010) there are no data about the collecting place and date.

We need to mention that from all specimens named above we had observed and identified directly just those belonging to the Zoological Museum from Cluj-Napoca, "Grigore Antipa" National Museum of Natural History from Bucharest, the ornithological collection of the Faculty of Silviculture and Forest Engineering from Braşov and Natural History Museum from Sibiu. The specimens from "Grigore Antipa"

National Museum of Natural History from Bucharest cannot be certainly determined due to their color deterioration.

Baillon's crakes in bibliography

In 1871, Herman published his observation about Baillon's crake presence in the Fizeş Basin (Cluj county). In 1875, Danford and Brown publish "The birds of Transylvania". In their study, among some others, they were helped by Buda Adam, an important ornithologist of 19th century, whose collection is now kept in the Natural Science Museum, from Sibiu. In this study they affirmed about Baillon's crak that is a rare species, but it was found in Strei valley and in other parts of the country (sites that were not named).

From Csató Iohn (which published between 1862-1905) (*citated in* Linția, 1955) we found that this species was observed in Braşov, Aiud and Crişeni, where it arrives in migration in mid April.

In this context, after 1950, the species has been reported in several points in the Danube Delta (Papadopol, 1963; Radu, 1979; Gâştescu, Ştiucă, 2006 (*quoted in* Munteanu, 2009)), in Istria (Weber, 2000) and Călăraşi (Ciochia, 1992). Between 1944-1995, Baillon's crake was located in „Lupilor" and „Saele" sands (Schmitz *et al*., 2001). In 2001, Păucă-Comănescu *et al.*, reported this species in Comana (Ialomița county).

In Transylvania, this species was observed in Fărăgău (Jud. Mureş) (Klemm, Kohl, 1988) and in Someş basin, near to Satu Mare (Ardelean, 1998). According to Salmen (1980), in the nineteenth century, in Transylvania (Hunedoara, Alba, Cluj and Sibiu county) a few specimens of Bailoon's crake were observed and collected.

Besides the specimens mentioned from Dombrowsky's collections, Vasiliu (1968) note another Baillon's crake collected in 18 May 1962 from Japişea- Buhaiov (Danube Delta). We do not know in which collection this specimen exist today. He also writes that this species is spread all over the country but in low numbers.

In the Breeding Birds Atlas from Romania, Munteanu (2002) marks nesting sites for Baillon's crake: one point in Transylvania (Fizeş Basin), two points on the Dâmbovița basin and two points in Danube Delta.

Baillon's crakes in "Natura 2000" database

In "Natura 2000" database we found three sites in which Baillons'crake was observed: Balta Albă-Amara – Jirlău (Brăila county), where are mentioned two breeding pairs, in Dumbrăvița-Rotbav – Măgura – Codlei (Braşov county) where are estimated one or two breeding pairs and also in Danube Delta and Razim-Sinoe lagunar Complex.

Baillon's crake in our observations

On May 3rd 2010, around 10:00 P.M., in the "Sic Redbeds" (Fizeş basin), for several minutes, at a distance of about 10-15 m from us, we heard a call which seemed to be a Bailon's crake call, but having no means of recording and never having heard that song, we cannot say for sure that the observation is valid.

Also, in May 2008 at around 5 km from" Sic Redbeds", in the "Pike Lake", David Alin photographed a nest with two eggs, which was very different in nest site, eggs size and color, from a Little crake's nest. In this context we think that it was a Baillon's crake nest, but having no measurements of nest and eggs we cannot say for sure that it was a *Porzana pusilla intermedia* nest.

Discussion

From all 16 museum collections investigated by us, we have found Baillon's crakes specimens just in six of them. From all this six collections we had the possibility to examinate directly just 10 specimens from four collection (from Braşov, Bucureşti, Aiud and Cluj-Napoca). We found that nine specimens were wrong determinated (being in fact Little crake) and one cannot be certainly determined due to their color deterioration.

This clearly suggests that in case of *Porzana* species, Romanian museum information contains a great error in association between nomenclature and species form. As a result of that all specimens determinate as *P. pusilla intermedia* are put to question.

In this context, we will take into account just those specimens which were not determinate directly or certainly by us. From this data, the oldest signaling of Baillon's crake in Romania is 1857 in Buda Adam collection from Sibiu natural History Museum and the earliest is 1909, from Dombrowsky's collection. These data assume the species presence in the central and southeast part of Romania in the late 19th - early 20th century (Fig.1).

From the literature we found that in the late 19th - early 20th century, this specie was spread in entire Transylvania, mostly in the western, south-western and south parts (Fig.1). After 1950, the literature data involving the species presence, both west and south-west Transylvania, but also in Danube Delta and in southeast and northwest Romanian (Fig.1).

Our observations and the "Natura 2000" database are the latest information that we have

about the presence of this species in Romania. Based on this we can say that nowdays Baillon's crake is, with the heist probability, present in specific habitats from north and south-eastern Transylvania, southeast Romania and Danube Delta.

In conclusion, we assume that Baillon's crake is pointed spread in specific habitats from Transylvania and in the south-eastern Romania, being a wary rare species.

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LIST OF ILLUSTRATIONS

Fig. 1. Baillon's crake geographical and historical distribution in Romania (data from 1857 to 2010).
Tab.1. Baillon's crake identification criteria used in our study.

LISTA ILUSTRAȚIILOR

Fig. 1. Distributia geografică şi istorică a speciei *Porzana pusilla intermedia* în România (date din perioada 1857 - 2010).
Tab.1. Criterile folosite pentru identificarea speciei *Porzana pusilla intermedia*

Tab.1. Baillon's crake identification criteria used in our study.

Identification criteria*	Characters	Baillon's crake (*P. pusilla intermedia*)	Little crake (*P.parva*)
Adult			
1	Flanks and thighs	Barring white and black;	No barred (if they are such barring form in the backwards on the flank, they are white, black and brown mostly);
2	Primary projection	Short (primary tips reaching only a little bit outside tertials, but folder primary tips can be more evident when tertials missing ore out of place)(Svensson *et al.*, 1999);	Long (wings reach almost to the top of tail)(Taylor, 1998);
3	Upperparts	More distinct white loops and squiggles; more are centered and bordered black (Taylor, 1998);	Some white spots or streaks;
4	Bill	No red on bill-base;	Red on bill-base;
Juveniles			
1	Chest	More barred;	Whitish;
2	Primary projection	Short;	Long;
3	Flanks	Distinct white and dark barred;	Less strongly barred (Taylor, 1998);
4	Upperparts	White loops and squiggles, black bordered;	White spots not black bordered;

*** Current number of the identification criteria (listed on their importance for our study)**

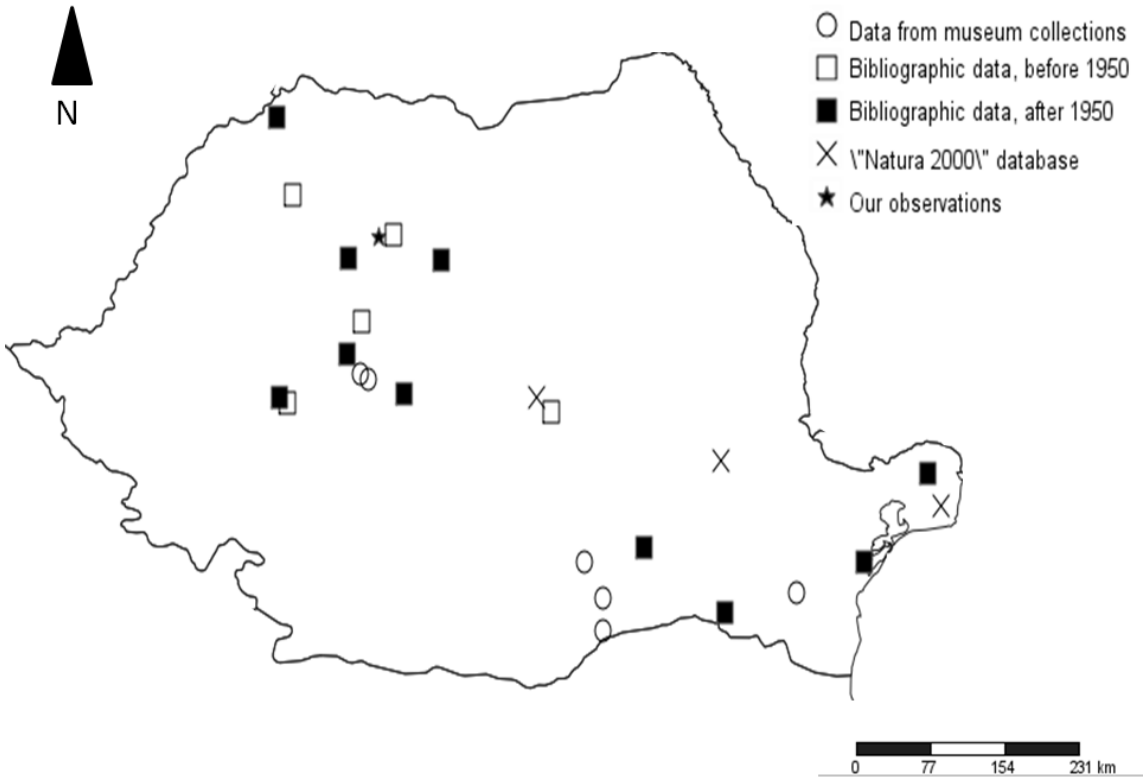

Fig. 1. Baillon's crake geographical and historical distribution in Romania (data from 1857 to 2010).

NEW DATA REGARDING THE BAT (MAMMALIA: CHIROPTERA) SPECIES DISTRIBUTION IN WESTERN ROMANIAN CAVE ROOSTS

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Raluca IANC[***]

Abstract. *This study provides a present day status of bat populations and the use of caves in SW and W Romania. After two field campaigns covering 8 caves (September-October 2009 and March 2010), we identified in total 17 species by morphological and biometric observations (mist netting), completed with echolocation call identification. Survey data are compared to existing information on the same study area.*
Keywords*: SW and W Romanian caves, bat species, Rhinolophus blasii, Românești*

Rezumat. *Lucrarea oferă o imagine de ansamblu asupra efectivelor populaționale şi a modului de utilizare a peşterilor de către lilieci. În urma a două campanii (septembrie – octombrie 2009 şi martie 2010) au fost identificate 17 specii în 8 peşteri din SV şi V României pe baza capturării lor în plasa chiropterologică, a observațiilor morfologice şi biometrice şi verificarea frecvenței de emisie a ultrasunetelor. Datele obținute au fost comparate cu datele publicate până în prezent.*
Cuvinte cheie*: peşteri din vestul României, specii de lilieci, areal Rhinolophus blasii, Românești*

Introduction

The cave C1 is an important shelter both as maternity and hibernation roost for *Myotis capaccinii*. C2, C5, C6, C7 seem to be common especially during the mating season. C3 and C4 is preferred by *Miniopterus schreibersii*, C4 is used for birth and rearing of *Miniopterus* young. C8 is a favorite cave of *Rhinolophus* genus species. The caves with the highest species diversity were C3 (9 species), C4 (8 species), C8, C7, C2 (7 species), followed by C5, C1 (4 species) and C6 (3 species).

According to IUCN Red Lists from 2010 the species in this study are listed as (Tab. 2.): Vulnerable: *Myotis capaccinii* found in the first three southwestern Romania caves investigated, presenting and confirming the southern distribution of this species in Romania.

Least of Concern: 5 species (*Eptesicus serotinus, Myotis oxygnathus, Nyctalus noctula, Plecotus austriacus, Pipistrellus pipistrellus*) were identified after spotting only one individual, and *Rhinolophus hipposideros* two individuals. Other more common species were *Rhinolophus blasii* (n=5 individuals), *Rhinolophus ferrumequinum* (27 individuals), *Myotis nattereri* (22 individuals), *Myotis emarginatus* (15 individuals), *Myotis myotis* (16 individuals), *Plecotus auritus*(5 individuals).

Near Threatened: The most common species was *Miniopterus schreibersii* (n=217). Other species identified in this category: *Barbastella barbastellus* (n=13), *Myotis bechsteinii* (n=15), *Rhinolophus euryale* (n=13 individuals).

Materials and methods

During September-October 2009 eight caves were investigated in the western and southwestern parts of Romania with the purpose of identifying bat species presence and relative abundance, and to gather information on the use of the caves as permanent or temporary bat roosts. Three of these caves were revisited during an overall survey of regional bat hibernacula in the greater area of W Romania. Bats were identified: a) by day by observing individuals in the underground roosts and b) at night using mist nets and bat detectors (Tranquility Transect, Pettersson D200). Individuals captured were identified along morphological and biometric key features (Dietz, Helversen, 2004).

The geographical position and dates visited of the caves included in this study (Fig.1) are:
C1). Gaura cu Muscă Cave (Peştera Gaura cu Muscă). Date: 06.10.2009, 01.03.2010.
Geographic coordinates: 44.6646904545455, 21.6989586363636.

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C2). Ceuca Valley Cave (Peştera din Valea Ceuca). Date: 07.10.2009, 02.03.2010.
Geographic coordinates: 44.7043491111111, 21.7290603888889.
C3). Gaura Ungurului Cave (Gaura Ungurului).
Date: 08.10.2009, 03.03.2010. Geographic coordinates: 44.84633, 22.4092183333333.
C4). Românești Cave (Peştera de la Românești).
Date: 13.09.2009. Geographic coordinates: 45.7970317073171, 22.3507366260162.
C5). Duțu's Cave (Peştera lui Duțu).
Date: 12.09.2009. Geographic coordinates: 45.9816607407408, 22.3384005555556.
C6). Uscată de la Moară Cave (Peştera Uscată de la Moară). Date: 22.09.2009.
Geographic coordinates: 46.4410766666667, 22.2435816666666.
C7). Moara cu Apă Cave (Peştera Moara cu Apă).
Date: 23.10.2009.
Geographic coordinates: 46.4410766666667, 22.2435816666666.
C8). Gălăşeni Cave (Peştera de la Gălăşeni)
Date: 23.09.2009. Geographic coordinates: 46.9887166666667, 22.4380157407407.

Results and discussions

17 species belonging to 3 families (*Rhinolophidae, Vespertilionidae* and *Miniopteridae*) were identified by visual observations and mist netting. Data related to each cave are shown in Tab. 1 and Tab. 3. The male to female ratio varied considerably over time in several of the mist netting experiments over one night. Results are discussed by roost site.

The Gaura cu Muscă cave (C1) is located on the left side of the river, 3 km downstream of Pescari village, Caraş Severin (Bleahu *et al*. 1976). It is a medium sized cave (254 m length). Mist netting was performed on October 6th, 2009, between 00:10 and 04:15 and the observations on 1st of March 2010 between 16:20 and 17:10.

- During the 2009 census 16 individuals belonging to 3 species were caught. In 2010, 111 individuals were caught: 60 *Myotis capaccinii*, 5 *Rhinolophus euryale/ blasii* and 45 *Rhinolophus ferrumequinum* and 1 *Rhinolophus ferrumequinum*).

- From at 00:10 when the observations began, the bat activity was low increasing towards 03:00. The sex ratio between males and females was equal (ratio 7/7, n = 14).

- Parasites were found on: 90% of *Myotis capaccinii* individuals (67% females), and 80% *of Miniopterus schreibersii* (46% of males, 54% of females) had external parasites.

The Ceuca cave (C2*)* is located at village Sfânta Elena border with Moldova Nouă (Caraş Severin), downstream Ceuca Valley. It is a medium length cave (132 m). Bats were caught from October 7th, 2009, from 21:30 to 01:16 and the census on 2nd of March 2010 between 17:45 and 18:20. During the 2009 survey 8 individuals belonging to 6 species were found. In 2010, 21 individuals were observed belonging to 3 species: 6 *Rhinolophus ferrumequinum*, 13 *Rhinolophus euryale/ blasii and* 2 *Myotis capaccinii*).

- The maximum bat activity was recorded around 22:00.

- Parasites were almost absents. Only on 1 *Eptesicus serotinus* and *1 Rhinolophus ferrumequinum* parasites were found.

The Gaura Ungurului cave (C3) is carved into the right side of Salistea Valley (Domogled Mountains) left tributary of the Cerna Valley, Herculane (Caraş-Severin), at 300 meters altitude. The length of the cave is 196 meters. The cave is considered a fossil cave.

Bats were caught on September 12th 2009, from 21:20 to 04:37, also being observed in census on March 3rd 2010 between 14:15 and 15:05. During the 2009 survey 2 individuals belonging to 9 species were captured, in 2010 7 individuals belonging to 2 species were observed.

- The activity of males peaked at 22:00, 24:00 and 02:00. Maximum activity of females was at midnight; at around 24:00 the number of females exceeded that of males (Fig. 3).

- Parasites were found on 60% of *Myotis capaccinii*, on the single female of *Rhinolophus euryale*, the single male *Plecotus austriacus*, on 55% of *Miniopterus schreibersii* (males and females equally affected) and the single female *Myotis oxygnathus* caught.

Româeşti Cave (C4) is part of the wooded area of Pustinica Valley left side, SE part of Românești village, Curtea District, Timiş County (Bleahu *et al.*1976). It is a fossil cave, medium length (340 meters accessible galleries, being explored for a distance of over 1450 meters). Bats were mist netted on September 13th, 2009, between 20:15 and 2:40. 162 individuals belonging to 8 species were idnetified, 91% were identified as *Miniopterus schreibersii.*

The male/female ratio for *Miniopterus schreibersii* (147 individuals) was 54 to 46%, for *Myotis myotis* (5 individuals) 75% were males.

Females were highly active in the first part of the night, followed by constant flight activity around 23:00 (Fig. 2). Around 01:00 female activity fell to a minimum, the males carrying out regular flights.38% of *Miniopterus schreibersii* and

80% of *Myotis myotis* individuals were found to have external parasites.

Duțu's Cave (C5) is located at the Hunedoara County border with Arad County, at 6 km from the center of Căprioara Village. Bats were captured on September 12th, 2009, from 20:30 to 03:10. 16 individuals belonging to 4 species were identified. The majority of the captured specimens active at midnight were males; females were spotted between the hours of 22:00 to 23:00.

The sex ratio was: 14 males belonging to 4 species and 2 females belonging to 2 species (Fig. 4).

Parasites were found on *Myotis myotis* and *Barbastella barbastellus*.

The Uscată de la Moară cave (C6) is found near Moara cu Apă Cave, part of the Crişul Alb River Basin, the Codru-Moma Mountains region, near the Moneasa Resort.

14 individuals belonging to 3 species were captured on September 22nd 2009, between the 22:00 and 03:00.

Male/female ratio: the cave was visited by a small and relatively constant number of individuals. 75% of *Miniopterus schreibersii* were females. The overall bat activity declined in between 22:00 to 23:45. The number of males declined around 01:00; females numbers numbers declined to zero in between 02:00 to 03:00.

All captured individuals showed external parasites, 75% of males *Miniopterus schreibersii* being affected *(total n=4)*. All *Rhinolophus ferrumequinum (total n=2) showed parasites*, both male and female in equal numbers.

The Moara cu Apă cave (C7) is located on a steep calcareous hillside, at 260 meters altitude. It is a large cave with a full development system of the galleries of over 2000 meters. Bats were caught on October 23rd, 2009, from 21:20 to 03:28. 51 individuals were found belonging to 5 species.

- The flight activity of bats fluctuated during the night with increases in the number of individuals every 2 hours (22:00, 00:00, 02:00). The sex ratio was relatively equal among species, *Myotis bechsteinii*) being only 2 males (Fig. 5).

- Parasites were found on equal ratios of both males and females of *Miniopterus schreibersii*; in total 50% of animals were affected.

The Gălăşeni cave *(C8)* is located downstream Deblei Valley, part of the Gălăşeni, at 2 km from Josani, Bihor. The cave is 2357 meters long.

Bats were captured on September 23rd 2009, from 20:45 to 03:00. 42 individuals belonging to 7 species were identified.

Male flight activity increased after 02:00; the flight activity of females was more intense around 21:00. At 01:00 the activity decreased.

3 species presented ectoparasites: *Rhinolophus euryale* (one male and one female), a male *Myotis naterreri* and a male *Myotis bechsteinii*.

Species discussion

Until today, *Rhinolophus blasii* was reported exclusively in the south of Romania. According to EUROBATS bulletin No. 5 (Battersby, 2010) the species extends to the area Apuseni Mountains Forest – (Fig. 7). During the study the species was found at the Gălăşeni Cave, at 2 km from Josani, Bihor County. Apart from the biometric data, the individuals were recorded on time-expansion Tranquility Transect bat detector at the entrance of the cave (Fig. 5). The cave is sealed with an iron grid. 7 individuals were identified, not entering the cave. Future studies are necessary to estimate numbers of *Rhinolophus blasii* that visit this cave.

Ninety-one percent of individuals captured (n=147) in Românești Cave were identified as *Miniopterus schreibersii*. This cave is used by the species both during the mating and the maternity season, as well as for hibernation. The adult sex-ratio found was 70 males and over 68 females with 8 juveniles also being present.

Miniopterus schreibersii was found at the Moara cu Apă Cave, at (equal gender ratio, 15 males and 14 females), the Gaura Ungurului Cave (12 males and 15 females). All *Miniopterus schreibersii* (n=219) captured, in the Dutu's Cave and the Ceuca Valley Cave were males.

Conclusions

This paper presents bat data from 8 caves, the Uscată de la Moară, Apă de la Moara, Ceuca Valley and Gălăşeni Caves never being documented for bat presence.

The Românești cave (C4) showed a more prominent bat activity in comparison to the other caves in this study (n =162), out of a total 359 bats 8 caves). *Miniopterus schreibersii* (n=147) is the dominant species. In the Românești cave, jazz and rock concerts are organized since 1984, attended by over 2000 people. The bats do not seem to be affected by these activities, their permanent presence in the cave is shown by the guano. During earlier studies, the cave was shown to harbor a *Miniopterus schreibersii* summer colony (Hoffmann, unpublished data). Great caution is advised on the use of the cave for cultural activities. The activity calendar should be adapted insofar not to endanger the future of bats in the RS cave.

The vertical part of *Gaura Ungurului Cave* (C3) was not accessible, and therefore not checked. The cave can only be entered with specialized climbing equipment.

The situation between Gaura Ungurului Cave (C3) and Moara cu Apă Cave (C7) is similar in terms of flight activity of bats, although the mist nets were placed inside the Gaura Ungurului Cave and at the entrance of Moara cu Apă Cave. The survey shows that individuals have the same activity patterns, with increases and decreases in their numbers every 2 hours. Bat activity at Gaura Ungurului Cave is questionable; bats remained active even after we have decided to finish the observations.

Myotis capaccinii also was reported exclusively in the south of Romania. We found it in the first three caves from the south western part of the country: Gaura cu Muscă cave (C1), Ceuca cave (C2) and Gaura Ungurului Cave (C3). In C1 we found the highest abundance (59%); 60 individuals hibernating in census, followed by C2 (35%) and 2 hibernating, and C3 (6%) with no specimens on census.

Parasites were presents, in generals, on individuals that formed compact colonies, but there were also cases where solitary individuals (eg. *Rhinolophus ferrumequinum*) or species that are usually found in tree hollows or bark (species: *Barbastella barbastellus, Plecotus auritus and austriacus, Myotis bechsteinii, M. nattereri)* were affected. These individuals become infested by parasitic insects that walk on cave walls (eg. *Nycteribiidae*).

Acknowledgments

Special thanks go to Ana-Maria Mesaroş (Natural History Museum Sibiu) and Vasile Alexandru Stoica (Lucian Blaga University of Sibiu) who kindly reviewed the first English version of the manuscript, and to my reviewers Ludo Holsbeek, Milca Petrovici and Eliana Sevianu.

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LIST OF ILLUSTRATIONS

LISTA ILUSTRAȚIILOR

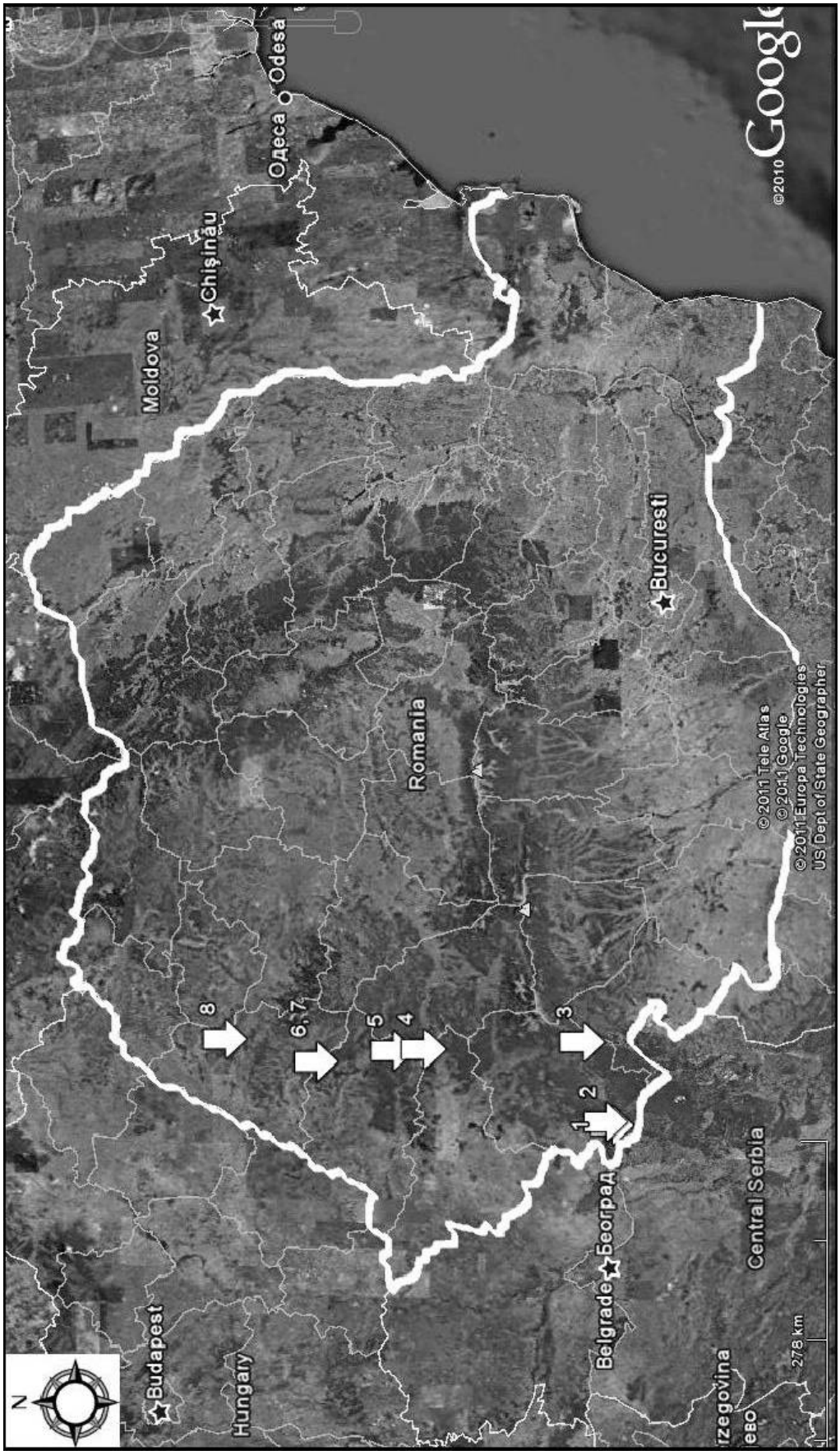

Fig. 1. Inventoried caves location (source: Google Earth)

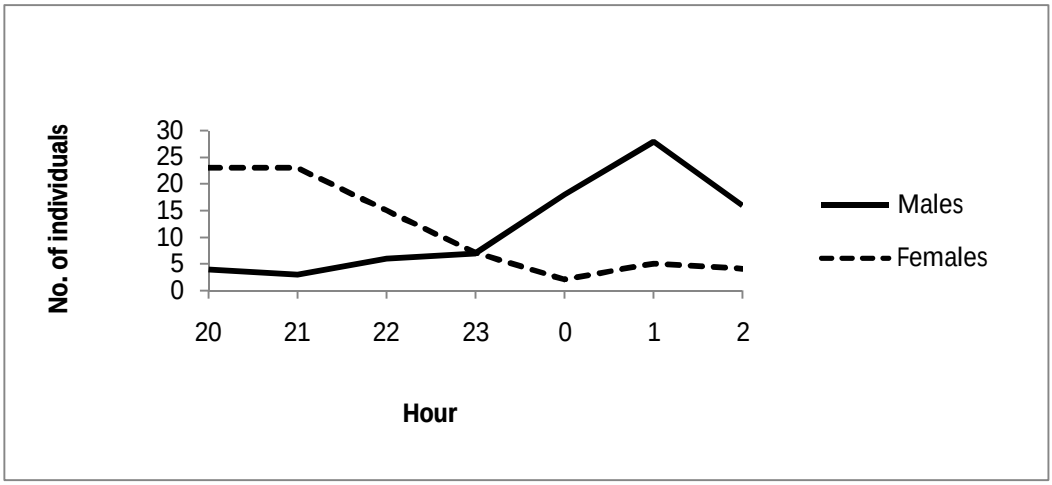

Fig. 2. The temporal dynamics of bats's sex ratio from Românești Cave (C4), n total = 52 % males

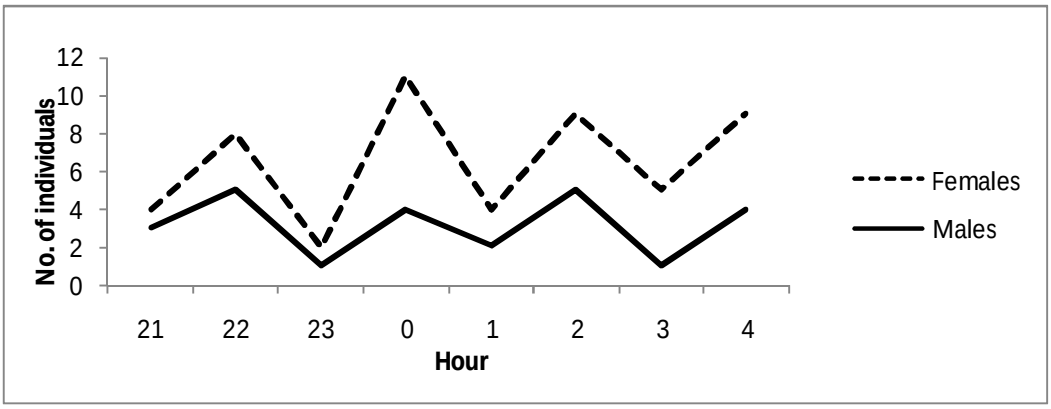

Fig.3. The temporal dynamics of bats's sex ratio from Gaura Ungurului Cave (C3), n total = 44% males* the mist net was placed into the cave, not at entrance like in the other cases.

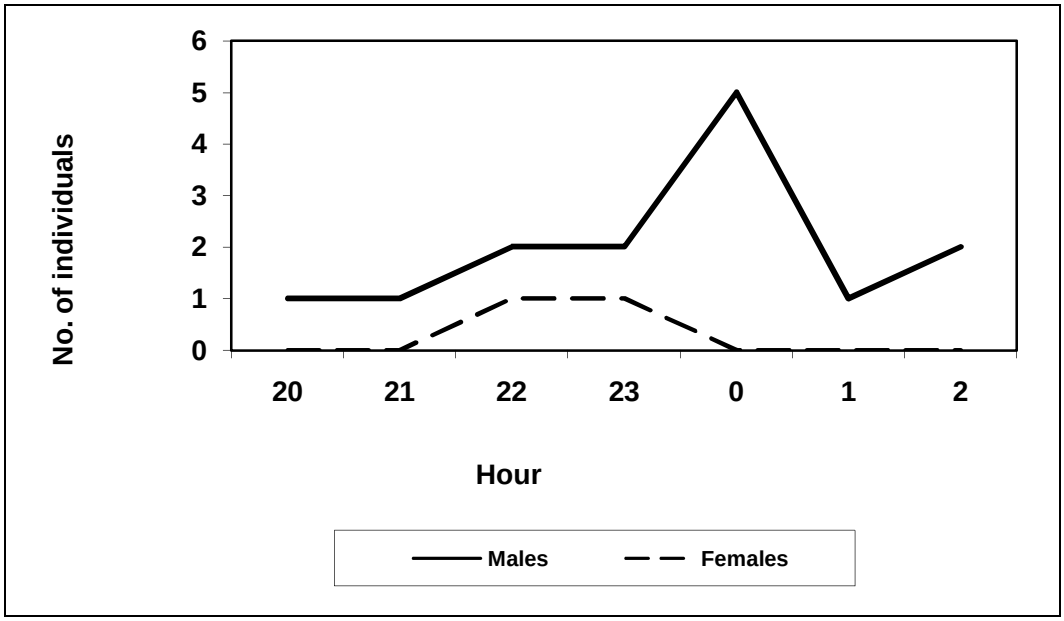

Fig. 4. Temporal dynamics of sex ratio bats communities in Duțu's Cave.(C5), n total = 88% males

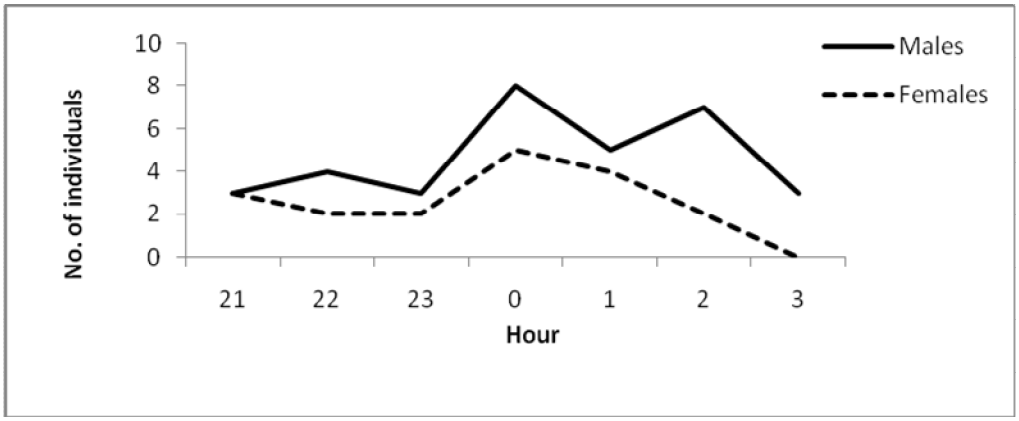

Fig.5. Temporal dynamics of sex ratio bats communities in Apă de la Moară Cave.(C7), n total = 61% males

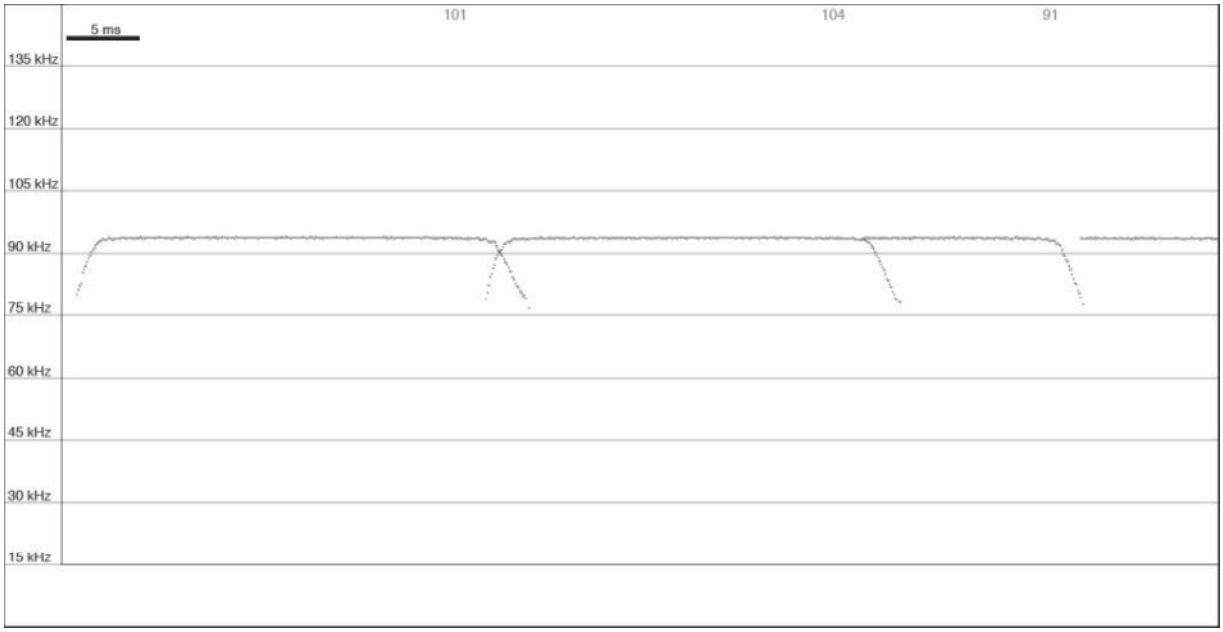

Fig. 6.1. Spectrogram of*Rhinolophus blasii*(the sounds were recordedat the intrance of Gălăşeni Cave, analysed in BatIdent)

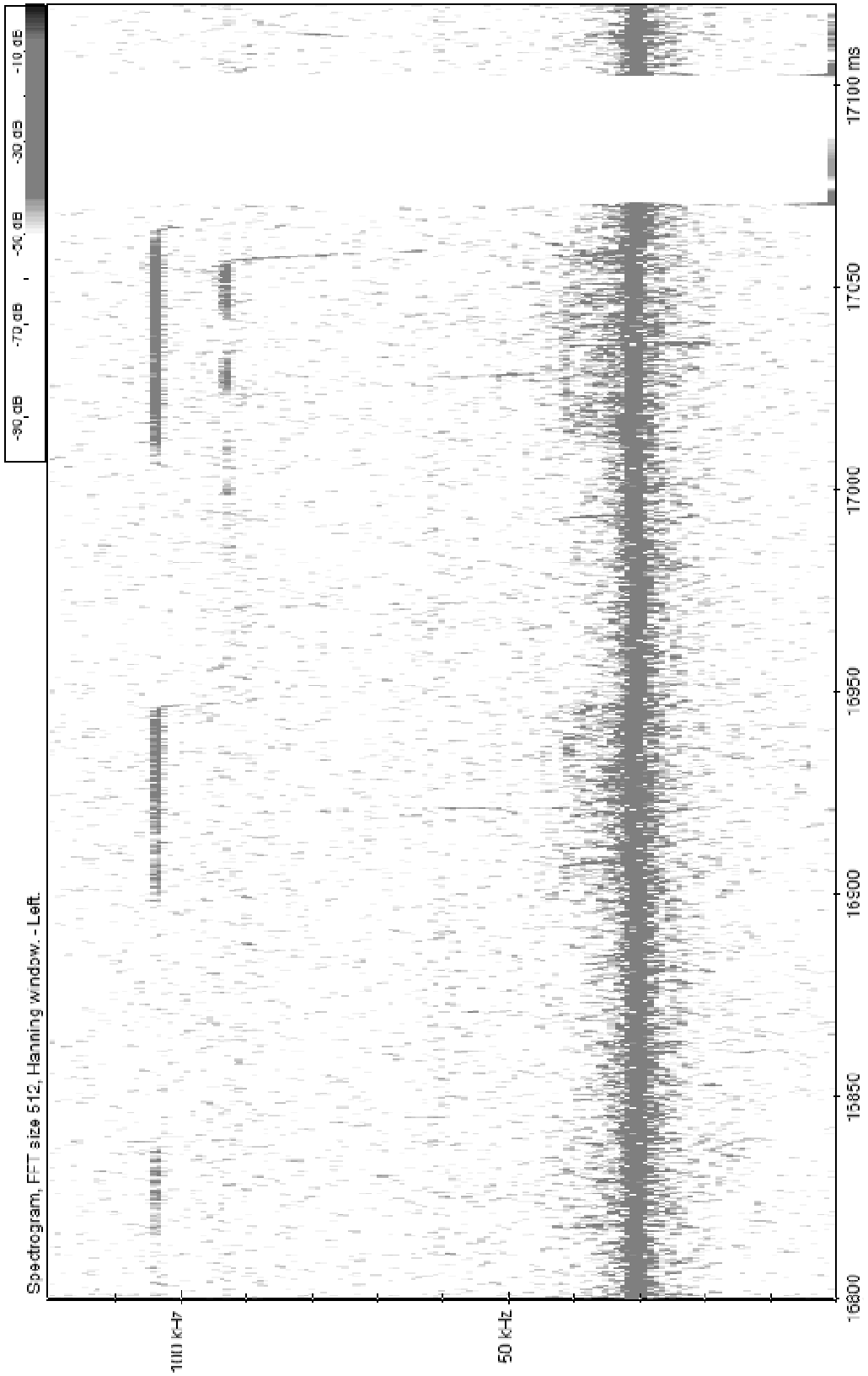

Fig. 6.2. Spectrogram of*Rhinolophus euryale*and*Rhinolophus blasii*(the sounds were recordedat the intrance of Gălăşeni Cave)

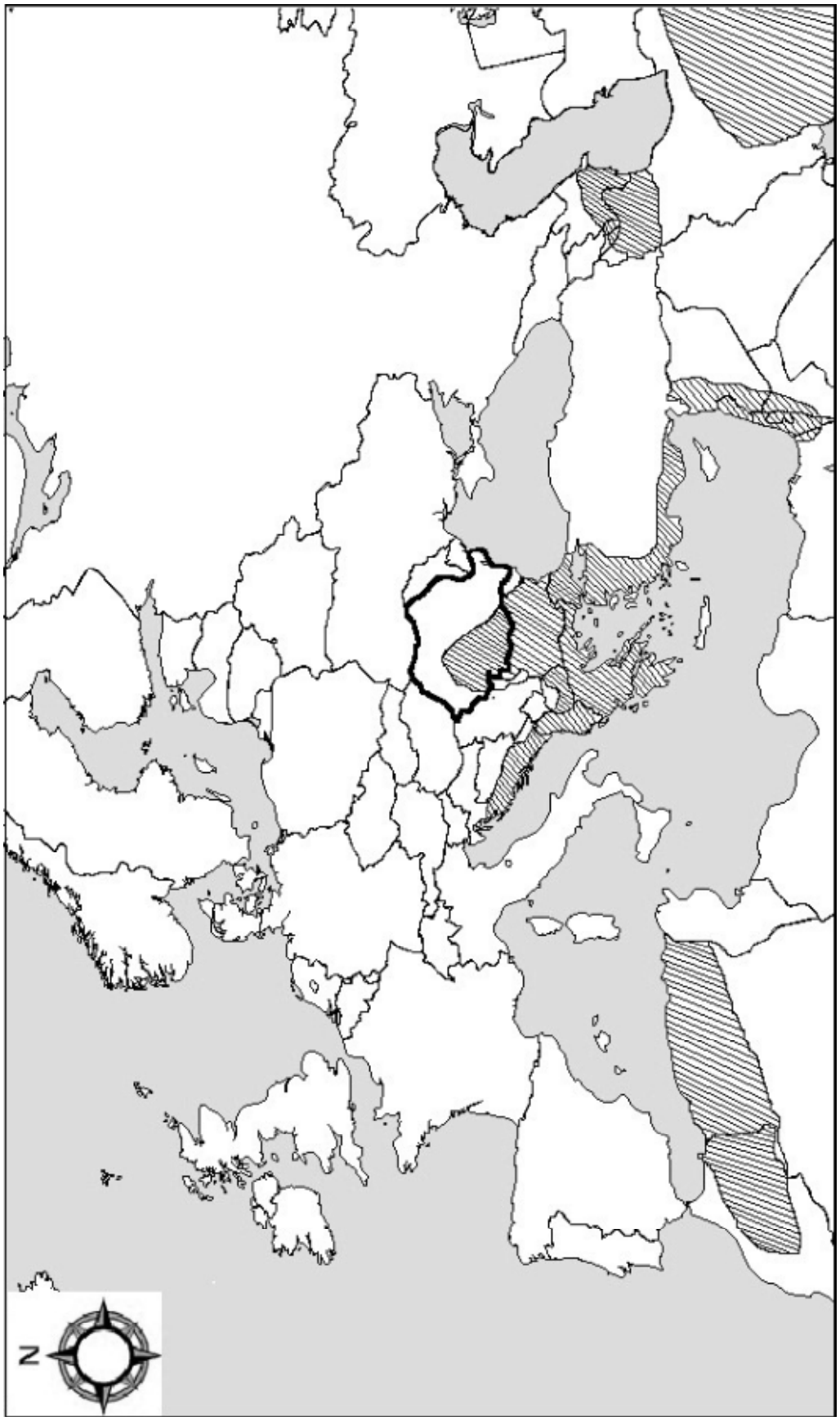

Fig. 7. The *Rhinolophus blasii*'sarea(Eurobats, Publication series no.5,modified)

Tab.1: Bat species identified, scientific name abbreviation andnumber of individuals/cave during the 2009 campaign

Species	C1	C2	C3	C4	C5	C6	C7	C8	*Total*
Rhinolophus ferrumequinum (Schreber, 1774)	1	2	5			7	8	4	*27*
Rhinolophus hipposideros (Bechstein, 1800)				*	*			2	*2*
Rhinolophus euryale Blasius, 1853			2					11	*13*
Rhinolophus blasii Peters, 1866			2					3	*5*
Myotis capaccinii (Bonaparte, 1837)	9	1	6						*16*
Myotis nattereri (Kuhl, 1817)						2	16	17	*35*
Myotis emarginatus (Geoffroy, 1806)				4				11	*15*
Myotis bechsteinii (Kuhl, 1817)				1	5		2	7	*15*
Myotis myotis (Borkhausen, 1797)		1	5	5	5				*16*
Myotis oxygnathus Monticelli , 1885			1						*1*
Nyctalus noctula (Schreber, 1774)				1					*1*
Eptesicus serotinus (Schreber, 1774)		1							*1*
Pipistrellus pipistrellus (Schreber, 1774)				1					*1*
Plecotus auritus (Linnaeus, 1758)		1	1	1	2				*5*
Plecotus austriacus (Fisher, 1829)			1						*1*
Barbastella barbastellus (Schreber, 1774)		2		6	4		2		*14*
Miniopterus schreibersii (Kuhl, 1817)	5		29	147		5		31	*217*
Total	*15*	*8*	*52*	*166*	*16*	*14*	*28*	*86*	***385***

Tab.2. The legal statut and global tendinces of identified bat species

Species	Berne Conv.	Bonn Conv.	EUROBATS Acord	Hab. Dir. Annexes	IUCN RL (2010.4)	Law 90/ 10.05.2000
Rhinolophusferrumequinum	II	II	+	II, IV	LR: LC	✓
Rhinolophushipposideros	II	II	+	II, IV	LR: LC	✓
Rhinolophuseuryale	II	II	+	II, IV	LR: NT	✓
Rhinolophusblasii	II	II	+	II, IV	LR: LC	✓
Myotiscapaccinii	II	II	+	II, IV	VU	✓
Myotisnattereri	II	II	+	II, IV	LR:LC	✓
Myotisemarginatus	II	II	+	II, IV	LR: LC	✓
Myotisbechsteinii	II	II	+	II, IV	LR: NT	✓
Myotismyotis	II	II	+	II, IV	LR: LC	✓
Myotisoxygnathus	II	II	+	II, IV	LR: LC	✓
Nyctalusnoctula	II	II	+	IV	LR: LC	✓
Eptesicusserotinus	II	II	+	IV	LR: LC	✓
Pipistrelluspipistrellus	II	II	+	IV	LR: LC	✓
Plecotusauritus	II	II	+	IV	LR: LC	✓
Plecotusaustriacus	II	II	+	IV	LR: LC	✓
Barbastellabarbastellus	II	II	+	II, IV	LR: NT	✓
Miniopterusschreibersii	II	II	+	II, IV	LR: NT	✓

Tab. 3. The 2009-2010 survey results

Cave	Date	Meteo Conditions	Identified species	Cited species	
				Species	**Publications**
Duțu's Cave	12.09.2009 20:30-3:10	Clearly sky 19ºC, 64%U 13.7ºC, 77%U	*B. bar., M. bec., M. myo., P. aur.*	*R. fer., R. hip., R. bla., M. myo., M. sch.*	Dumitrescu *et al.*1962,1963; Negrea *et al.* 1967
Românești Cave	13.09.2009 20:15-2:40	Raining 15ºC, 87%U	*M.bec., P.pip., M.sch., N.noc., P.aur., B.bar., M.myo., M.ema.*	*R.fer., R.hip., M.myo., M.sch.*	Dumitrescu et al. 1962, 1963b
Uscată de la Moară Cave	22.09.2009 22:20-	16.5ºC, 72%U	*M. nat., M. sch., R. fer.*	-	-
GălășeniCave	23.09.2009 20:30-3:00	Clearly sky 15.8ºC, 64%U	*M. nat., M. bec., M. ema., R. eur., R.hip., R. fer., R. bla.*	-	-
Gaura cu Muscă Cave	06.10.2009 0:10-4:15	Clearly sky 19.7ºC, 68%U 14.9ºC, 93%U	*R.fer.,M.cap., M.sch.*	*M. bec., R. fer., M. sch., E. ser., R. fer., R. hip., R. eur., R. bla., M. myo., M. ema., M. cap.*	Ansell, 1976; Murariu, 2004; Dumitrescu *et al.*1962,1963; Negrea *et al.* 1967; Negrea, Negrea 1971; Nágy *et al.* 2003.
	01.03.2010	14,4°C, 77%U	*R.fer., M.cap.,R. eur.*		
Ceuca Valley Cave	07.10.2009 21.30-1:16	Clearly sky 13.8ºC, 93% 12.6ºC, 99%	*B.bar.,E.ser., M.cap., M.myo., P.aur., R. fer.*	*R. fer., M. myo.*	Negrea *et al.* 1967
	02.03.2010	14,1°C, 79%U	*R. fer., M.cap., R. eur.*		
Gaura Ungurului Cave	08.10.2009 21:30-4:37	Clearly sky 16.8ºC, 83%U 15.6ºC, 92%U	*M. cap., M. sch., R. eur., R. fer. P. aur., P. aus., M. myo. R. bla., M. oxy.*	*R. fer., R. hip., R. eur., M. cap., M. ema., M. myo., M. sch.*	Dumitrescu *et al.* 1962, 1963, Negrea *et al.* 1967
	03.03.2010	14,9°C, 88%U	*R. eur., R. fer.*		
Moara cu Apă Cave	23.10.2009 21:20-3:28	Cloudy 12.6ºC, 94%U 11.8ºC, 99%U	*M.nat., M. sch., R. fer., M. bec, B. bar.*	-	-

HISTORY AND FATE OF THE PLANT COLLECTION OF PETER SIGERUS (1759 -1831), PHARMACIST AND BOTANIST AT SIBIU/ HERMANNSTADT

Erika SCHNEIDER-BINDER*

Abstract. *The botanical research in Transylvania on the beginning of the Linnéan period is strongly related to the name of the Peter Sigerus (1759-1831) pharmacist at Sibiu/ Hermannstadt. But on the search of his botanical work it is not possible to find this collection as a whole, original herbarium. The author presents the facts i. e. the fate of the collection initially composed by 26 volumes with 451 Genera and more than 1600 species, the way on which the Herbarium came in the possession of the Protestant Gymnasium, being mentioned as a "School Herbarium" and later in the third decade of the 20th century in the possession of the Museum of Transylvanian Society of Natural Sciences at Sibiu/Hermannstadt. At the beginning of the twenties Dr. Karl Ungar (1925) prepared a Transylvanian Flora Book, a field guide with determination keys. As documentation base for his book, a comprehensive plant collection of the Transylvanian flora has been realised. This plant collection known under the name "Herbarium Dr. Karl Ungar" included also the Herbarium of Peter Sigerus, the old collection from the end of 18th and beginning of 19th century being completely disintegrated. Unfortunately also the old etiquettes of the Herbarium Sigerus were changed by new ones. The only way we know about the composition of the collection of Peter Sigerus is his catalog in form of a hand written book, containing all his collected plants beginning with the year 1789. It constitutes not a simply listing of species, but with all description, popular names and use of plants presents the manuscript for his planned "Flora Cibiniensis" and "Flora Transylvaniae" which due to financial problems was not possible to be finished and printed.*
Key words*: plant collection, classification system of Linné, Transylvanian flora*

Rezumat. *În al treilea deceniu al secolului 20, s-a înregistrat un avânt în activitatea ştiinţifică a naturaliştilor strânşi în jurul Societăţii Transilvănene de Ştiinţe Naturale din Sibiu. Astfel, în 1925 medicul-botanist sibian Dr. Karl Ungar, custode al colecţiilor botanice pe aceea vreme, menţionează în revista ştiinţifică a Societăţii organizarea unei colecţii botanice cuprinzătoare a florei din Transilvania care să servească drept bază documentară pentru noua sa carte "Flora Siebenbürgens"/Flora Transilvaniei (Ungar 1925), un ghid de excursii, remarcând că "...Herbarul conţine plante ale tuturor botaniştilor şi din toate regiunile ţării începând cu anul 1793 până în prezent. În ultimul timp a fost înşirată valoroasa colecţie şcolară a lui Peter Sigerus" (Schneider-Binder, 1983, 2003). Cu toate că la Muzeul de Ştiinţe Naturale din Sibiu există numeroase herbarii istorice, păstrate sub formă de colecţii de sine stătătoare, colecţia unuia dintre pionierii cercetărilor botanice din Transilvania, cea a farmacistului Peter Sigerus (1759-1831) nu se află printer ele. Mulţi botanişti şi-au pus întrebarea asupra soartei colecţiei Sigerus, care mult timp n-a fost cunoscută. Multe specii colectate de Peter Sigerus în diferite localităţi din Transilvania sunt menţionate cu prescurtarea "Sg." (Sigerus) în "Flora Transsilvaniae Excursoria" a lui Michael Fuss (1866), care a studiat colecţia Sigerus după ce a fost donată în 1843 Gimnaziului Evanghelic din Sibiu. Colecţia conţinea 26 de volume cu 451 genuri şi mai mult de 1600 specii şi varietăţi de plante în majoritate din Transilvania, clasificate după sistemul lui Linné. Uitată în colecţiile gimnaziului, abia în timpul activităţii lui Karl Ungar herbarul Sigerus intră din nou în atenţia botaniştilor, ajungând probabil prin demersurile lui în posesia Muzeului Societăţii. Se pare că deja la intrarea colecţiei în muzeu (1925) ea era puţin dezmembrată, mai multe eşantioane fiind integrate în colecţia lui Fuss încă din timpul în care colecţia Sigerus făcea partea din aşa zisul "herbar şcolar", nefiind însă o colecţie organizată în scopuri didactice. În cursul organizării noului Herbar transilvănean, colecţia Sigerus a fost complet desfiinţată. Este firesc, că în scopul unei mai uşoare şi mai bune documentări, Ungar a trecut la organizarea după principii mai moderne ale herbarului. Din păcate însă n-au fost păstrate nici etichetele originale scrise de Sigerus, pierzându-se astfel şi această parte a originalităţii colecţiei. Doar datorită unui catalog manuscris „Verzeichnis meiner Pflanzen*

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gesammelt seit 1789"/"Registrul plantelor mele, colectate începând cu anul 1789", catalog ajuns în 1924 în proprietatea Societății de Ştiințe Naturale prin donație din partea Muzeului Brukenthal, se poate reconstitui conținutul întregului herbar Sigerus, din care s-a păstrat doar coperta unuia din cele 26 de volume (fig. 1). Pe baza catalogului, se poate reconstitui exact conținutul acestui volum IV, redat fiind în lucrare cu textul original. Datele documentează că acest catalog a fost de fapt manuscrisul pentru "Flora Cibiniensis"şi flora Transilvaniei, pe care intenționa să le elaboreze Sigerus (fig. 2). Plantele colectate de Peter Sigerus au o deosebită importanță pentru documentarea începuturilor cercetărilor botanice din Transilvania, în perioada Linnéană de la sfârşitul secolului 18.
***Cuvinte cheie**: colecție de plante, sistem de clasificare Linné, flora Transilvaniei*

Introduction

In the third decade of the 20th century, after the First World War, an increase of prosperity and revival of scientific activity take place in and around the Transylvanian Society for Natural Sciences. At that time in the scientific review of the society "Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt"/ "Proceedings and Communications of the Transylvanian Society for Natural Sciences at Sibiu" the custodian at that time of the botanical collection, Dr. Karl Ungar mentions the organisation of a comprehensive plant collection of the Transylvanian flora serving as a sampling base for his new book "Flora Siebenbürgens" / "Flora of Transylvania" (Ungar 1925). This collection was a field guide for the whole Transylvanian Province, with the remark that "…the works for the realization of a Transylvanian Herbarium progresses very well". The collection is organized following the system of the flora book (refers to its own field guide) and under the same numbering, so that it can be easily used. The Herbarium contains plants of all botanists and from all regions of the country [the author means Transylvania] and beginning with 1793 to present (until 1925). In the last time has been enquired the precious school collection of Peter Sigerus" (original quotation: „Die Arbeiten zur Aufstellung eines siebenbürgischen Herbars schreiten rüstig vorwärts. Das Herbar wird nach dem im Florenbuch benützten System und unter der gleichen Numerierung geordnet, so dass es leicht benützt werden kann. Das Herbar enthält Pflanzen aller Floristen aus allen Gegenden des Landes und von 1793 bis auf die Gegenwart. In letzterer Zeit ist die wertvolle Schulsammlung des Peter Sigerus eingereiht worden"; Verh. und Mitt., 1925; Schneider-Binder, 1983, 2003).

Although in the Museum of Natural Sciences at Sibiu exists a remarkable number of famous historical herbaria preserved as independent collections, the collection of one of the pioneers of Transylvanian flora researches, the pharmacist and botanist Peter (Petrus) Sigerus (1759-1831) is not between them. The question about the fate of this plant collection between the other historical collections is put by the most botanists who studies the Transylvanian flora and consults the botanical collection at the Museum of Natural Sciences at Sibiu.

About the existence of many plant species, samples collected by Peter Sigerus in different places of Transylvania is speaking the references "Sg." (= Sigerus) in the "Flora Transsilvaniae Excursoria" of Michael Fuss (1866). But, first of all, older bibliographical information helps to find out details of the scientific activity of Peter Sigerus.

Objectives, Materials and Methods

To show the circumstances of the plant collection of Peter Sigerus came after his dead in 1831 from the family to the Protestant Gymnasium, what happened there with the collection and in which period and how it came in the possession of the Transylvanian Society of Natural Sciences and its Museum, is the objective of the present paper. It have to be clarified also why the collection is mentioned under the name of a "School Collection" and why the collection of Peter Sigerus was disintegrated and cannot be get as a whole.

The paper is based on the archive and bibliographical studies as well as studies in the historical plant collections of Michael Fuss, Herbarium of the Transylvanian Society of Natural Sciences and the Transylvanian plant collection of Dr. Karl Ungar mentioned above, all preserved in the Museum of Natural Sciences at Sibiu/Romania.

Results and discussions

Under the title "Anzeige für die Liebhaber der Botanik" ("Announcement for fanciers of botany") the "Siebenbürgische Quartalschrift" (Transylvianian Quarter Revue) from 1790, is calling attention for the scientific activity of the pharmacist Petrus Sigerus mentioning that "from two years ago he made the beginning for a complete *Flora Cibiniensis*, arranged to follow system of Linné; and he advanced quite far in the achievement of this excellent working" (original quotation: „Schon seit zwei Jahren hat er den Anfang zu einer vollständigen *Flora Cibiniensi*

gemacht, die er nach dem Linnéischen Systeme einrichtet; und er ist bereits ziemlich weit in der Ausführung dieses vortrefflichen Unternehmens gekommen“) (Siebenbürgische Quartalschrift, 1790, Schneider, 2009). The mention of a flora Cibiniensis refers to the first line to the town of Hermannstadt/Sibiu and its surroundings with the Cibin River, but also to a larger area. From the collected material is coming out, that the plant collection contains many samples from whole Transylvania, not only from the Cibin area.

Five decades later the Newspaper „Transilvania, Beiblatt zum Siebenbürger Boten“ from 1843 is publishing in his pages the following information :”The collections of Natural Sciences of the Protestant Gymnasium of Hermannstadt received through the gift, which has been made a few days ago (in November 1843) on the part of the university chancellor Karl Sigerus with the Herbarium of his deceased father a highly distinguished and precious increase.

Characterized through honesty and conscientiousness the pharmacist Peter Sigerus belongs in the same time to the most assiduous and knowledgeable naturalists of Transylvania and his name glares in the history of the Transylvanian plant science beside the dignified Baumgarten. The most meaningful proof of his disquietingly activity in this field gives the mentioned, by him build Herbarium. It contains in 26 Folio volumes 451 Genera and more than 1600 species and varieties of plants mostly collected in Transylvania. Between them are several rare, genuine Transylvanian species, also several species which are not included in Baumgartens opus, and finally several plants, which following the opinion of a very experienced botanist, owing him this communication, seems to be likely until now still unknown species” (original quotation: „Die naturhistorischen Sammlungen des Hermannstädter evang. Gymnasiums haben durch das Geschenk, welches der Universitätskanzlist Karl Sigerus demselben vor wenigen Tagen (im November 1843) mit dem Herbarium seines seligen Vaters gemacht hat, einen sehr bedeutenden und werthvollen Zuwachs erhalten. Ausgezeichnet durch geradsinnige Biederkeit und Gewissenhaftigkeit gehörte der Apotheker Peter Sigerus zugleich zu den eifrigsten und kenntnißreichsten Naturforschern Siebenbürgens, und sein Name glänzt in der Geschichte der siebenbürgischen Pflanzenkunde neben dem würdigen Baumgarten. Den sprechendsten Beweis seiner rastlosen Thätigkeit auf diesem Felde gibt das erwähnte von ihm angelegte Herbarium. Es enthält in 26 Foliobänden 451 Genera und über 1600 Spezies und Varietäten größtentheils in Siebenbürgen gesammelter Pflanzen. Darunter befinden sich mehrere seltene, ächt siebenbürgische, dann mehrere in Baumgartens werke nicht enthaltene, und endlich mehrere Pflanzen, welche nach dem Urtheil eines sehr geschickten Botanikers, welchem wir diese Mittheilungen verdanken, wahrscheinlich bis noch unbekannte Spezies sein dürften“).

The “experienced botanist” mentioned above is Michael Fuss, at that time teacher at the Protestant Gymnasium (Schneider 2007a). He used the plant collection of Sigerus for his botanical studies and mentioned in his own work “Flora Transsilvaniae Excursoria” (1866) numerous plants from localities known first by Peter Sigerus (“Sg”) and documented with samples collected by him. In the same time, plants from the collection of Sigerus were taken over in the Herbarium of Michael Fuss, today also preserved as an independent collection at the Herbarium of Museum of Natural Sciences at Sibiu, were at present can be found numerous plant samples from Peter Sigerus. It seems that the taking over of plants from the collection of Sigerus into the collection of Michael Fuss has been the first dismembration of the original Herbarium Sigerus.

As the plant collection of Peter Sigerus were further preserved at the Protestant Gymnasium it was considered part of the School collection, from where came the later name of Sigerus Herbarium as a “school collection”, but it was not build as a collection with didactical purposes. It was a scientific collection which comes only in the possession of the school at a time when the Academic Gymnasiums put a great attention to scientific knowledge and to building collections from different fields of Natural Sciences for the academic education of the scholars called “students”. In the same time the collections served as subject for scientific research realized by the teachers.

In the middle of the 19th century was the beginning of foundation of scientific societies which had as important objective to build collections and support scientific research (Schneider, Schneider, 2007). In 1849 was founded the Transylvanian Society of Natural Sciences, which later take owner the scientific collections of the Protestant Gymnasium.

Long time the collection of Peter Sigerus was buried in oblivion. In the third decade of the 20th century with the overall revival of scientific research at the Transylvanian Society of Natural

Sciences and its Museum, the collection of Peter Sigerus was again discovered and came in 1925, as mentioned above, in the property of the Transylvanian Society for Nature Sciences. Short time before at a meeting of the board of the Society from 8th of January 1924, published in the "Proceedings and Communications of the Transylvanian Society for Natural Sciences at Sibiu", Karl Ungar mentions „From the Museum Brukenthal the Society received an old plant catalogue from Peter Sigerus" (Ungar, 1924). This catalog "Verzeichnis meiner Pflanzen gesammelt seit 1789" /"Catalog of my plants collected beginning with 1789" is a comprehensive listing of plants and represents the key for understanding the plant collection of Sigerus. The manuscript is the basis for his planned "Flora Cibiniensis" and even more than this, it constitutes the basic work for his flora of Transylvania, classified following the system of Linné, and foreseen with latin diagnoses/despcriptions of the plants. More of that, the catalogue contains data concerning popular plant names in German, Romanian and Hungarian, as well as in Saxon dialect. Great importance is given to the use of plants being mentioned medicinal plants, honey plants, tinctorial plants and forage plants. This manuscript in form of a book is at present in preparation to be published soon by the author of the present paper.

It can be considered as sure, that the entrance of the catalogue in the possession of the Society called after longer time attention to the vergodden collection of Peter Sigerus at the Protestant Gymnasium and accelerated the taking ower in the possession of the Transylvanian Society of Natural Sciences and its museum. In the third decade of the 20th century Dr. Karl Ungar organized his Herbarium of the Transylvanian flora and included in it the plant collection of Peter Sigerus. His plan was to organize a complete collection of Transylvanian flora, as base of his book, i. e. a field guide of the Transylvanian flora. In this context he mentioned: „Without damaging anyhow the basic collections of the Society in their completeness, were valorized for example from Michael Fuss plants from the still existing and not deteriorated fascicles of the Herbarium Normale and the existing collection of doubles, further samples from the School collection taken over from the Protestant Gymnasium, in which still have been found valuable plant specimens, especially from Peter Sigerus" (original text:"Ohne dass die Stammsammlungen des Vereins irgendwie in ihrer Vollständigkeit geschädigt worden sind, wurden z. B: von M. Fuss die noch vorhandenen und nicht zerstörten Faszikel des Herbarium normale und die vorhandene Doublettensammlung verwertet, ferner die vom evangelischen Gymnasium übernommene Schulsammlung, wo noch wertvolle Pflanzenstücke, namentlich von Peter Sigerus, sich fanden..."; Verh. und Mitt., 1927). a great part of plants prepared by Michael Fuss for the Herbarium Normale Florae Transsylvaniae has been deteriorated 1878 by fire in its home at Groß-Scheuern/Sura/Mare. From the remained part, plants where taken over, as it is above mentioned in the Herbarium of Dr. Karl Ungar.

From these remarks can be understood, that the Herbarium of Peter Sigerus where not preserved in his integrity in the period from 1843-1925 at the Protestant Gymnasium and came somehow dismembered in the possession of the Transylvanian Society of Natural Sciences. This dismembration continued by being included in the collection of Dr. Karl Ungar. On the one hand it was a progress in the organization of a modern and more accessible herbarium for studies, on the other hand it is a loss as the collection of Peter Sigerus has been together with the collection of Joseph von Lerchenfeld, preserved in its integrity at the Museum in Sibiu/Hermannstadt the two oldest collection following the classification of Linné. Unfortunately the old etiquettes written by hand from Peter Sigerus where not preserved and changed by new ones written by Dr. Karl Ungar (Schneider-Binder, 2003).It had been more valuable, if the old etiquettes where preserved as prove for the original work of Peter Sigerus.

From the 26 volumes of the Herbarium only a single cover, that of vol. IV Dodecandria, Didynamia, has been found at the Museum remaining as an example of how the collection of Sigerus has been organised (fig. 1). How has been the repartition of the plants in the other volumes can only be estimated in general lines.

Following the above mentioned catalogue of Sigerus' plant collection, it is possible to reconstitutes the content of this one volume, given bellow with the original text existing as manuscript in old German writing and old orthography (fig. 2) as an example of how Sigerus planned his work of the Transylvanian flora. For each species is mentioned the latin name, the German popular name - where it is known - the popular Saxon (S), Romanian (V) and Hungarian (H) name of the species, the locality where the species have been collected, the general repartition area of the species (V.=Verbreitung) and the use, in particular as a medicinal plant (Off….).

The numbers on the right side are the pages in the manuscript of the catalogue of the Herbarium.

DODECANDRIA, DIDYNAMIA
Gymnospermia

Ajuga L.

272. *pyramidalis*. 2. Gülden Günsel. 790, Maij. On meadows and bushes (Auf Wiesen, in Sträuchen). Off. *Consolida media* Bugula. Laich. ex. descr. Jaqu. Schk. T. 155. with mention that A. genevensis can be a variety from this species (nebst Anmerkung dass A. Genev. eine Abart von diesen seyn könnte). In former time a wound-plant (Ehedem ein Wundkraut); against brownness (wider die Bräune). Flowers red and white (Blüht roth u. weiß).

275. *reptans*. 5. H: Kőszép Nadály-fű. Ge.:Kriechender Günsel. 791, 22 Maij. Near bushes (An Gesträuchen). Perenn. *Bugula reptans*. Scop. The same use like the above species (Gleichen Gebrauch t. d. vorigen) Schk.

Ajuga chamaepitys Schreb. Baumg. 93

Teucrium L

9518. *chamaepitys*. 4. T. Feldcypreßen. H. Kalintza fű. V. Temuiitze [Tămuițe]. 793, 28. Sept. On arable fields near Kis Ludos (Auf Aeckern bey Kis-Ludos). Perenn. Off. Chamaepitys herba. Bugula Chamaepitys Scop. Is an aromatic plant (Ist aromatisch); for tea as wound cleaning (zum Thee als eröffnend, wundreinigend). Schk. Against the gout (Wider die Gicht). B. Following Baumgarten (nach Baumg.) *Ajuga chamaepitys*. Schreb.

9519. *marum*. 12. Katzenkraut. H. Életfűve. 789, Aug. In the Garden of Baron Brukenthal (Im v. Br. Garten). Repartition (V.) Valenc, Syrien, Candia. Off. Mari veri Hba. The penetrating offensive smell of the pulverizesed plant provoke sneezing (Der durchdringend stechende Geruch der geriebenen Pflantze erregt Niesen); the plant still the exudatiion during consumption (sie stillt den abmattenden Schweiß in der Schwindsucht); a very quick acting refreshing median (ein sehr geschwind würkendes Erquikungsmittel); attract the cats (die Katzen gehen ihr sehr nach). B. Levis.

9533. *chamaedrys*. 26. Gamanderlein. H. Kis Tser-levelű fű. V. Dumbetz [Dumbăț]. 789, Julj; on hills (Auf Bergen). Perenn. Off. Chamaedrys herba. Is like a condiment, exudative and diuretic (Ist gewürtzhaft, schweiß u. urintreibend); by horses against worms, in the past used against the gout and ague (bey Pferden wider das Wurm beißen , vormahl gegen Gicht u. Wechselfieber).- The coins are normaly only with 2 flowers (Die Winkel sind gewöhnlich nur 2 blumig). Schk. T. 155. B. cop.

9536. *montanum*. 19. Berg Gamander. 792, 30 Aug. On the hill Steinberg near Talmatsch (Am Steinberg bey Talmatsch). Perenn. Scop.Schk. Wird statt T. cret. gebraucht. B.

9521. *laxmanni*. 798 Junj. On all hills of the Transylvanian plain near (Auf allen Hügeln der Mezöség, bey) Blutroth etc. Perenn.

93b

9532. *Scordium*. Lackenknoblauch. Perenn. Off. Hba Scordii. 799, 25 Julj in a swamp (in einem Sumpfe) ½ hour distance from Brenndorf to Marienburg on the way, left (½Stunde von Brenndorf gegen Marienburg am Wege links)

.*Satureja* L.

8539. *hortensis*. 5 Gem. Saturey. H. Tsombor. V. Tschimbru [Cimbru]. S. Eisbeth. 789, 10 Julj In gardens (in Gärten); like in Germany almost wilde (wie in Deutschl. fast wild). Einj. Satureja Off. Leers, Schk. With important notes (mit wichtigen Anmerkungen). T. 150. In Kronstadt In Kronstadt the plant is used for cooking as vegetable together with meat (wird das Kraut häufig als Gemüse bey Fleisch gekocht). I can find frequnetly only with one flower (Ich finde oft nur ene Blume am Stiel).

Hyssopus L.

5045. *officinalis*. 1. Isop. H. Sop. V. Iszop. S. Kirchen Eeisbeth; 789, 14 Junj. In gardens .In Austria a wild plant (In Gärten. In Oesterr. wild). Perenn. Off. Hb. Hyssopis, Aqua. Cons.Aromatic plant, taking part of the pectoral and lung herbs (Ist aromatisch und gehört unter die Brust und Lungenkräuter). B. Schk. T. 152.

Nepeta L.

6583. *cataria*. 1. Katzenmüntze. H. Matska fü . V. Ketuschnitze [Cătuniță]. S. Nicht. 789, Julj, on uncultivated fields (Auf ungeb. Orten) Perenn. Scop. Four bathings against nervous complaints (Zu Nervenbädern). Off. Nepeta herba. Against women problems and anaemia (Wider Mutterbeschwerden u. Bleichsucht.) B. chk. T. 157

94

6590. *nuda*. 793 Junj. Above the locality Hammerrsdorf (Ober Hammersdorf). Perenn.

Lavandula L.

5493. *spica*. 1. Lawendel. H. Lavendula. S. Spik. 789. Julj In gardens, in Southern Europe wilde (in Gärten, im südlicheren Europa wild). Zeich. Off. Flor. Hb. Aqu. Spir. Ol. Spica et Lav. For Fortifier for nerves, diaphoretic (Stärkt die Nerven, ist auflösend; schweißtreibend); for fine grained powder (zu Hautpulvern); for perfums (zum parfümieren). Oil of this species is prepared in particular in France (Das Spikoehl wird bes. in Frank.). Frequnt species (Häufig bereite. Sch. T. 157. B.

94b

Sideritis L.

9001. *hirsuta*. 11. Zottiges Gliedkraut. Ist die S. montana. 793, 28 Sept. near Kis Ludos rare on the Burrku funatzi place (bey Kis Ludos auf dem Burku funatzi selten). Einj. Laich. Following Schkuhr it can be S. montana; it seams to heal fresh wounds (Schk. nach welchem es wohl auch die S. montana seyn könnte; soll frische Wunden heilen). Off. Sideritis herba. Vormahl (in older times against white flow, enchantment (wider den weißen Fluß; Bezauberungen. 789. In the Transylvanian plaine (In der Mezöség).

Mentha L.

6236. *sylvestris*. 3. wilde Müntze. H. Lo-menta. V. Jisme Selbatike [Ismă sălbatică]. S. Vaeldt Brolsem. 789. Julj. On ways (An Wegen) Perenn. Off. Menthastri fol. olim. Schk. B. Strong condiment (Widrig gewürtzhaft).

6240. *crispa*. 6. Krausmüntze. H. fodorminta. V. Jisme Kriatze [Izsmă creață]. S. Krouß Boolsem. Off. Mentha crispa, Ol. Aqua, Conserva. An excellent median against aerogastrocolia (Ein vorzügliches Blähungtreibendes Mittel); and protect the milk against coagulation and hinders its separation in the animal body (u. hindert die Abscheidung derselben im thierischen Körper); for bees (für die Bienen), Schk. B. In our area the oil and destillated water is generally famous against worms, the last under the name Balsamwater (Bey uns ist das Oehl u. destillierte Wasser als Würmerstillend allgemein berühmt, Letzteres unter dem Nahmen Balsamwaßer). The stamina are frequnetly longer as the petals (Die Stf. Sind oft länger als das Blumenblatt). Perenn.

6242. *aquatica*. 8. Waßermüntze. H. Vizi-Mentha. V. Jisme Api. S. Kruadeboolsem. 792, 22 Aug. bey Saltzb/near Saltzburg/Ocna Sibiului. Perenn. Scop. Laich. Schk. Off. *Mentha aquatica*. The medicinal use is the same as for *Mentha crispa* (Mediz. Gebrauch wie *M. crispa* Spiellman. The variety □. Is growing on lakes , is higher, ramified, and less rough; the coins of the stems are more blunted, the leafes with acuminate tooth; the stamina are no longer as the flower; the whole plant of green colour (Die Abänd. □. wächst an mehreren Teichen, ist höher; sehr ästig; etwas weniger rauh; die Eken der Stengel mehr abgestumpft, die Blätter spitziger gezähnt; die Staubf. kaum von der Länge der Blume; die gantze Pflantze grüner von Farbe).

6243. *piperita*. M. From Mr. Lerchenfeld from Hungary (V. H. v. L. aus Ungarn). Off. Hba et Oleum dest.

Mentha hirsuta Schmiert. 8 Aug. 1819, Salzburg on wet soil (in feuchten Boden).

95

6246. *arvensis*. 12. 789, Julj. On arable fields (Auf Aekern). Perenn. Mentha gentili vix differre. Scop. I would consideri t as this plant if my plant would be not rougher and with longer stamina as the plant described by Schkuhr (Ich würde sie auch für diese halten wenn meine Pflantze nicht rauer wäre u. nicht längere Staubfäden hätte als Schk. Abbildung). T. 158. Lasich. 795 Aug. Jens. Talmatsch.

6250. *pulegium*. 16. Poleykraut. H. Putnok-fű. V. Busiok dje Kirup [Busuioc de chirup]. S. Püll. 790, 28. Julj. On the right beyond the bridge near the village Hammersdorf (Rechts jenseits der Brüke bey Hammersd). Perenn. Off. Hba Pulegii. Scop. Is highly edged, against pertussis (Ist besonders scharf; wider Keuchhusten; Engbrüstigkeit); B. in our area famous as plant used against women problems (Hier wider Mutterbeschwerden berühmt).

6245. *gentilis*. Balsammüntze. 798. 4 Sept. from Alter Berg to the town on a ditch (herwärts. d. Alten Berg am Graben). Perenn. Schk. Perhaps a new species. (Vielleicht eher eine neue Spec. ?) 799 near the village Hammersdorf (bey Hammersd).

6238. *viridis*. Grüne Müntze. Perenn. 799 Julj in the Garden at Talmatsch and on fences. The leafes are smelling like Tamant. Balsam (im Tallmatscher Garten u. an Zäunen. Die Blätter riechen wie die des Tamant. Balsam).

6245. *exigua* ? Mentha arv. var. □ major.

Glechoma L.

4350. *hederacea.* Gundelrebe; Kerék nadra-fű. V. Selnike [Sălnică]. S. Gangter rieven. 789 Maij. Largely spreaded (Aller Orten). Perenn. Off. H. Hederae terrestris, Conserva. Calam. Hederacei. Scop. A strong condiment, is healing inner and outside abscesses; disolving mucus.For treatments with the plant in May the plant is cutt in small pieces and used in soups (Gewürtzkraft, heilt in u. äußerliche Geschwüre; löst Schleim auf. Zu Maykuren wird sie klein geschnitten in Suppen genossen. B.

95b

Lamium L.

5432. *arvula*. 1. Das Arwelkraut. 790, 20 May . Onbushes along ways (An Weggeb). Perenn. The leafes have white spots as are described by Lam. Maculatum (Die Blätter haben weiße Flecke wie bey Lam. macul. angegeben werden); stems and leafes are slightly rough (Stengel u. Blätter sind etwas rau). Scop. T. 27.

5436. *album*. 5. Weiße taube Neßel. H. Hold-Tsalyán. V. Ursike muarte [Urzică moartă]. 789, 20 Maij. On ways (An Wegen). Perenn. Off. Lamii albi. S. Galeopsidis flores. Scop. Variat fl. carneo. R. used as vegetable (als Gemüse); in the past used against the white flow; against scrophele used in and outside (vormahl wider den Weißen Fluß; Skrophele inn u. äußerlich). B. Lam. foliosa Cr. Schk. T. 159.

5437. *purpurascens.* 6. Rothe Taubnessel. H. Büdes hold Tsalyan. 789, April. Togheter with the above mentioned (Mit den Vorigen). Einj. Scop. Used to banish verruca (Vertreibt die Wartzen). B. The leafes are sometime with white spots (Die Blätter sind bißweilen weiß gefleckt). Schk. T. 159. Is flowering sometime also white (Blüht bisweilen auch weiß).

5438. *amplexicaule*. 7. Kleine rothe Akerneßel. 791, 14 Apr. In the vignard, on ways Im Weing. an Weegen. Einj. Schk. T. 159.

5435. *maculatum* L. Gefleckte Taubneßel.796 May. On hedges, fences and bushes An Hecken, Zäunen u. Gebüschen. Perenn. The characteristics given by Schkuhr for distingue from number 5436, that the smallest leafes on the top have almost the same lenght and broad, but are on the last one more lanceolate (Das von Schk. angegebene Kennzeichen wonach sich diese von nr. 5436 unterscheiden lässt, dass nämlich die kleinsten oder obersten Blättchen größtentheils so breit als lang, an der letzten aber merklich lanzettförmiger sind ist richtig).

96

Galeopsis L.

4104. *ladanum*. 1. Rote Hanfneßel. H. Kenderfü. 789, 20 Julj. On arable fields, on borders of streams, annual species (Auf Aeckern, an Ufern der Bäche. Einj). The chalices are spinos (Die Kelche sind in der That stachlich).

4105. *tetrahit*. Hanfartiges Katzengesicht. H. Tarka Kender-fű. 789, Julj, Ende. On ways, along fences. The bristly barbes are oriented downstairs (An Wegen, Zäunen. Die borstigen Stacheln sind am Stengel nach unten gekehrt).

4106. *galeobdolon.* 3. Gelbes Katzengesicht. H. Sárga Tsalyomka. 791, 26 Maij. In the place called „In den breiten Heken". The flowers are good for bees (Die Blumen dieser Arten für die Bienen). B. Named at present (Heißt jetzt) *Galeobdolon luteum.* Sch. Baumgart.

Betonica L.

1356. *officinalis.* 1. Betonien. H. Bak-fű. V. Járbe thejeturi [Iarba tăieturii]. 789 Junj on meadows (auf Wiesen). Perenn. Off. Betonicae herba. A median taking out slime (Ein Schleimziehendes Niesemittel). B. In pour area are used the leafes for fresh wounds (Hier braucht man die Blätter auf frische Wunden).

Stachis L.

9339. *sylvatica*. 1. Wald Roßpoley. 790, 19 Junj. On bushes. Annual; the stem is like by cannabis. The juice is used against collics (An Gesträuchen. Einj. Der Stengel ist hanfartig. Der Saft wider die Kolik). B.

9340. *palustris*. 2. Sumpf Poßpoley. Perenn. 790. Aug. On sstreams, wet meadows. The root presents good food for pigs (An Bächen, auf feuchten Wiesen. Die Wurtzel ist den Schweinen angenehm); is farinaceous and can used for bred (ist mehlig u. kann zu Brod angewendet werden). B.

9342. *germanica*. 4. Deutscher Roßpoley. H. Fejer mezei Sálya. 790, 16 Julj. Near the village Hammersdorf on the right of poor hills (Hammersd. rechts an magern Anhöhen). Abraded have a bad smell (Gerieben richt sie widrig).

9353. *recta*. 15. Aufrechte Roßpoley. Perenn. 790, 26 Maij. Above Hammersdorf on the right, on the top of the hill (Ober Hammersd. rechts am Berge). Sch. T. 161.
9354. *annua*. 16. [only a latin diagnose, and no other data].
9341. *alpina*. On the Fedeles mountain (Auf der Fedelesche).

97

Ballota L.

1286. *nigra*. 1. Schwartzer Andorn. H. Bujdosó Tsalyán. 790, 3 Julj. On ways (An Weegen). Perenn. In Gothland used as medicament for cattles (in Gothland eine Artzney beym Rindvieh). Maybe good in cases of hystery (Bey hysterischen Zufällen vielleicht nicht undienlich). B.
6108. *vulgare*. 6. Weißer Andorn. H. Fejér Pernet-fű. V. Ungurás. 789 Julj. On ruderal places (Auf wüsten Orten). Perenn. Off. Marrubii albi herba. The plant is strong in cases of breast and intenstinal problems (Er ist kräftig bey Stauungen der Brust u. der Eingeweide); due to the particular smell perhaps also for women problems (seines besonderen eignen Geruches wegen vielleicht auch bey Mutterbeschwerden).
Mar. *creticum*. Sprengel. Baumg. 789 Junj 4. Near Carlsburg/Alba Iulia (Bey Carlsburg) . Perenn.

Leonurus. L.

5554. *cardiaca*. 1. Hertzgespan. H. Sziv-erösitö-fü. V. Crásta Kokoschuluj [Crasta cocoşului].789 Junj. On waste places (Auf wüsten Plätzen). Perenn. Cardiaca Off. IN the past used against heart palpitation (Vormahl wider Hertzklopfen); against mucous obstructions; (Verschleimungen); diuretical (den Harn zu treiben). B.
5556. *marrubiastrum*. 3. Andornförmiger Löwenschwantz. 791, 25 Aug. On fences near the village Hammersdorf (An Zäunen bey Hammersd). Perenn. Laich. t. Jaqu. Beschr. The accepted name is *Chaiturus leonuroides*.

97b

Phlomis

7301. *tuberosa*. Knollichte Phlomis. 798 Junj. Near Carlsburg and the entire Transylvanian plaine/Mezöség (Bey Carlsburg u. der ganzen Mezöség). Perenn. Schk. T. 103.

Molucella L.

6435. *laevis*. 1. Molucelle. 788 Sept. From the Botanical Garden at Pest (Aus d. Pest. Bot. Ga).

Clinopodium L.

2565. *vulgare*. 1. Würbel Dosten. 790, 18. Julj. Perenn. In the bushes near Poplaca (In Popl. Sträuchen). Perhaps good for tanning (Vielleicht ein Gerbemittel); is frequently collected by mistake as *Melissa calamintha* (wird oft falsch für *Melissa calamintha* gesammlet). B.

Origanum L.

6836. *vulgare*. 7. Dosten. H. Varga Majorana. V. Sovurf [Sovârf]. 789, Aug, Near bushes (An Sträuchen). Perenn. Scop. A very good condiment (Ein vortreffliches Gewürtz); for power (stärkend); deaggregating (zertheilend); against decomposition, putrefaction (fäulnißwirdrig); gives the beer strongness (theilt dem Bier beraschende Kraft mit); colors the wool in a light red-brwon (färbt die Wolle hellrothbraun). B. Off. Origani herba, Ol. dest. I have found also a variety with white flower (Ich habe auch die Abänderung mit weißer Blume gefunden).
6840. *majorana*. 11. Majoran. H. Majorána. V. Meiran [Măiran]. S. Majerom. 784 Julj. In gardens (In Gärten). Biannual (Zweij). Area Pontic (V. Pont). Off. Hba, Ol. Ung. Condiment for cooking (Ein Speisegewürtz); for sneezing (Niesemittel); used against swollen breast (bey geschwollenen Brüsten); the clyster is used in Egypt against the four days fever (die Klistiere davon in Egypten wider 4 tägige Fieber); the oil eliberate a volatil salt (das Oehl setzt ein flüchtiges Saltz ab).

98

9612. *serpillum*. 1. with 11 varieties from which var. 6 is our common Quendel (mit 11 Abänderungen; von welchen var. 6 unsere gewöhnliche ist. Quendel). H. Kakuk-fü. V. Serpun. Tsimbru Selbatik [Cimbru sălbatic]. S. Veld Eeisbet. 789 Junj. On meadows, ways (Auf Wiesen, Weegen). Perenn. Off. Herba, Oleum. As a condiment for desaggregation and fortification (Als Gewürtz, zum zertheilen u. stärken äußerlich). B. Var. 1. Scop. 792, 23 Julj; on the Prejba mountains (auf der Presba)..
9613. *vulgaris*. 2. Gem. Thymian. H. Kerti Kakuk-fü. 793, 8. Junj Perenn. Off. Thymi herba, ol. dest. Is used as cooking condiment, strong in flavor; the oil ist used for hair grease (Dient mehr als Speisegewürtz; ist scharf am Geschmack; das Oehl zu Pomaden). B. In G. V. der Normandie.

9615. *acinos*. 4. Basilienartiger Thymian. 791, 25 Junj, Above the village Hammersdorf, on the right, annual (Ober Hammersdorf, rechts Einj.).

9616. *alpina*. 5. Alen Quendel. 792, 25. Aug. On the Fedeles Mountain, annual (Auf dem Fedelesche. Einj). Scop. Laich. Use the description of Jaquin der sieht Jaqu. Beschreibung). All parts of the plant are hairy (Alle Theile sind etwas haarig).

Herb. Litt. A. Thymus ? 796. On the castle near (An der Burg bey) Michelsberg. Described by mr. v. Lerchenfeld (V. H. v. L. beschrieben). Is flowering with three weeks later than Thymus serpyllum (Blüht um 3 Wochen später als Th. Serp). In den Plant. Rarior. Hung. Taf. 71. Thymus mont. namend (benannt).

Melissa L.

6206. *grandiflora*. M. intermedia Baumg. Großblumige Meliße. Schk. Scop. 798. 27 Aug. Nera the river (Neben dem) Reu Vaduluj. Perenn

98b

6205. *officinalis*. 1. Melissen. H. Méh-fű. V. Matetschine [Matăcină]. S. Bokekrokt. 784. Junj. Ende of June in gardens (Ende. in Gärten). Perenn. Repartition (Verbreitung). Genua, Italien. Scop. Mentioned incorrect (wird in Laich unrichtig angeführt). Due to its smelt it can be prepared a good tea (Wegen seines erquikenden Geruchs ein vorzüglicher Nervenstärk. Thee). For the monthly cleaning (Zu Treibung der monathlichen Reinigung). B. Off. Herba Melissae citratae.

H. L. A. Melissa? 798 12 Junj already withered on the hill beyond (schon verblüht am Berge jenseits) Mots.

6207. *calamintha*. From Mr. Lerchenfeld from Hungary (V. H. v. L. aus Ung). Perenn. Off. H. Calaminth. Is named now (Heißt jetzt) Calamintha officinalis Baumg.

Dracocephalum L.

3442. *moldavica*.8. Türkische Müntze. H. Török Méh-fű. S. Tirkesch Bootsen. 789 Junj In gardens (in Gärten). Repartion (V.) Moldau. Annual it is balsamic and refreshing (Einj. Ist balsamisch u. erquikend). B. Off. Melissa turcina, olim. The smell is like Melissa, Thymus and basil (Der Geruch ist Melissen, Quend u. Basilienartig).

D. austriacum. L. Schildförmiges Drachenkraut. 791, 23 Junj. On the rose garden (Am Ros. G.) Area the Orient, annual (V. Morgenl. Einj.). During grinding the plant is smelling disagreable (Beym Reiben riecht die Pflanze widerwärtig.

99

Melittis L.

6211, *melissophyllum*. 1. Immenblatt. H. Dobronika. V. Dobronike [Dobronică]. 790, 26 May. Under bushes, perennial (Unter Gesträuchen. Perenn). Off. Melissophylum Lamium montanum. Used for monthly cleaness, diuretical (Treibt die monathliche Reinigung den Harn. B.) Offers for bees much honey and smells very good (Giebt den Bienen viel Honig und riecht sehr angenehm).

Ocymum L.

6645. *basilicum*. 6. Basilienkraut . H. Básalicomk. V. Busiok. S. Betzilch. 789, Julj. In gardens (In Gärten). Area India, Persia, annual (V. Indien, Persien. Einj.) Off. Basilici herba. Have more varieties, is a very strong condiment and serves more for food as for medicinal purposes. For decoration (Hat mehrere Abänderungen. Ist sehr gewürtzhaft u. dient mehr zur Speise als Artzney; zur Zierrath). B.By Romanian people an exceptional herb. It produce sneezing (Unseren Walachen ein vorzüglich angenehmes Kraut. Macht Niesen).

Scutellaria L.

8772. *galericulata*.6. Schildkraut. H. Tsakoka-fű. 789, 29 Maij. On river borders, on meadows (An Rändern der Bäche, auf Wiesen). Perenn. Is bitter and smells like garlic. For this reason it is used against fever and worms. Also gainst brownness (Ist bitter, riecht nach Knoblauch u. daher wider Fieber u. Würmer. B. Wider die Bräune).

8773. *hastifolia*. Spontanblättriges Helmkraut. 796, 20 Junj. Im Lazareth. Perenn. Schk.

8778. *peregrina*. Fremdes Schildkraut. 798. d. 7. Junj In the Gorge of Thorda/Turda (in der Thordaer Hasadék). Perenn. Schk. 99b

Prunella L.

7864. *vulgaris*. 1.Gem. Braunheil. H. Gjék-fű. V. Busiok dje Kirup [Busioc de chirup]. Off. Prunella herba. 789, 20 Aug. Every where, perrennial (Ueberall. Perenn) randiflora. With the next on the same sites (Mit der folgenden an einerley Orten). Brunella Scop.

7866. *laciniata*. 2. Gerißenere Braunheil. 789. 20 Aug. On meagre hills (Auf mageren Anhöhen). Perenn. Laich. The species is more rough than the above have a variety with white flower (Er ist immer rauher als der Vorige. Aendert ab mit weißer Blume). The medicinal power of the previous species is very small (Die Artzneykräfte des Vorigen sind sehr gering. B.)

Angiospermia

Bartsia

1318. *alpina*. Alpen Bartsie. Perenn. 794. On the Srul mountains from mr. V. Lerchenfeld (Auf dem Szurul. V. H. v. L.) 796. 7 Julj on cliffs on the foot of Rakovitzanulan frequntly (Felsen unter dem Rákovitzanul häufig). Named in the honour of a Prussian scientist Johann Bartsch (Einem preuß. Gelehrten Johann Bartsch zu Ehren so genannt).

Rhinanthus L.

Rhin. glaber Dec. Hahnenkamm. H. Tsengehoro. V. Czirne Lup. 789. Junj. On meadows annual (Auf Wiesen. Einj.) Used for dyeing (Zur Färberey); the seeds deteriorate the flour (der Saamen verdirbt das Mehl). B. Mimulus crista galli. Scop.

Rhin. hirsutus. Decand. Baumg. Rh. alectorol. L.

Odontites.

Odontites rubra. Pers. Following Baumgarten (Nach Baumg.).

100

Euphrasia L.

3901. *officinalis*. 2. Augentrost. H. Szem-fü. V. Szilur [Silur]. S. Uugentrüst. 789. Julj Ende. On poor sites. Annual (Auf magern Orten. Einj.) Off. Euphrasiae herba, Aqua. Scop. In the past this bitter herb has been of great importance for weak eyes (Vormahl war dieses etwas bittere Kraut bey Schwäche der Augen in großem Ansehen.) B.

3903. *odontites*. 4. Zahntrost. H. Fogantsch-virág. 790, 25 Aug. On the way to the powder mill , annual (Am Weege nach der Pulvermühle - Einj.) Scop. It seams to help against toothache (Soll wider Zahnweh helfen). B. Heist. Odontites rubra following Baumgarten (nach Baumg.).

3904. *lutea*. 5. Gelber Augebtrost. 792, 25 Aug. Near Salzburg /Ona Sibiului, annual (Bey Saltzburg. Einj.) Scop. Laich. With the general description of Jaquin (mit der weitläuf. Jaqu. Beschreibung).

Melampyrum L.

6165. *cristatum*. 1. Kammförmiger Kuhweitzen. 793, 7 July near Salzburg almost withered (bey Saltzburg fast verbl.) Scop. Annual (Einj.)- daffodil meadow (Narzißen Wiese).

6166. *arvense*. 2. Acker-Kuhweitzen. H. Tsormolya. V. Tschurmoják [Ciurmoiac]. S. Kaderveiß. 789. Junj.On arable fields, annual (Auf Aeckern. Einj.). The bread become blue and bitter, but not dangereous. The colour stock become red with alcalin substances and green from oak galls. An four day old infusion with rain water is dyeing durable in blue. (Das Brod wird hievon blau u. bitter aber nicht schädlich. Die Farbenbrüh der Pflantze wird durch Alkalien roth, von Galläpfeln grün. B. Ein mit Regenwasser gemachter 4 tägiger Aufguß färbt dauerhaft blau).

6167. *nemorosum*. 3. Waldkuhweitzen. H. Kék-ütö-fü. V. Kerpena [Cherpena]. 789 End of June in bushes , annual (Junj, Ende. In Sträuchen. Einj.) forage and nutrition for bees (Viehfutter u. Bienennahrung); a herb für wounds (ein Wundkraut); it have of beautiful coloration (hat eine sehr schöne Färbung). B.

100b

6168. *pratense*. 4. Wiesenkuhweitzen. 792, 22 Junj. Not far from the shruberry of Heltau. annual (Unweit der Helt. Sträucher. Einj.) Scop. Ir colors the butter of cow in a beautiful yellow (Soll die Butter der Kühe schön gelb machen.) B.

6169. *sylvaticum*. 5. Kleiner gelber Kuhweitzen. 790, 8 Aug. In the forest near the shruberry of Poplaca. Annual (Im Wäldchen bey den Popl. St. Einj.) Scop. Laich. The plant found on the Poschomok hills have no dentate leafes. Leafes of old specimens of Melampyrum become by desiccation black, the last most (Die auf dem Poschomok gef. Pf. hat keine gezähnten Blätter. Alte Mel. werden durch das Trocknen schwartz, diese Letzte am meisten).

Lathraea L.

5471. *squamaria*. 4. Gem. Schuppenwurtz. H. Fogatsán. V. Muma poduri [Muma pădurii]. In saxon dialect in the village Martinsberg is named Goud root. As the plant is used by the local farmers against gout (S. Bey Martinsberg Gichwurtzel weil sie wieder dieses Uebel von den dasigen Bauern gebraucht wird). 792, 11. Apr. Above the Bee garden of Hutter in shruberry (Ober dem Hutt. Bienengarten im Gesträuch). Perenn. Squamaria Orobanche Scop. In old time used against falling sickness (Vordem

wider die Fallsucht). B. She can have variations with dark flowers (Sie ändert ab mit dunkeln Blumen).

Tozzia. L.

9661. *alpina*. 796 7 July Under the Racovitzanul mountain (unter dem Rakovitzanul). Perenn. Schk. Tab. 171.

Pedicularis L.

7147. *palustris*. 1. Sumpf Läusekraut. H. Piros Kakastarej.793, 7 Julj. Near Salzburg in wetlands. Annual (Bey Saltzb. in Sümpfen. Einj.) Scop. It is hot and caustic (Ist scharf u. aetzend); only eat by caprines (wird nur von Ziegen gefressen). B.

101

7151. *verticillata*. 5. Gequirltes Läusekraut. 792, 23 Julj. Beyond of the prejba mountain.(Jenseit der Presba). Perenn. Scop. Laich. Jaqu. Descrition (Beschreibung). Cor. obtusae opurpureae. Is growing not higher than 5 inch (Wächst nicht über 5 Zoll hoch).

7160. *comosa*. 14. Zopfiges Läusekraut. 792, 23 Julj. Perenn. Cllected by mr. Von Lerchenfeld on meadows between Verespatak and Zalatna (V. H. v. L. auf Wiesen zwischen Verespatak u. Zalatna).

7161. *foliosa.* Blätterichtes Läusekraut. 796, 8 Julj. On the stream near the Stina intre râuri. The flowers yellow; the roots not very dick, as Schkuhrs opinion (Am Gebürgsbach neben der Stina entre Reu. Die Blumen sind gelb; die Wurzel aber nicht sehr dick, wie Schkuhr meint).

7150. *sceptrum-carolinum.* 801. On the Schuler/Postavarul mountains found by Mr.von Lerchenfeld (V. H. v. L. gef. Auf d. Schullergeb). Perenn.

Antirrhinum L.

694. *elatine*. 3. Cymbalaria Elatine Baumg. Erdwinde. H. Len-fojtó. 793, 12 Aug. On arable fields near Doborka, annual (Auf Aeckern vor Doborka. Einj.) Scop. The sand-sedge is brown , the other parts of the flower yellow (Der Helm ist braun, das übrige der Bl. Gelb); the plant is hairy (die Pfl. Haarig).

695.s*purium*. 4. Falscher Darant. Cymbalaria Spuria Baumg. 791 Aug. Collected by mr. V. Lerchenfeld near Stolzenburg, annual (V. H. v.L. bey Stoltzenburg. Einj.) Scop.

Cymballaria

b. foliis oppositis

Linaria

L. genistifolia Rch.

L. vulgaris Riv.

c.) foliis alternis

722. *genistifolium.* 31. Ginsterblättr. Darant. 791, 18. Sept. On the left , above the vignards of Hammersdorf, perennial (Links ober den Hammersd. Weingärten). Perenn. Laich. With the exact description of Mr. Jaquin (mit der genauen Beschr. des H. v. Jaquin). Grows three shoes high (Wächst gegen 3 Schuh hoch). At present (Jetzt) Linaria genistifolia.

724. *linaria*. 33. Leimkraut: H. Vad-Len. V. Jin Selbatik [In Sălbatic]. 789 Junj. On waste places (Auf wüsten Stellen). Perenn. Off. Linariae herba, Unguen. Contains toxic substances constituting a poison for flies. Is diuretic; the unguent produced from this plant is against in situation of pains (Giebt eine Fliegengift ab; ist harntreibend u. purgierend; die Salbe bey Schmertzen der blinden goldenen Ader); the flowers are used internal against durable eruptions (die Blumen innerlich gegen langwierige Außschläge). B. Now (Jetzt) *Linaria vulgaris* Riv.

727. *chalepense*. 35. Chalepeu-Darant. 792, 13 Junj. In the garden of Rosenfeld (Ros. G.) Distribution Italy. Annual (V. Italien. Einj.). The wall ist double long as the flower (Der Sporn ist noch einmahl so lang als die Bl.) Laich.

101b-102

d) Cor. hiantibus aut ecaudatis

732. *majus*. 40. Großes Löwenmaul. H. Oroszlán-Szái-fü. S. Livemell. 789, 20 Julj In gardens (in G.) In Crain wilde. Scop. Have more varieties (Hat mehrere Abänderungen). Laich. Ornamental plant (Zur Zierde). B.

733. *orontium.* 41. Kalbsnase. 791, 4 Julj. Garden of Rosenfeld (Ros. G.) In Crain wilde. Scop. Annual/Einj. The plant is probabely poisonous (Die Pflantze soll giftig seyn). B.

Scrophularia L.

8751. *nodosa*. 2. Knotige Braunwurtz. H. Fekete Tsalyan. V. Ursike nyagre [Urzică niagră]. 790, 24 Maij. On ways (An Weegen). Perenn. Scop. Off. Scrophulariae rad. Against browness, Skeophele etc. (Wider die Bräune, Skrophele ect. soll sie geholfen haben). S. Biis Bloderekrokt, it is put on fresh wounds (in dieser Eigenschaft auf frische Wunden). The seeds against worms (Der Saamen wider die Spuhlwürmer). B. x in bushes beyound Westen to Talmatsch (im Gebüsch jenseits Westen gegen Talmatsch).

8752. *aquatica*. 3. Wasser Braunwurtz. 791, 4. Junj. On stream banks (An Bachufern). Scop. Improuves the smell and flavour of Sennes leafes; good as wound herb. (Verbeßert den Geruch u. Geschmack der Sennesblätter; ein gutes Wundkraut). B. (the stem is producing roots; the leafes not so dark green; the nether leafes are not so acuminated and are more in form of heart as the above species (der Stengel ist wurtzelschlagend); the leafes are not so dark green (die Blätter nicht so dunkelgrün; die untern Blätter nicht so scharf gezähnt und mehr hertzförmig als bey der vorigen Art). – The leafes in the top are frequently completely ovate, stump denticulated and on the top also stump. The roots are fibered (Die obern Blätter sind oft gantz eyrund, ungleich stumpf gezähnt, und an der Spitze stumpf. Wurtzel faserig). Schk. T. 173.

8754. *scorodonia*. vernalis. Sc. Melißenblättr. Braunwurz. 795, 25 May. Not far from the garden of pastor Filtsch's garden (Unw. Verst. Stadtpf. Filtsch Garten). Perenn. Schk. – the roots are fibered (die Wurtzel ist faserig).

Scrophularia laciniata Vest. 798 / Junj In the gorge of Thorda (in der Thordaer Hasadék). Described by mr. von Lerchenfeld (V. H. v. L. beschrieben).

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Digitalis L.

3312. *ambigua*. 5. Zweifelhafter Fingerhut. H. Sárga gyüszü-fü. 790, 6 Julj. In the bushes at Heltau and Poplaca. (In den Helt u. Popl. Sträuchen). Perenn. The flowers are inside with rost spots (Die Blumen sind von innen mit Rostflecken besetzt). Schk. Tab. 174.

3308. *purpurea*. Rother Fingerhut. 800 Flowering from vom 20th June to August in my garden (vom 20 Junj bis 20 Aug. blühend in meinem Garten). Perenn. Off. Hb. Digit. Purp.

D. lanata L. From mr.v. H. Kolar u. Murray on the border of Transylvania (an der Sieb. Grenzen). From Baumgarten near Deva (Baumg. bei Deva)etc.

Lindernia L.

5747. *pyxidaria*. 1. Das Büchsenkraut. 793, 24. Aug. On the half way between Schellenberg and Westen in a swamp area (Auf halbem Wege zwischen Schellenbg. u. Vesten in einem Sumpfe).

Orobanche L.

6869. *major*. 2. O. lutea Baumg. Große Sommerwurtz. H. Mise ärtya. V. Krejelitsch. 790, 19 Junj. On Near the bushes right above the village Hammersdorf (Am Gesträuche rechts ober Hammersd). The flowers and stem are yellow like cera and smells as pinks. This fact was remarked also by Bauhin and Scopoli. The scions are eatable (Die Blumen und Stengel sind wachsgelb, u. riechen nach Nelken. Das Letztere hat schon Bauhin bemerkt u. Scop. Die Sproßen essbar). 795, 25 Maij. Above the compartment 8 on left part of vignards at Hammersdorf (Ober der 8then Abtheil, der links liegenden Hammerd. Weingärten). Galeae et labii lacin.

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6874. *ramosa*. Kleine Sommerwurz. Perenn. 797, 21 7br. Beyond Talmatsch on sandy arable lands .Have blue flowers (Hinter Talmatsch auf sandigen Aeckern. Schk. blüht blau).

Orobanche ? The most frequent species seams to be a new plant, although it are very near to Orobanche levis. The most common plsnt growing in the bushes sems to be a new species (Die am gemeinsten in Sträuchn wachsende scheint eine neue Art zu seyn, obschon sie in gewissen Stücken mit Orob. Laevis übereinkommt).

Limosella

5743. *aquatica*. Etland plant (Sumpfpflanze). 801, 1 Aug.Neart to Kerz on the river. Annual (neben Kertz in Gebürgbächen. Einj).

Acanthus.

Ac. Spinosus. L. Near Karlsburg (Bey Karlsb.) collected by 817 Gräfin Josika. Also (Auch) Kollar.

Following the text included in the catalogue it came out very clear, that it is not only a simple listing of the collected plant samples contained in the 26 volumes of the Herbarium of Peter Sigerus. It constitutes the basic lines for his planned work of "*Flora Cibiniensis*" and the *Transylvanian*

Flora, which due to financial problems was not possible to be realised at that time (Schneider-Binder, 1983, 2009).

Conclusions

Including the plant collection of Peter Sigerus in the large collection named today Herbarium of Dr. Karl Ungar, preserved in the Museum of Natural Sciences in Sibiu, the collection of Peter Sigerus has been dismembered and loss the character of its uniqueness as one of the first large Transylvanian plant collections following the classification system of Linné. Only on the base of the existing catalogue, it is possible to document the content of the original plant collection of Peter Sigerus and to estimate the importance of this collection concerning the volume of information not only for the repartition of the plants in different area of Transylvania, but mentioned plants also for the knowledge of different use of the mentioned plants.

The collection is wrongly named as "school herbarium" as it is a scientific collection of the botanist Peter Sigerus, pharmacist and recognized for his researches concerning the Transylvanian Flora in the last two decades of the 18th and the first decades of the 19th century. Only due to the place of preservation at the Protestant Gymnasium at Sibiu/Hermannstadt, the collection received the name of a school collection.

The plant samples of Peter Sigerus included in the Transylvanian Herbarium of Dr. Karl Ungar are a contribution of outstanding importance to the documentation of the Transylvanian flora and marks the beginning of these researches in the last decades of the 18th century, being completed in the course of the 19th and 20th centuries by other botanists, members of the Transylvanian Society of Natural Sciences.

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Fig. 2. Catalogul colecției de plante a lui Peter Sigerus.

Fig. 1. Cover of volume IV of the Transylvanian plant collection of Peter Sigerus

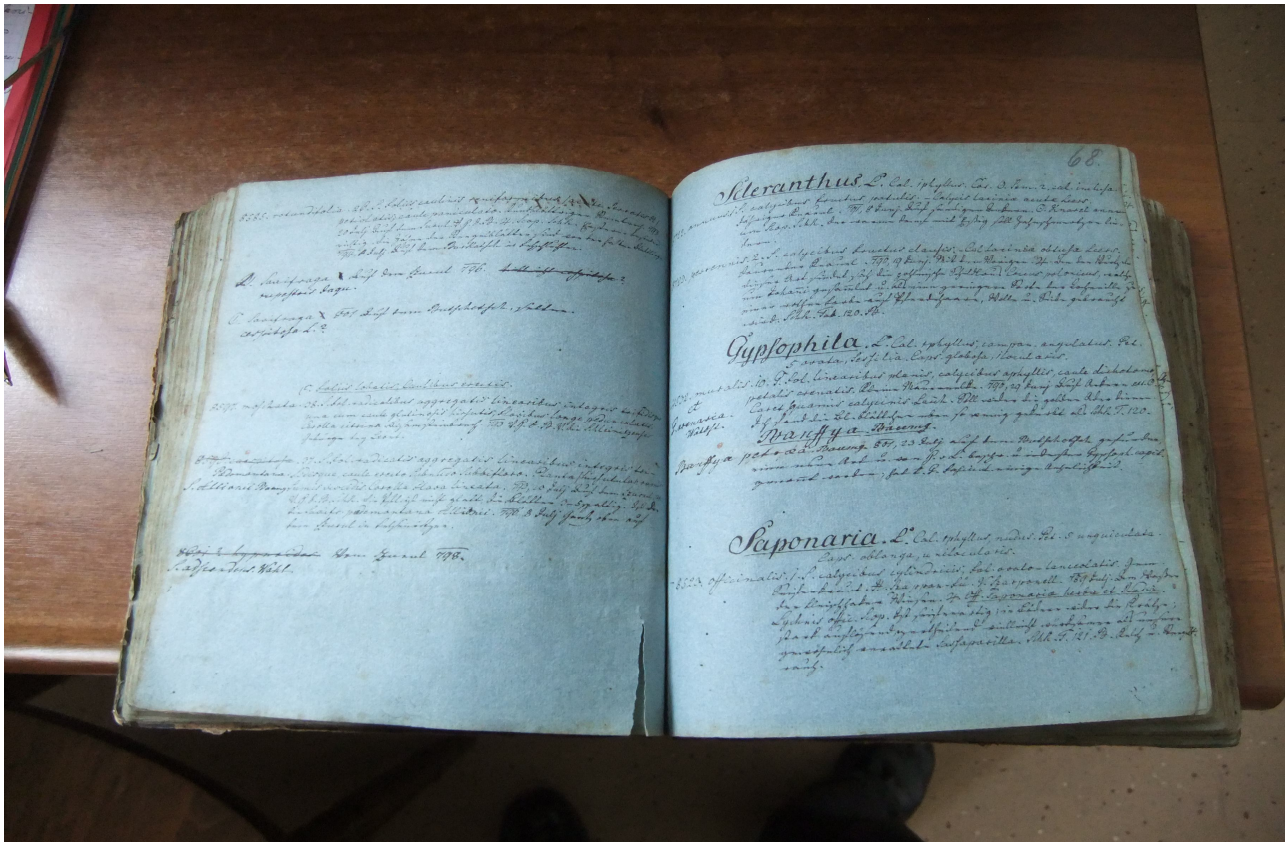

Fig. 2. Catalog of the dried plants collection of Peter Sigerus

IDENTIFICATION AND INVESTIGATION OF ROMANIAN SPONTANEOUS FLORA IN ORDER TO DO INTERNATIONAL EXCHANGES

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Abstract. *The biodiversity of Romanian and Korean spontaneous flora conducted to the development of an international partnership for improving and exchanges floral assortments and breeding technology. In this aims, it was initiated a research project with the title "Investigation of ornamental plant germplasm and exchange of breeding technology" between Floricultural Department of University of Agriculture Scince and Veterinary Medicine (UASVM) , Cluj-Napoca and National Horticultural Research Institute (NHRI), Suwon, Republic of Korea. In the frame of this project were made some actions regarding the identification and monitoring of the Romanian spontaneous plant species in the following locations: Cheile Turzii Nature Reserve, Peţea River Oradea, Rosarium of Timişoara,"Alexandru Borza" Botanical Garden Cluj-Napoca, Botanical Garden of USAMV Cluj-Napoca. The present paper reffers to the following spontaneous plant taxa: Allium obliquum L., Dianthus spiculifolius Schur., Aster alpinus L., Viola joói Janka, Geranium sanguineum L. Asplenium lepidum C. Presl., Sempervivum sp., Nymphaea lotus L. var. thermalis (DC) Tuzson, Nelumbo nucifera Gaertn. These exchanges will improve the ornamental germplasm with spontaneous taxa, in order to cultivate or use them as biological material in breeding programs.*
Key words*: plant material exchange, germplasm, Romanian spontaneous flora*

Rezumat. *Bogăţia şi diversitatea florei spontane din România şi Republica Coreea au determinat dezvoltarea unui parteneriat internaţional cu privire la îmbunătăţirea sortimentelui actual de plante şi a schimburilor de tehnici de ameliorare. În acest scop, a fost iniţiat un proiect de cercetare cu titlul "Investigarea fondului de germoplasmă la plantele ornamentale şi schimburi de tehnici de ameliorare" între Universitatea de Ştiinţe Agricole (USAMV), Cluj-Napoca şi National Horticultural Research Institut (NHRI),Suwon, Republica Coreea. În cadrul acestui proiect au fost efectuate câteva deplasări privind identificarea speciilor spontane din România, în următoarele locaţii: Rezervaţia Naturală Cheile Turzii, Pârâul Peţea lângă Oradea, Rosariul din Timişoara, Grădina Botanică "Alexandru Borza" Cluj-Napoca, Grădina Botanică USAMV Cluj-Napoca. Lucrarea de faţă tratează următorii taxoni din flora spontană identificaţi pe parcursul deplasărilor: Allium obliquum L., Dianthus spiculifolius Schur., Aster alpinus L., Viola joói Janka, Geranium sanguineum L, Asplenium lepidum C. Presl., Sempervivum sp., Nymphaea lotus L. var. thermalis (DC) Tuzson, Nelumbo nucifera Gaertn. Aceste schimburi vor contribui la îmbunătăţirea germoplasmei de plante ornamentale, cu taxoni spontani, cu scopul de a le promova în cultură sau utiliza ca material biologic în cadrul programelor de ameliorare.*
Cuvinte cheie*: schimb de material vegetal, germoplasmă, flora spontană a României*

Introduction

As compounds of natural frame, the flora has an economical importance.

In Romania, the high level of habitat diversity reflects a high level of spontaneous plant taxa diversity. Each of spontaneous and ornamental plant taxa has its own history, some have become commonly today, others are still forgotten on pathless zone, and others were protected by law.

Due to geographical position, climate, (which includes large variety of topoclimates) and soil types, the Romanian flora is very rich. Some plants are protected at national and international level; others are used as raw materials for pharmaceuticals, in herbal medicine, while others have decorative value, being grown in gardens and parks.

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In Romania have been identified about 3,700 species of plant taxa; 23 have been declared natural monuments, 39 are endangered, 171 vulnerable and 1253 rare (Ciocârlan, 2009). The endemic species represent 4% of the Romanian flora. There are total of 57 endemic taxa (species and subspecies) and 171 subendemic taxa (Raport privind Starea Mediului în Romania, 2000).

Republic of Korea have similar climatic conditions to those in Romania, there are wide variations in temperature and precipitation (Park, 2008). The average temperature of the four seasons varies between 5° C to 14° C and precipitation from 500 to 1500 mm / year. These environmental conditions make it possible to have favorable conditions to a very diverse flora (www. flora.academybook.co.kr).

An enumeration of Korean plants, published in 1946 by Pak Man-Kyu, listed 201 families, 1,102 genera, 3,347 species, 50 subspecies, 1,012 varieties and 168 forms of higher plants including pteridophytes. Woo (1997) in „tchul's Lineaments Florae Korea", mention 190 families, 1079 genera, 3129 species, 8 subspecies, 627 varieties, subvarieties and 306 higher plants (including *Pteridophyta*) and 400 endemic plants.

Knowing the flora diversity of the two countries, respectively Romania and Republic of Korea joint actions have been initiated to study and collect spontaneous taxa aiming to preserve the biological material in collections and to make some recommendations for breeding works.

Results and discussions

*Botanical Garden of USAMV Cluj-Napoca***.**

The visit consisted in the knowledge of plants existing in the collection (Fig. 1).

The following taxa have shown interest in the exchange: *Asclepias syriaca* L., *Dianthus* sp., *Lonicera* sp., *Chrysanthemum* sp., *Gentiana lutea* L., *Iris variegata* L., *Iris pumila* L., *Lilium martagon* L., *Lilium candidum* L., *Silene compacta* Fischer.

"Alexandru Borza" Botanical Garden Cluj-Napoca which contains more than 10,000 taxa from around the world.

The Romanian flora and vegetation are represented by plants from the Transylvanian Plain, the Carpathian Mountains, and different regions of the country (Fig. 2.). In order to identify the ornamental plants proposed for exchanging were visited by the team, the next sectors:

Ornamental sector, where many species are cultivated of woody and herbaceous plants that have delighted areas such as the Japanese Garden, Rose Garden and Mediterranean Garden;

Phitogeographical sector, which content a plant collection arranged in order natural associations;

Systematic sector, that include a large number of species grouped by families, which are arranged in orders and ranks, in point of phylogeny;

The complex of greenhouses, where equatorial and tropical plants are grown:

Aquatic plants greenhouse – where grown *Victoria amazonica* (Poepp.) J.C. Sowerby., with large leaves at 1.5 m diameter;

Palms greenhouse – include more than 80 species of decorative or industrial palms (coconut, oil palm), from Japan, Australia, Asia and Canary Islands;

Australian and Mediterranean vegetation with different species of trees and ferns;

Orchids and ferns greenhouse*;*

Bromelias greenhouse;

Succulent plants greenhouse.

Following this visit, our partners were interested in the exchanges of the following taxa: *Lilium candidum* L., *Lilium martagon* L., *Rosa canina* L., *Iris sibirica* L., *Clematis integrifolia* L., *Gentiana lutea* L., *Dianthus* sp., *Paeonia tenuifolia* L., *Chrysanthemum* sp., *Potentilla* sp., *Rosa chinensis* Jacq. „*viridiflora*".

Cheile Turzii Nature Reserve. There are approximately 1000 plant taxa (Pop & Bartha, 1973). Among these, we mention some rare species:

- *Allium obliquum* L. – wild garlic, named by the loco people as „*onion crow from the gorge*", which is growing on steep cliffs, in hiden places, on rocky slopes with an inclination of 60-80 degrees. "Onions crow" is famous because the nearest location where this plant can be finding is the Ural Mountains area, south of the Volga.

Here is the westernmost point of its area. Moreover, "onions crow" is a characteristic species of cent Asian mountain.

- *Aster alpinus* L. - eye of the ox and
- *Ranunculus oreophylus* M. Bieb., crowfoot

species, two alpine species that have survived until today

From amoung the 17 endemics we met:

- *Dianthus spiculifolius* Schur. White carnation called as Hungarian's beard, with fragrant flowers which gives a hint of color to gray rocks.
- *Viola joói* Janka - incense, which color the limestone cliffs in red-lilac flowers.
- *Thymus comosus* Heuff. ex Griseb. var. *transsylvanica.*

- *Geranium sanguineum* L. - red cyclamen geraniums reminded us of the current geraniums which are always present in all houses and balconies.

The team met ferns such as: *Asplenium lepidum* C. Presl.

Besides the species mentioned above, the team met on limestone cliffs some succulents, such as *Sempervivum* sp., which is presents interest in landscape design, particularly to build "*green roofs*".

Petea river.

Nymphaea lotus L. *var. thermalis* (DC) Tuzson - thermal water lily, which grows in warm waters of the Pețea river between Rontău and Haieu villages, at 9 km from Oradea. The species is a remnant of a warm climate vegetation of Tertiary period that survived cooling climate during the Quaternary Ice Ages, due to warm water of brook (Borza, 1924). This is the only case where a tropical species lives spontaneously in temperate climate (Fig. 4). With a particular scientific importance for both Romania and European flora (Genetic Resources), thermal water lily was declared natural monument and Pețea River is a Natural Scientific Reserve. Thermal water lily was first described in 1798 by the botanist Kitaibel Pál. The close relation of thermal water lily lives in the Nile (*Nymphaea lotus* L. *aegyptia* Planch).

Also, in this region you can see the lotus flower (*Nelumbo nucifera* Gaertn) at Felix Spa, a species originating from Asia and growing in artificial pools with geothermal water, made for decorative purposes (Burescu *et al*. 2002)

Rose Garden Timişoara.

The park was established in 1891, initially included more than 1.200 varieties of roses which were destroyed during the war (1944), and began to recover and reach, at present over 500 varieties of roses (Fig. 5).

Timişoara City Hall together with the University of Agricultural Sciences of Banat Timişoara, aimed to obtain funds for rebuild the landscape of the park.

Recommendations

In the team foray at botanical gardens and nature reserves, fascinating sights, masterpieces of nature, they have captured the attention of thousands of shapes, colors and unexpected shades. All plants mentioned in this paper deserve to be known and carefully studied in order to be transmitted to future generations and to preserve them.

It is recommended to make a comprehensive study of the dynamics of vegetation, to establish scientifically monitoring protocols of habitats which require special conservation measures.

The scientific exchanges between partners from different countries can complete germplasm resource, with wild or cultivated species in order to improve the current floricultural assortment and also the use of valuable biological material in the breeding work.

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SPONTANEOUS FLORA – ORNAMENTAL PLANTS RESOURCE WITH MEDICINAL PROPERTIES

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Abstract. *The beginning of the Millennium is hardly felt because the high rhythm of technology and stressful life, while various pollutants and risk factors act on the body, causing various diseases. It is recorded the return of herbal medicine practices in detriment of the modern medicine; this is the reason that the knowledge and study of medicinal flora is essential. It was found that about 50% of pharmaceutical products are based on medicinal plants in the form of extracts, tinctures, powders, oils, and pure active principles. The reasons for these products are increasingly used for therapeutic purposes, are: absence of side effects and low cost of herbal preparations. In Romania there are known over 300 medicinal plants and their number is continuously increasing with the discovering and identifying of other species with therapeutic effects. Newly identified wild medicinal plants exceeded 328 taxa.*
Key words*: phytotherapy, active principles, medicinal plant species*

Rezumat. *Începutul mileniului se resimte tot mai mult de ritmul alert al tehnologizării şi pulsul unei vieţi stresante, fapt pentru care asupra organismului uman acţionează diverşi factori poluanţi şi de risc, care determină apariţia diferitelor boli. Se înregistrează, pe zi ce trece, o revenire la practicile medicinei naturiste în detrimentul medicinei moderne, de aceea cunoaşterea şi studierea florei medicinale este absolut necesară. S-a constatat că aproximativ 50% din produsele farmaceutice au la bază plante medicinale, sub formă de extracte, tincturi, pulberi, uleiuri volatile, sau principii active pure. Motivele pentru care aceste produse se utilizează tot mai mult în scopuri terapeutice, sunt: lipsa efectelor secundare şi costul redus al preparatelor fitoterapeutice. În România se cunosc peste 300 de plante medicinale, iar numărul lor creşte continuu, pe măsura identificării altor specii cu efecte terapeutice. Plantele medicinale spontane identificate recent depăşesc cifra de 328 taxoni vegetali.*
Cuvinte cheie*: fitoterapie, principii active, specii de plante medicinale*

Introduction

Medicinal plants use has been one of the most important human preoccupation concerns at the beginning of its existence. In search of basic needs, the man observed that the wounds made known pain relieving plant, promoting their healing, and other consumed, held certain diseases.

Medicinal history show that the Egyptians know about these and they used castor oil, wormwood, saffron etc. and the Greeks and Romans developed much knowledge on medicinal plants, knowledge that prevailed throughout the Middle Ages.

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In ancient Egypt, Imhotep, the physician of pharaoh Zoser was the first who used for treating different herbs and oils. In Greece, Asclepius was considered the first physician who based his practices on the miraculous effect of the medicinal plants, although the speciality literature mentions Hippocrates as being the father of medicine.

After the discovery of America, it was found that the locals know about the medicinal effect of pepper, the leaves and seeds of the Coca. The local populations from Africa used from ancient times, coca seeds, as a stimulant in cases of fatigue or exhaustion.

The history of herbs shows that in China, *Rheum palmatum* L. (rhubarb) was used 5,000 years ago as a purgative, without knowing its active principles (oxometilantrachinone) that give him a purgative action, and *Ephedra* sp. to treat asthma, while active principle, ephedrine, it was discovered later, in 1887.

Traditional Chinese Medicine is an integral part of the health system, while in Western culture is seen merely as alternative medicine. It is used by at least 3,000 years. The the Indian Ayurvedic system was in antiquity the only ancient medicine and health care system that can competed with this.

Romania has a long and rich tradition because the people use plants from spontaneous flora to treat diseases. Geto-Dacian tribes used of medicinal plants in curing various diseases (Ardelean, Mohan, 2008; Book of herbs, 2009).

This herbs have been known not only to treat diseases but also for destroying bacteria and insects. The number of natural products, the world exceeds 100,000, which is modified annually, with the discovery of new compounds from plants (Svoboda, Svoboda, 2000).

Attention is given to medicinal plants which are inexhaustible sources of raw materials to get medicines. But consumption of medicines for long periods at a time starts to be not efficient and can even produce side effects.

The medicinal herbs are used for the substances they contain (active principles). The therapeutic principles are part of chemical composition of medicinal plants. The two terms, the active principles and chemical composition, do not overlap. The compositions of each plant are many chemical compounds but someone present therapeutic interest (Laza, Racz, 1975).

The aim of this paper has the following considerations: knowledge and use of medicinal plants, to carry information on the usefulness of these plants to the interested persons and to make obvious the rational use of medicinal plants.

Material and methods

Economic weight of medicinal and aromatic plants is growing, and their therapeutic value is becoming increasingly recognized (Miller, 2004).

In herbal medicine, are used today, many species of spontaneous flora. All these species are also used for landscape architecture and design.

Harvesting of medicinal species of spontaneous flora has some disadvantages: many species are grown in difficult places, harvesting usually is done manually, the quantitives produced are small; the content of active principles in plants vary depending on a number of environmental and biological factors and possibilities of confusion may occur with similar species (Bojor, Alexan, 1982; Encyclopédie des plantes médicinales, 2001). For these reasons and for conservation biodiversity of medicinal plants is recommended to organize horticultural crops.

In this article spontaneous plant taxa with ornamental importance and medicinal effects are presented and discussed in systematic order.

Ranunculaceae: *Aconitum tataricum* L. (aconite, monkshood), is a perennial, which is used in landscape design combine other species. It is highly recommended for treating neuralgia, facial pain, sciatica, laryngitis, bronchitis, flu and cough. Also has action on the respiratory and thermoregulatory center.

Adonis vernalis L. (pheasant's eye, spring pheasant's eye, yellow pheasant's eye and false hellebore), perennial species used as cardiogenic, in tachycardia, extra systole and neurovegetative disorders. It is considered an old remedy for treating dropsy and migraines.

Caltha palustris L. (Kingcup, Marsh Marigold), airy parts contain active ingredients with a diuretic, laxative and sedative role. It is used empirically to treat gout, constipation, gallstones and to calm the nervous system.

Consolida regalis S.F. Gray (*Delphinium consolida* L.). It is used internal to treat gout, bronchitis asthma, kidney disease, blood pressure and to control the sterility. Caution is advised because of the highly toxic alkaloids.

Helleborus purpurascens W. et K. (hellebore), the entire plant is toxic, due to as fresh and dry (Pârvu, 2006). In small quantities it is used internal to treat inflammations of the intestine and amenorrhea, and as externally for sciatic neuralgia and rheumatism. It is also used to treat genital cancer, mammary nodules, and ovarian cysts.

Nigella sativa L. (nigella), is an annual plant. Their seeds have therapeutic uses in traditional medicine. It is used internal for different diseases: asthma, bronchitis, fighting dizziness, stimulates appetite and helminths.

Pulsatilla montana Hoppe (pasque flower or pasqueflower), airy parts of the plant are recommended as internal use for tachycardia, migraine, neurosis, paralysis, and external use for psoriasis. *Pulsatilla vulgaris* L. is used for joint pain, but also has antibacterial and antibiotic effect.

Papaveraceae: *Papaver rhoeas* L. (corn poppy, corn rose, field poppy, Flanders poppy and red weed) is recommended for cough effect, acute and chronic bronchitis, laryngitis, flu and insomnia. *Papaver somniferum* L. (red poppy) has analgesic effects and it is used for vascular spasms, headache, cough, angina pectoris, severe pain, insomnia.

Charyophyllaceae: the roots of *Gypsophila paniculata* L. (Baby's-breath,) it is recommended for biliary problems, anti worm, eczema, wounds.

Polygonaceae: Rhizome of *Polygonum bistorta* Samp. (L.) (Bistort or Common Bistort) is

recommended for uterine bleeding, dysentery, diarrhea as well as oral thrush, stomatitis and gastric ulcer.

Crassulaceae: *Sedum acre* L. (Goldmoss Stonecrop, Goldmoss Sedum, and Biting Stonecrop) is recommended for treating sore feet and arthritis. It is also used in the cosmetics industry to combat acne eruption. *Sedum telephium* L. combat wounds and burns, facial paralysis, and *Sedum tectorum* L. lowers fever, reduces muscle spasms, combat ear pain. It is also used to treat warts.

Rosaceae: *Filipendula ulmaria* (L.) Maxim. (Meadowsweet) IT is a perennial species rich in volatile oils, tannins, minerals, etc. It is used as treatment for skin eruption, pains, fever, hemorrhoids, and rheumatism.

Onagraceae: *Oenothera biennis* L. (Common Evening primrose or Evening star). In recent years it has become a species known for its oil obtained from seeds. *Oenothera* seeds at fully ripe has high content (7-10%) of gamma-linolenic acid (GLA), an essential fatty acid with nutritional and medicinal value and positive effect on the human body (cancer treatment). Young roots can be eaten as vegetables (with added pepper), and young shoots are consumed as salad. The entire plant can be used as an infusion with astringent and sedative properties. It is recommended to treat asthmatic touches the gastrointestinal disorders, and to relieve pain. This species named after the "cure-all", reflecting its great therapeutic area, although this effectiveness was not demonstrated clinically. Recently, *Oenothera* has gained popularity among horticultures, although the original varieties were used for seed production, now, thanks to the elegance and color of flowers, it is used with great success in landscape design.

Lythraceae: *Lythrum salicaria* L. (Purple loosestrife) grows on wetlands and water margins. The top of the steam has substances such as flavones, essential oils, minerals and anthocyanins. It is used for gastrointestinal disorders, dysentery, bleeding.

Rutaceae: *Dictamnus albus* L. (Burning-bush (False Dittany, White Dittany, Gas-plant); in herbal therapy it is used the rhizome and roots rich in volatile oils, choline, sugars, mineral salts and bitter substances. It is recommended for epilepsy, hysteria, gallstones, and kidney stones, biliary and renal colic.

Linaceae: *Linum usitatissimum* L. (Flax) is appreciated for his medicinal properties whose seeds are rich in mucilage, cellulose, minerals and glycosides. It is recommended for digestive tract inflammation, constipation and cystitis.

Apiaceae: *Eryngium planum* L. (Sea-holly or Eryngo) the airy parts contain saponins, triterpenoids, sucrose, and minerals. It is used to treat bronchitis, whooping cough and acute tracheobronchitis.

Hypericaceae: *Hypericum perforatum* L. (Tipton's Weed, Chase-devil or Klamath weed) airy parts of the plant have the following active ingredients: volatile oils, flavones, choline, carotene, valerian acid, vitamins C and PP, saponins and minerals.

Droseraceae gathers small herbaceous plants, found in peatlands, bogs or marshes, majority are insectivorous. The leaves of *Drosera rotundifolia* L. (common sundew or round-leaved sundew) have a high content of tannin, citric acid, malic acid and flavonoids. It is recommended to treat bronchitis and lung abscess.

Violaceae: from floriculture point of view, two spontaneous species are important. The first is *Viola odorata* L. (Sweet Violet, English Violet, Common Violet, or Garden Violet) with various active ingredients (oils, sugars, mucilage, salicylic acid), which relieves coughing and has diuretic and laxative effect. The second, *Viola tricolor* L. (Heartsease) is rich in mineral salts, anthocyanins, tannins, A and C vitamin. It is recommended for kidney disease, acne, hives, dermatitis and sinusitis.

Malvaceae: *Althaea officinalis* L. (Marshmallow). It is a spontaneous species, very popular and often cultivated in rustic gardens. The leaves, flowers and roots contain many active ingredients (starch, mucilage, palmitic, oleic, butyric acids, flavonoids, glucose and minerals). In phytotherapy, it is used to relieve cough, bronchitis and laryngitis and to treat renal disease. For external use, mallow leaves can be used in furunculosis, apathies and stomatitis.

Thymelaeaceae: *Daphne mezereum* L. (Mezereon) is a short deciduous shrub that decorates by leaves and fruits. Mezereon bark is rich in active ingredients (umbeliferone and mezeron) and essential oils. It is recommended to treat dermatitis, rheumatism and helmintiasis.

Ericaceae: *Calluna vulgaris* (L.) Hull. (Common Heather, ling, simply heather), *Vaccinium myrtillus* L. (Bilberry and whortleberry) and *Vaccinium vitis-idaea* L. (Cowberry or lingonberry). Airy parts and flowers of these plants are used against kidney disease, bleeding, treatment of rheumatism, the abdominal colic and to drop fever. The bilberry leaves contain thiamine, riboflavin, while fruits are rich in sugars, protein, vitamins A, PP, B, E, tannins and minerals. Bilberry leaf is used for different treatments, including diabetes. Cowberry leaves is

recommended to treat cystitis, kidney stones, and cough.

Primulaceae: representatives with medicinal properties and also with ornamental importance are: *Lysimachia nummularia* L. (Creeping Jenny, Moneywort, Herb Twopence and Twopenny grass) and *Primula veris* L. (Cowslip, primrose). The first species has a high content of mucilage, saponosides, tanning substances and silicates and it is recommended for stomach problems and bleeding. Rhizome, leaves and flowers of the primrose are used to treat coughs, sinusitis, bronchitis, pneumonia, but may equally well be used in cases of rheumatic diseases, neuralgia, heart disease and bladder stones.

Solanaceae: *Physalis alkekengi* L. (Bladder cherry, Chinese lantern, Japanese lantern, or Winter cherry) fruits are rather used in traditional medicine, empirical, than the modern medicine. They are rich in citric acid, bitter substances, mucilage, sugars, caffeic acid ethyl ester, 25, 27-dehydro-physalin L, physalin and minerals. The active principles have diuretic and antirheumatic effects, to drop fever and also are anti-inflammatory. External applications, especially in dermatological diseases are used.

Gentianaceae: species with medicinal properties and decorative effect are: *Gentiana asclepiadea* L. (Willow Gentian), *Gentiana lutea* L. (Great Yellow Gentian) and *Gentiana punctata* L. (Spotted Gentian). The first species rhizomes have a high content of bitter substances, tannins and enzymes. It is recommended to treat flu, liver diseases and to fight anorexia. Great yellow and spotted gentians are recommended for stomach problems, stimulates secretion slobber, intestinal and gastric juices, helping to make a normal digestion.

Apocynaceae: *Vinca minor* L. (Lesser periwinkle or Dwarf periwinkle) contains alkaloids, peptic substances, tannin and carotene. It is used as digestive tonic, to stop bleeding, to treat constipation and wound healing.

Scrophulariaceae: For treatment of heart diseases, in traditional medicines are used some species of the genus *Digitalis*: *D. grandiflora* Mill. (Big-flowered Foxglove), *Digitalis lanata* Ehrh. (Woolly Foxglove or Grecian Foxglove), *D. purpurea* L. (Common Foxglove, Purple Foxglove or Lady's Glove). The leaves of these species contain cardiotonic glycosides such as digitalin, gitoxin, verodoxin etc. *Digitalis purpurea* fruits have a high content of mineral salts (Pârvu, 2006). Medicines based on *Digitalis* have action on movement's heart and increase the amplitude of the heartbeat.

Lamiaceae: A species often used in garden design is *Ajuga reptans* L. (Blue bugle, Bugleherb, Bugleweed, Carpetweed, Carpet Bungleweed, Common bugle, or Burgundy lace). In alternative medicine the airy parts of the plant are used, due to the content of tannins, volatile oils, resins and delphinidin. The active principles have favorable action on angina, pneumonia and asthma.

Asteraceae: include herbaceous plants, shrubs and succulents. The most common medicinal species is *Achillea millefolium* L. (yarrow). It grows in sunny or shady areas in meadows or at forest edges. Vegetative parts and flowers are rich in volatile oils, formic acid, ascorbic and folic acid, sucrose, glucose, tannins, minerals, etc. These active ingredients stimulate the appetite, have a favorable effect on allergies, cystitis, liver and biliary diseases, gastric and duodenal ulcers, cough, rhinitis etc.

Arnica montana L. (leopard's bane, wolf's bane, mountain tobacco or mountain arnica) is used increasingly in herbal medicine. The flowers are rich in fatty acids, oxygenates, acting on heart insufficiency and it is a good healing. It is used externally as a tincture or compresses handle various gashes.

Leaves and the whole plant of *Bellis perennis* L. (Common Daisy, Lawn Daisy or occasionally English daisy) are recommended for the control of headaches, mental shocks, due to the valuable active principles: saponins, malic acid, oxalate, mucilage, and essential oils.

Carlina acaulis L. (Stemless carline thistle, Dwarf carline thistle, or Silver thistle), is a plant with very short stem, looking like a silver brooch. It blooms in August and remains so until the first frost of autumn (Drăgulescu, 1996). The roots and rhizomes have a high content of volatile oil, in particular the antibacterial carlina oxide, tannin and minerals. It is recommended for stomach diseases, urinary diseases. Externally is used for eczema.

Centaurea cyanus L. (Cornflower, Bachelor's button, Bluebottle, Boutonniere flower, Hurtsickle, Cyani flower): the flowers are important in human medicine and in veterinary medicine. Their active principles serve as a diuretic, anti-inflammatory, but are also used for kidney problems, rheumatism, anorexia, conjunctivitis, and immune system. For medicinal purposes there are used only the blue flowers and not the pink ones. Aqueous extracts have a valuable antibiotic spectrum inhibiting the growth of pathogenic bacteria without influencing the normal microbial flora.

Solidago virgaurea L. (goldenrod or woundwort) is a common species from the lowland

region to the alpine area. It has a high content of volatile oils, bitter substances, tannins. The whole plant is used in traditional medicine to treat urinary and biliary disorders, external wound healing and dental pains.

Liliaceae includes many herbaceous plants, most bulbs, tubers and rhizomes. *Asparagus officinalis* L. (asparagus) grows spontaneously in dry meadows. Tuberous root and rhizome has proteins, lipids, carbohydrates, fiber, Mg, Ca, Co, Si, Zn, Al, vitamins B1, B2 and C, plant hormones and enzymes. It is used in the treatment of the following diseases: physical and mental fatigue, uric stones, gout, bronchitis, renal colic, liver insufficiency.

Colchicum autumnale L. (autumn crocus, meadow saffron or naked lady) grows spontaneously on wet meadows and pastures of the hilly mountainous areas. Bulbs and seeds have a high content of colchicines, an alkaloid used to treat gout and cancerous tumors. Colchicine have a strong action on cell division and it use in plant breeding in order to obtain polyploidy plants.

Convallaria majalis L. (lily of the valley or lily-of-the-valley) grows in deciduous forests, bushes and meadows. In alternative medicine there are used the leaves, flowers and airy parts of the plant rich in glycosides, organic acids and bitter substances. It is recommended for heart disease, nervous migraines, headaches, and dizziness.

Ruscus aculeatus L. (Butcher's Broom) is a species often used in floral design. It grows and develop in forests, meadows and rocky places. The rhizome of *Ruscus* is rich in saponine, volatile oils and resins. It is recommended to treat hemorrhoids and thrombosis.

Amaryllidaceae: species of the family are perennial bulbs. The most common species is *Galanthus nivalis* L. (snowdrop). Main alkaloid it contains is the galantamine which has effect on the nervous system. It is recommended in peripheral nerve paralysis, intestinal paralysis and intestinal atony (Pârvu, 2006).

Iridaceae: *Iris pseudacorus* L. (yellow iris or yellow flag) grows in swampy areas, from plains to highlands. Iris rhizome has a high content of starch, tannin, iridin and minerals.

Conclusions

The description of the species and their use provide scientific information on the safety, efficacy, and quality of widely grown medicinal plants. It is important to know contain of herbs, the harvesting period, the chemical compounds and the morphological characters.

Nowadays the number of natural products obtained from medicinal plants has reached over 100 000 and every year new chemical compounds are being discovered.

Some of the doctors are recommending herbal medicines, but in Romania this have high price. It is strongly recommended because natural remedial measures are healthy and are an alternative to the modern medicine.

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PROBLEMS AND CONFLICTS IN THE IDENTIFICATION OF *CENTAUREA* L. SPECIES

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Abstract. *Centaurea is one of the most complicated genuses because it shows great morphological diversity. Due to this fact, it has been little studied in scientific literature from Romania. The aims of this paper address to the determination problems of Centaurea species (Cardueae tribe) from the Romanian flora, with special emphasis on the Transilvanian Depression. The paper presents taxonomy and hybridization issues, introgression of Centaurea species resulting in high specific variability and dichotomous key determination problems. The observations were made on voucher specimens (species and their hybrids) of the Natural History Museum Herbaria Sibiu but some other species were observed in the field.*
Key words*: hybridization, poliploidy, polymorphism, introgression, variability, Romania, Transylvania Depression*

Rezumat. *Genul Centaurea este un gen polimorf ce a ridicat multe probleme de identificare, motiv pentru care a fost mai puțin abordat în lucrăriile de specialitate. Sinteza de față își propune să abordeze problemele întâmpinate la determinarea speciilor din cadrul genului Centaurea (secția Carduae) din flora României, în special din Transilvania pentru a uşura pe viitor, abordarea lor în orice direcție de cercetare. Lucrarea reda aspecte legate de taxonomia speciilor şi informațiile oferite de cheile dichotomice, fenomenul de hibridizare precum şi introgresia speciilor în urma cărora rezultă o variabilitate specifică mare ce ridică adevarate probleme in determinarea Centaureelor*
Cuvinte cheie*: hibridizare, poliploidie, polimorfism, introgresie, variabilitate, România, Depresiunea Translvaniei*

Introduction

Centaurea is a large genus with nearly 250 species that belongs to the tribe *Cardueae*, one of the largest in *Compositae* (Susanna, Garcia-Jacas, 2009). It is also one of the most complicated because it shows great morphological diversity and because it comprises many species (Bovina, Polevova, 1998; Petit *et al*. 2001).

This genus was the least aborded in scientific literature from economic point of view, because of its taxonomic and nomenclatural problems. These difficulties arise from changes commonly found in this group of plants due to introgression and morphological variability.

The biggest and the most important problem of this genus is the taxonomy, which has been changed several times over the years. However, more recent molecular analyses of the genus and of subtribe *Centaureinae*, together with studies of morphology, pollen type and karyology, have enabled the natural limits of *Centaurea* to be established with greater confidence (Susanna *et al*. 1995; Wagenitz, Hellwig, 1996; Garcia-Jacas *et al*. 2000, 2001, 2006).

The boundaries of *Centaurea*, were delimitated at three subgenera: *Centaurea* (formerly the *Jacea* group) with around 120 species; *Acrocentron* with around 100 species, and *Cyanus* with around 30 species (Susanna, Garcia-Jacas, 2007). The evolution of the characters seems also clear and it is very illustrative. After this classification, *Centaurea* genera from Romanian flora reduces considerably, which had 168 species and many subspecies in older classifications (Prodan, 1930; Nyárády *et al*. 1964).

Flora Europaea recognized 221 species and hybrids of *Centaurea* (Dostál, 1976), and in Romanian flora there are recognized only 54 species, without hybrids (Ciocârlan, 2009). Only a few hybrids from the Romanian flora are recognized, because they are considered to be specific of the certain geographical areas.

Materials and methods

Observations were made on voucher specimens of *Centaurea* species from Natural History Museum. Were checked 1360 voucher specimens

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(species and their hybrids) of *Centaurea* from Nyárády Herbarium. Observations were made on the involucral bracts of the *Centaurea* inflorescence. In the field, observations on *Centaurea atropurpurea* Walds. & Kit., *Centaurea scabiosa* L. and *Centaurea phrygia* L. were made.

Description

We will show now some problems which appear in determining the species of the genus *Centaurea* from Romania, especially from Transylvania.

Taxonomy

Many species were described like non-hybrid which proved later to be wrong identified and it reduces the number of species also. In Romanian flora there are many synonyms, described like independent species. For example, *C. haynaldii* Borb. is synonym of *C. jacea* subsp. *haynaldii*, *C. rocheliana* (Heuffel) Dostál is synonym of *C. jacea* var. *rocheliana* Heuffel, *C. pannonica* (Heuff.) Simonk. is synonym of *C. jacea* subsp. *angustifolia* (D.C.) Gremli, *C. carniolica* Host is synonym of *C. nigrescens* subsp. *vochinensis* (Greuter, 2001).

This problem was also observed in North-West of Europe by Koutecký (2007) in the *Jacea-Lepteranthus* group.

Incomplet information of dichotomic keys.

Incomplete information provided by the dichotomic keys makes identification of species a very difficult task, even for an experienced botanist. For example, within the *C. stoebe* L. (sensu lato) group, C. *maculosa*, C. *muretti* and *C. rhenana* cannot be separated from C. *stoebe* subsp. *stoebe* on the basis of morphological, geographical and molecular characters. Therefore all natural populations with diploid chromosome number which occurr in central-eastern Europe belong to the same subspecies, subsp. *stoebe* (Ochsmann, 2001; Mráz *et al*. 2011).

Another group with pronounced morphological variation is the *Centaurea triumfettii* group, wich resulted in confusing taxonomic treatments of this group in the Western Carpathians and Pannonia (Olšavská *et al*. 2009; Boršić *et al*. 2011).

Another example is *Centaurea subjacea* included at the specific or subspecific rank (*C. jacea* ssp. *subjacea*) in the majority of Central European floras and determination keys. It is usually described as a plant similar to *C. jacea* (Dostál, 1976). All specimens studied in herbaria by Kouteky (2008) belong to other taxa or to hybrids between *C. jacea* and other taxa from sect. *Jacea*. In the herbarium of the Natural History Museum *C. subjacea* varies widely and requires more extensive studies.

The same problem appears in two cytotypes of *Centaurea phrygia:* diploid from north-east Europe and tetraploid from West Carpathians and adjacent East Sudetes (Koutecký, 2008). Many botanists described these species like different species under different names, but the cytotypes seem to be separated just geographically.

Another species, *Centaurea macroptilon* and *C. oxylepis*, are treated in Romanian flora as *C. macroptilon* Borb. subsp. *oxylepis* (Wimm. & Grab.) Soo (Ciocârlan, 2009). These two taxa are very similar morphologically, and their morphological differentation is unclear in flora of Romania description and should be revised (Koutecký, 2007).

Hybridization

Information about reproductive modes in *Centaureinae* is necessary to understanding the determination problems of these species. Many studies strongly suggest that hybridization and introgression are much extended in *Centaurea*, as it could be expected because of the lack of barriers between species (Fernández Casas, Susanna, 1986; Garcia-Jacas *et al*. 1998; Hellwig, 2004). Actually, hybridization is one of the most conflicting features of sections *Acrocentron*, *Acrolophus*, *Jacea-Lepteranthus* and *Cyanus*.

In this genus it could meet autogamy and allogamy and sometimes it could meet cleistogamy and myrmechogamy. There is no section containing annual species in which autogamy can be excluded (Porras, Muñoz, 2000). Of the genera or sections for which the occurrence of autogamy is proven, 85% comprise annuals, while 75% consist of annuals only. In many cases the plants will probably be facultative autogamous, since no substantial reduction in flower size can be observed (Porras, Muñoz, 2000).

Fertile hybrids are frequent not only within a section (e. g. *Acrocentron*, cf. Kummer, 1977), but also between sections (e. g. between *Acrocentron* and *Chamaecyanus*, cf. Fernández Casas, Susanna, 1986).

The problem relies in the difficulties of detecting hybridization, for example within sect. *Acrocentron*. In this section, the hybrids are evident if the parental species have florets of different colour. (Garcia-Jacas, 1992; Garcia-Jacas, Susanna, 1994; Garcia-Jacas *et al*. 1998).

Centaurea jacea specie, from sect. *Jacea*, is insect pollinated and self-pollination experiments have shown that it is self-incompatible, whatever

the cytotype or morphotype considered (Wendelbo, 1957; Gardou, 1972; Hardy *et al*. 2001). In knapweeds, capitula contain approximately 40 central hermaphroditic disc flowers and they may or may not include a ring of sterile ray flowers. Nyárády (1962) observed that an anthodium of *Centaurea* contained different seeds because it was differently pollinated. The inflorescence of *Centaurea* was visited throughout the day by insects from different species and therefore the inflorescence can be diversely pollinated.

In Romania, after Ciocârlan (2009) taxonomical treatment, the *Jacea-Lepteranthus* group is represented by many species as *Centaurea carniolica* Host., *C. carpatica* (Porcius) Porcius, *C. indurata* Janka, *C. jacea* L., *C. macroptilon* Borbas subsp. *oxylepis* (Wimm. et Grab.) Soo, *C. nervosa* Willd., *C. nigrescens* Willd., *C. pannonica* (Heuffel) Simonk., *C. phrygia* L., *C. pseudophrygia* C. A. Mey., *C. rocheliana* (Heuffel) Dostál, *C. simonkaiana* Hayek and *C. stenolepis* A. Kern. Among them, *Centaurea jacea* has the widest distribution range and it is common both in lowlands and mountains. In part of Central Europe, *C. jacea* relatively easily hybridizes with *C. oxylepis* Hayek (Saarisalo-Taubert, 1966; Koutecký, 2007). *Centaurea jacea* agg. can also hybridize with *C. phrygia* agg. although offspring of these crosses are observed more rarely and can be hypothesized (Saarisalo-Taubert, 1966; Koutecký, 2007; Dydak *et al.* 2009).

Cleistogamy is another type of reproduction in *Centaurea*. This reproductive feature is known for *Centaurea melitensis* L. (Porras, Muñoz, 2000). The individual plants of this species produce chasmogamic as well as cleistogamic capitula. In *C. melitensis*, cleistogamy is associated to adverse growth conditions, while favourable conditions result in the enhanced production of chasmogamic capitula, and that, may cause problem in determination (Porras, Muňoz, 2000).

Ploidy level (aneuploidy, poliploidy, diploidy, amphiploidy, alloploidy)

Chromosome rearrangements, dysploidy and polyploidization play important roles in this mode of evolution. It is estimated, for example, that about half of species from *Jacea-Phrygia* group are polyploids. (Hardy, Vekemans, 2001) The enormous radiation of the modern *Centaureinae*, but also diversification of other clades in reaction to the aridization of the Mediterranean and the formation of the Irano-Turanian deserts was apparently accompanied by the formation of aneuploid series in many groups and enhanced autogamous tendencies, while other groups became relictic (e.g. *Rhaponticoides*) and in many cases are polyploids.

Chromosome base number and genome evolution is a way of speciation, which occurs repeatedly in a group of *Centaurea* taxa, leading to quantum evolution. In the *Centaureinae* there is a trend towards reduction in chromosome base number. This is roughly corroborated by modern phylogenetic analyses, though there are quite a number of exceptions. (Garcia-Jacas *et al*. 1996).

In *Centaurea* genus for example is found six chromosome base numbers. Three are known from sect. *Cyanus* subsect. *Cyanus* (annual species), and two base numbers have been reported in *Centaurea* sect. *Acrocentron*, *Calcitrapa*, *Hymenocentron*, *Microlophus* and *Cyanus* subsect. *Perennes* (perennial species, cf. Garcia-Jacas *et al*. 1996). The known chromosome numbers show that annual species (*Cyanus*, *Calcitrapa*, *Hymenocentron*) are more subject to dysploidy than perennial groups. Only, *Centaurea* c*yanus* subsect. *Perennes* comprise exclusively perennial species, and here changes are by far less dramatic than in groups with annuals (Boršić *et al.* 2011).

Dysploidy and polyploidy are also well documented in *Centaurea*, especially in sections *Acrocentron, Acrolophus, Jacea* and *Lepteranthus.*

In a hybridization experiment, Koutecký (2007) observed that design of hybridization, between the same level of ploidy and between species with different ploidy level, was similar. He described three types of crosses: autogamy (control), crossing with the same taxon (different individual), and crossing between the taxa. Hybridization experiments have shown that the ploidy levels are reproductively well isolated.

Knapweeds (*Centaurea jacea* L. sensu lato) constitute a very polymorphic polyploid complex with three ploidy levels. Diploids (2x=22) and tetraploids (4x=44) are frequently and intermediate triploid level rarely crosses between diploids and tetraploids (Hardy, Vekemans, 2001; Koutecký, 2008, 2009). The ploidy complex consists of morphologically well-defined units at the diploid levels (2n = 22), with distinct ecogeographical distributions, linked by intermediate tetraploids (2n = 44) (Koutecký, 2008).

One of the important feature distinguishing diploids and tetraploids from that contact zone is the pappus of the achenes, which is more developed in diploids than tetraploids (Hardy, Vekemans, 2001). It is worth noting that, in general, these features do not distinguish diploids and tetraploids. Based on these results, Gardou (1972) suggested that the complex could be

regarded as a single biological species (*C. jacea* complex).

Another example is *C. phrygia***,** where two ploidy levels have been reported, but no population with the co-occurrence of both ploidy levels was found (Koutecký, 2008). Diploid level (2x) found at *C. pseudophrygia* C. A. Mey., *C. stenolepis* A. Kern, *C. phrygia* L. sp., tetraploid level (4x) found in *C. oxylepis X*, *C. melanocalathia* Borbas, *C. phrygia* L. sp. (Koutecký, 2007).

Diploid (2n=2x=22) and tetraploid (2n=4x=44) ploidy levels have been published for the *C. triumfettii* group too. (Bancheva, Greilhuber, 2006; Olšavská *et al*. 2009). Both cytotypes showed a striking morphological differentiation between the population samples from the SW Alps and those from the W Carpathians and Pannonia (Olšavská *et al*. 2009).

C. stoebe, has also different levels of ploidyzation. In addition to postploidyzation processes of, it was observed morphological differentiation between diploid and tetraploid cytotypes. This differentiation on should be result principally from either direct autopolyploidization of the diploid cytotype or from allopolyploidization (Mráz, 2011).

Polyploidy occurs in first place among perennial species. In *Centaureinae*, 10 out of 13 genera or sections of *Centaurea* s.l. for which polyploidy is known are strictly perennials, while two others unite perennial and annual species. The observation of multiple changes of chromosome base number in groups of annual *Centaureinae* may explain the clear species boundaries within such groups. Quantum speciation may have happened repeatedly. Unfortunately, our knowledge of chromosome numbers in *Centaureinae* is still rather fragmentary, further variation may therefore be discovered in the future.

Introgression

Introgression, also known as introgressive hybridization, is the movement of a gene (gene flow) from one species into the gene pool of another by repeated backcrossing of an interspecific hybrid with one of its parent species. Purposeful introgression is a long-term process and it may take many hybrid generations before the backcrossing occurs. In Romania, the first observation of *Centaurea* introgression was described by Nyárády (1962). In this genus, you can meet this kind of hybridization in all subgenera, especially in sections *Acrolophus*, *Phalolepis*, *Lepteranthus*, *Acrocentron* and *Cyanus* subsect. *Perennes*.

Koutecký (2008) observed a probable pattern originated from introgressive hybridization into *Centaurea phrygia* populations. These populations of *Centaurea phrygia* agg. are morphologically intermadiate between two taxa. Variation within typical populations of either species may be possible but there is considerable variation among the intermadiate populations. They differ slightly from one another, forming a more or less continous transition from one species to the other, each of the intermediate populations being one „step". Besides morphological variation, there are other facts that seem to agree with a hybrid origin of the intermediate populations: pattern of ploidy levels (always the same in putative hybrid and presumed parents), geographic distribution of the intermediate populations on a contact zone of distributions of putative parents, intermediate position of the intermediate populations on climatic/altitudinal gradient between putative parents (Koutecký, 2008).

Another example of introgression was observed in subgenus *Centaurea* between different sections. Introgression of *C. diffusa* into *C. stoebe* subsp. *micranthos* could be proved as well as the close relationship between the two sections *Acrolophus* and *Phalolepis* (Ochsmann, 2001).

Polymorphism

One of the more general conclusions concerns the different speed of evolution in perennial versus annual species. In many cases annuals show signs of fast development especially as to chromosome number and achene characters. Finally three functional syndromes will be discused which occur in several groups or in different species of one section.

Autogamy syndrome is found in annuals where marginal flowers are narrowly tubular. This may be related to a reduction in nectar- production. This syndrome is very clearly shown by *Centaurea melitensis* L. (anthers with only two pollen- sacks in some flowers.), *C. pulchella* Ledeb. (sect. *Hyalea*), etc.

Myrmekochory syndrome is usually found in perennial with a shortened or prostrate stem, and shortly pappose achenes with a distinct elaiosome. Wagenitz and Hellwig (1996) presented examples for a so-called myrmekochory syndrome. Plants whose achenes are dispersed by ants often have capitula closely adpressed to the ground. The achenes are freely exposed and can easily be taken away by the ants. Most myrmekochorous species have a strongly reduced or even completely lacking pappus, e.g. species of *Centaurea* sect. *Willkommia* in Spain and Morocco, or sect.

Chamaecyanus from subgenus *Lopholoma* and another species of *Centaurea* from the eastern Mediterranean, Anatolia and Iran. Well developed elaiosomes point to myrmekochory being widespread in the three subgenera (*Centaurea, Cyanus and Lopholoma*, with some exceptions). The heavy achenes are not fit for long distance dispersal. This may be one reason why these species have only very small areas of distribution. Some are local endemics confined to a single mountain (Blanca, 1980; Fernández Casas, Susanna, 1986).

Zoochory is found in annuals or perennials with small, showy-flowered capitula. The involucre remains more or less closed at fruiting time, the pappus is short or lacking. The phyllaries usually have short spines making them suited for zoochory. The capitula are easily detached. The syndrome is shown most clearly by some species from sect. *Acrolophus* (Hellwig, 2004).

Adaptation to man-made habitats and evolution

Peculiarities in characters like fruit shape or pappus caused older taxonomists to segregate those species from larger genera (e.g. *Cnicus*, *Stephanochilus*, *Schischkinia*, *Crupina*). They looked for a similar phenomenon in DNA sequence evolution. Evaluation of data from the nrDNA ITS showed that indeed character states that were unique at a specific position in the set of taxa were more frequent in annuals than in perennial species (Hellwig, 1996; Susanna *et al*. 2011). Annuals are over-represented in the higher ranks while the lower ranks are filled with perennial species. Annual species contribute the majority to a group which deviates from other species by many molecular characters. Annuals are especially frequent in two types of environments: in (semi-) deserts and in anthropogenic habitats (see above). Semideserts already existing in Northern Africa and Central Asia approached the Mediterranean at about the Pliocene/Pleistocene border. All annual species of *Centaureinae* inhabit the ecotones from the Mediterranean to semidesertic vegetation. Anthropogenic habitats became available to annual species much later. The annual species being already present in the region could successfully colonize those

The perennial groups mostly inhabit areas of non-arid temperate zones. They are also part of the flora of many mountain ranges in the Mediterranean and beyond (perennial species of sect. *Acrocentron* and *Cyanus*). Here we find intricate groups of species often taxonomically difficult and hard to determine (e.g. *Centaurea triumfettii* and *Centaurea scabiosa* groups).

The difficulties in species delimitation may be caused by still incomplete separation of infraspecific units but also can be due to hybridisation and introgression, e.g. in *sect. Acrocentron* (Garcia-Jacas *et al*. 2009). The results of karyological, morphological, chorological, and molecular data provide evidence for the existence of different modes of evolution in the subtribe. *Centaureinae* exemplify the different adaptive syndromes. Members of *Centaureinae* show different adaptations to survive the selective forces exerted on arable fields. For example, the capitula had to escape cutting during harvest. Either the achenes ripen before harvesting (*Centaurea cyanus*, *C. solstitialis*, *C. calcitrapa*, *C. melitensis*) or plants grow adpressed to the ground (e.g. *Centaurea derderiifolia* Wagenitz). If the plant is perennial, the root system has to survive lesions caused by ploughing. An example is *Centaurea cephalariifolia* (Willk.) Holub, a weed on arable fields in SW Europe, a tetraploid relative of C. *scabiosa* (L.) Holub. The extended root system is cut and effectively dispersed over the field by ploughing.

From many pieces of the roots new plants regenerate. Evidence for manmade evolution is difficult to obtain. On the one hand time may have been too short to result in the formation of well separated species. On the other hand many of the hybrids we observe today would not have existed if man not brought two allopatric species into contact. Ecotype formation in connection with adaptation to agriculture is another way man can influence evolution, but it is not known from *Centaureinae*. Other weeds that are also successful outside Europe are *C. solstitialis* (yellow star thistle), *C. stoebe* subsp. *micranthos* (spotted knapweed). They colonize very quickly open habitats, like the margins of the roads. The opening of new ways made many allopatric species to come in contact and intrograde (Font *et al.* 2002).

Conclusions

Centaurea belongs to these plant genera where polymorphism plays a considerable evolutionary role and causes taxonomic difficulties in many species. The main morfo-characteristics of *Centaurea* determination, are the length of steam, lengh and width of the leaf, shape of inflorescence, length and width of involucral bracts, number and colour of appendage. Morphometric analysis of these features could confirm the separation of some taxa from their polymorphic groups, esspecialy taxa from *Jacea* subgenus In addition for determining of these species, is also necessary to taken the genetic analysis.

The large numbers of hybrids in Centaurea are realities that multiply and occur every year, creating chaos in species determination. Plant identification is often hindered by population variations. In Romania, the frequent taxonomic problems encountered in this genus, derived from:

-Contradictory data distribution for some taxa;

-Wrong determination or many species was described like non-hybrid;

-Unclear morpho-variability of some taxa;

-Unclear relationship between morphological variation and chromosome number.

Usually none of these problems are regarded as key for the determination, but they report only a small change in the primary diagnosis. Because of this, there are many unidentified taxa. The variation pattern found in some groups of *Centaurea* slows their recognition and notation and make it very difficult. So, for description of these species, we will consider equally the genetic analysis, geographic distribution and morphological characteristics (the shape of involucral bracts, length of appendages, the number of appendages etc.). In many cases, these features are very important and discriminatory. However, in some problematic groups of *Centaurea*, due to lack of clear differences in qualitative character, only a few characters can be used to determine the species (e.g. *C. trumfetti, C. stoebe*).

A good identification of *Centaurea* species is a support for other studies, especially for economical studies. This paper is an important step for identification from spontaneous flora, proposal and for obtaining decorative species.

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EOTRIGONODON (OSTEICHTHYES: PLECTOGNATII) ORAL TEETH IN RICHARD BRECKNER'S COLLECTION (NATURAL HISTORY MUSEUM OF SIBIU)

Rodica CIOBANU*

Abstract. *In this paper, we present 9 oral isolated teeth belonging to the Eotrigonodon genus, part of Richard Breckner's paleontological collection. Breckner was a member of the Transylvanian Society of Natural Sciences. On describes teleostei teeth from the paleontological reserve "Calcarele eocene de la Turnu Roşu (Romania)". The E. serratus specie has been described, until today, as being the only European specie belonging to the Eotrigonodon genus. The oral teeth analysed in this paper are similar to the ones found in the scientific literature. From the Richard Breckner's paleontological collection 4 teeth were identified as E. cf. serratus and 5 teeth were described at genus level.*
Key words*: oral teeth, Eotrigonodon, Teleostei, eocane, Turnu Roşu (Sibiu)*

Rezumat. *În prezenta lucrare sunt descrişi şi identificaţi 9 dinţi orali, izolaţi ce aparţin colecţiei paleontologice, Richard Breckner. Breckner a fost membru al Societăţii Ardele de Ştiinţele Naturii. Se descriu dinţi de teleosteeni din rezervaţia paleontologică „Calcarele eocene de la Turnu Roşu (România). Specia „serratus" a fost descrisă, până în prezent în literatură ca fiind singura specie europeană a acestui gen. Dinţii descrişi în lucrare se aseamănă celor prezentaţi în literatură până în prezent. Astfel, 4 dinţi ce aparţin la Eotrigonodon cf. serratus iar 5 dinţi au fost determinaţi doar la nivel de gen*
Cuvinte cheie*: dinţi orali, Eotrigonodon, Teleostei, eocen, Turnu Roşu (Sibiu).*

Introduction

At the initiative of several Saxon Naturalist intellectuals, in a time when Transylvanian as well as European Naturalism was going through a period of rapid development, on May 4th 1849, in Sibiu (Hermannstadt), after two years of meetings which took the form of book clubs, The Transylvanian Society of Natural Sciences (*Siebenbürghische Verein für Naturwissenschaften zu Hermannstadt*) was founded. The founders wanted to be part of an organization, which gathered people with a common passion for nature, who could also share with their community, and not only, their findings as well as educate the young generation in the spirit of knowing and protecting nature.

The first collections of plants, animals, fossils, minerals and rocks were created even before the establishment of the Society during the period when its founders were members of the Transylvanian Cultural Society – *Siebenbürghische Landeskunde*) (Schneider & Stamp, 1970). Due to the rapid growth of the collections, storage places changed constantly, however, after considerable financial efforts, the Natural History Museum was opened on May 12th 1895 as a public institution and main office for the Society.

After more than 160 years from the creation of the Society, the paleontological collection gathers alone 57,000 items.

In the present paper, we present the oral teeth belonging to the gen *Eotrigonodon*, part of Richard Breckner's paleontological collection. Breckner was a member of the Transylvanian Society of Natural Sciences.

The teeth was collected from the paleontological reserve "Eocene Limestone from Turnu Roşu" (Sibiu). The richness of the Eocene fauna recovered in these deposits, from which the fish teeth were also collected, attracted the scientists' attention as early at the beginning of the 19th century, when several valuable systematic researches were conducted. The majority of the paleontological studies referring to this peculiar area were conducted by the members of the Society.

These limestone rich in fauna are part of the Eocene shallow marine sequences lying north of Făgăraş Mountains, belonging to the southern border of the Transylvanian Basin. Around Turnu Roşu, the Eocene formations emerge like a

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limestone ”patch” area on the north-western ending of the Făgăraş Crystalline (Fig.1).

The latest concept regarding the stratigraphy of the limestone of Turnu Roşu belongs to Mészáros (1996) who defined the Turnu Roşu Group, including Valea Nişului and Valea Caselor formations. The faunal analysis underlined the existence of almost all Eocene groups and up to the recent they represent the largest deposits bearing isolated fish teeth. Environment reconstructions based on correlation between fossil fauna and recent representatives of the species, are indicating warm tropical-subtropical waters, rich in oxygen and fauna (Mészázros & Ianoliu, 1972, 1973; Bucur & Ianoliu, 1987, Ciobanu, 2006).

The natural reserve the fish teeth are from refers to Valea Nişului and Valea Caselor (Fig. 2). Unfortunately, Breckner – never mentioned the exact location where they collected the fossils. The sample of fish teeth collected in the last few decades is very small compared to the old collections.

In Romania, the first reports on the existence of ”Eotrigonodon” teeth for the Transylvanian Paleogene belong to Koch (1900), who mentioned in a faunal list the presence of *Capitodus* in the limestone formations from Cluj. However, it is possible that this fossil could be rather an *Eotrigonodon* tooth. Codrea et al.(1997) includes in the list of fossil fish originating from the Cluj Limestone, *Eotrigonodon* as well. For Romania, the first mention related to their presence in Cretaceous deposits was done by Dica et al.(1998), referring to a single oral tooth of *Eotrigonodon serratus*. The authors described the tooth specifying that the “oral edge is sharp, smooth, with one fourth of its anterior part showing some wear-traces.”

In a complex study on paleonvironment reconstruction based on fish assemblages, Dica (2005) mentioned 6 pharyngeal teeth and 1 oral tooth belonging to *Eotrigonodon serratus*, in the Cluj Limestone (Priabonian), Racoți Sandstone and Jibou. The oral tooth described in the work resembles the cretaceous one published in 1998: lingual side is slightly concave in the central zone, the edge of the tooth is sharp. The described teeth do not show serrations on the oral edge. The author attributed this tooth to the *serratus* species because this species is specific to the deposits from Europe.

From Turnu Roşu, Ciobanu (2011, in press.) are described and illustrated 6 pharyngeal teeth from *Eotrigonodon* genera, in the Turnu Roşu limestone.

Systematic palaeontology

Class *Osteichthyes*
Subclass *Actinopterygii*
Infraclass *Teleostei*
Order *Tetraodontiformes (Plectognathi)*
Suborder *Balistoidei*
Family *Eotrigonodontidae* WHITE, 1935

Eotrigonodon cf. serratus
(Fig.3, 4, 5, 6)
Material: oral teeth from R. Breckner’s collection (PaBr 34151, PaBr 34152, PaBr 34153, PaBr 34154).
Origin: Eocene limestone from Turnu Roşu (Porceşti)

Eotrigonodon sp.
(Fig.7, 8, 9, 10, 11)
Material: oral teeth from R. Breckner’s collection (PaBr 34155, PaBr 34156, PaBr 34157, PaBr 34158, PaBr 34159).
Origin: Eocene limestone from Turnu Roşu (Porceşti)

Description

The teeth from fig. 3, 4, 5, 6 are similar each other. The labial side of the teeth is flat to gently convex. While of their lingual side is deeply concave in upper portions of the crown and more or les flat at its base. On the labial view they show irregular ornamental wrinkles that spread over the whole side. The wrinkles are blunt here and there. The lingual side of these teeth show deep wrinkles, parallel, placed in the lower half of the crown. The wrinkles are deeper in the proximity of the contact zone between the crown and the root. The apex of the crown is in the form of a cutting edge, smoothly worn out and slightly curved. The tooth from fig. 1 has a cutting edge with a slight serration on one third of the length.

Show incipient crenulations on the lingual edge of the crown. The serrations are irregular and not parallel to one another.

The teeth from fig. 7, 8, 9 resemble each other in aspect but also in dimension. The labial side displays a deep concavity in the upper half. The teeth show some wear traces.

The teeth from fig. 10, 11 resemble each other in aspect but also in dimension. At these teeth, on the lingual side, the concavity is placed in the upper half, centrally positioned.

The length/height ratio analysis (Fig. 12) cannot be considered to tell apart one specie from the other. The ratio values are between 1, and 1,7

(Tab. 1) small differences can be noted describing the teeth from Fig. 7 and 8.

Discussions

The genera and species assignations are faced with major odds, as all discoveries refer exclusively to isolated teeth and not to a full dental apparatus. The teeth found expose wide morphological variability but also present similarities between related taxa.

In the majority of works, the *Eotrigonodon* species are based on oral teeth. The association between oral and pharyngeal teeth is highly uncertain because it is based on the fact that they are just found together in same sediments.

These flat sickle-shaped teeth drawn researchers' interest and were described in references since the 2nd half of the 19th century. These teeth were found in deposits from Cretaceous until the end of the Eocene.

There were also other authors who described the "claw" or "sickle" shaped teeth as belonging to different species of pycnodontes. So, Woodward in 1917 (quoted by Kriwer, 2005, p.174) noted that some pycnodontes have teeth claw type in their gill chamber, whereas Bell (1986) described the "claw" teeth type as being gill teeth belonging to the pycnodont *Hadrodus* genera.

Weiller (1929) defined for the first time the *Eotrigonodon* genera based on several *Trigonodon* oral teeth with dentate oral edge, considering that this species occupies an intermediary position between *Stephanodus* (Cretaceous) and *Trigonodon* (Cenozoic). The author believes that "Ancistrodon" teeth which accompany incisors do not belong to the *Trigonodon* species but they resemble more the *Sparidae* and *Sciaenidae* teeth.

Zittel (1932) quoted by Kumar and Loyal (1987) considers that the serrated and pectinated teeth belong to the *Eotrigonodon* genera and the smooth ones to the *Trigonodon* genera.

Casier (1946) seems to agree with Weiller; and he further explains the relative richness of pharyngeal teeth found in the strata by explaining that each individual has 4 incisors (2 superior and 2 inferior) and 70 pharyngeal teeth. Casier also explains the morphological variations though wear. Leriche (1906) explains as well the large variability of morphologies due to wear. Furthermore, he mentions that these teeth have a sideway flattened root, slightly thicker than the crown and with folds.

In his presentation of the ichtiological fauna from the phosphate deposits for the Ypresian from Morocco, Hermann (1972) also includes an incisor and as a diagnosis he makes a reference to Casier`s paper (1946).

In his presentation of the fauna from the maastrichtiene deposits from Nigeria, besides the pharyngeal teeth Cappetta (1972) also includes an oral one (Fig.2, 3; pl.13) under the name *Stephanodus lybicus*.

Kumar and Loyal (1987) considers that "serrations or smoothness of the crown is a feature function of positional difference in the jaw". In this sense Casier (1946) described the serrated oral teeth of the upper jaw and the smooth teeth from lower jaw for *E. serratus*.

Case (1994) considers that the "Ancistrodon" teeth are "nibbling" teeth for eating at coral biohermes. They are situated alongside each other in groups of 4 to 6 flattened teeth in the symphyseal regions of the jaws. He describes oral teeth as being teeth that are not ornamented and are flattened laterally.

The taxonomy of fossil eotrigonodontid fish is hard to deal with because of the lack of complete fossilized jaws, recent comparative material and references. There are debates on their taxonomy, but the majority of authors catalogue them as *Plectognathi* – marine tropical fish with unified teeth to form a beak which they use for nibbling at coral biohermes.

Regarding the stratigraphical distribution Romer (1966) considers that the *Eotrigonodon* genera ranging geologically from the lower Cretaceous up to the Eocene. This would probably indicate a synonymy with *Stephanodus (Ancistrodon)* of the Cretaceous period.

Wank (1986) described and illustrated an *Eotrigonodon serratus* tooth collected from Wietersdorfer (Carinthia, Austria). The author specified that the Eotrigonodon genera is found in the Cretacic deposits sup. Until the Eocene in Africa and just eocene in Europe.

Regarding the taxonomy of fossil genera *Eotrigonodon*, Romer (1966) considers them as belonging to the *Trigonodontidae* family and their present systematic position was established by Casier (1966). In our study we adopted the systematic and terminology introduced by Casier (1966). Patterson (1993) suggested that the eotrigonodontids are not teleosteens (teleosts) but pycnodonts and so considers that they belong to the *Pycnodontiformes* order and not to the Teleostei division and they disappeared at the end of the eocen.

Conclusions

Kumar, Loyal (1987, p.74) remarks that: "the taxonomy of fossil eotrigonodontid fish is hard to deal with because of the lack of complete fossilized jaw". The *E. serratus* specie has been described, until today, as being the only European specie belonging to the *Eotrigonodon* genus. The majority of scientific papers distinguished the teeth concise. That is why it is hard to note if the morphological differences are related to the type of specie, to the tooth's position on the fish jaw, to its ontological age of the individual or even to the sexual dimorphism

According to the available references, I believe the teeth – figs.3, 4, 5, 6 can be referred to as *Eotrigonodon cf. serratus*. In conclusion, I consider that the teeth of figs. 7, 8, 9, 10, 11 can be assigned only up to genus level.

Eotrigonodontids, the extinct puffer fish are analogous to the present day tetraodontidae. They are characterized by four oral teeth in the jaws, the pair in each jaw forming a parrot like beak. Besides the oral teeth, they have a number of pharyngeal teeth. *Tetraodon cutcutia* the common puffer fish is native to the fresh and slightly brackish waters of India. In India eotrigonodontids are much more abundant in the Lower Eocene marine sequence also in the Middle Eocene in brackish to fresh water transitional sequence (Kumar & Loyal, 1987).

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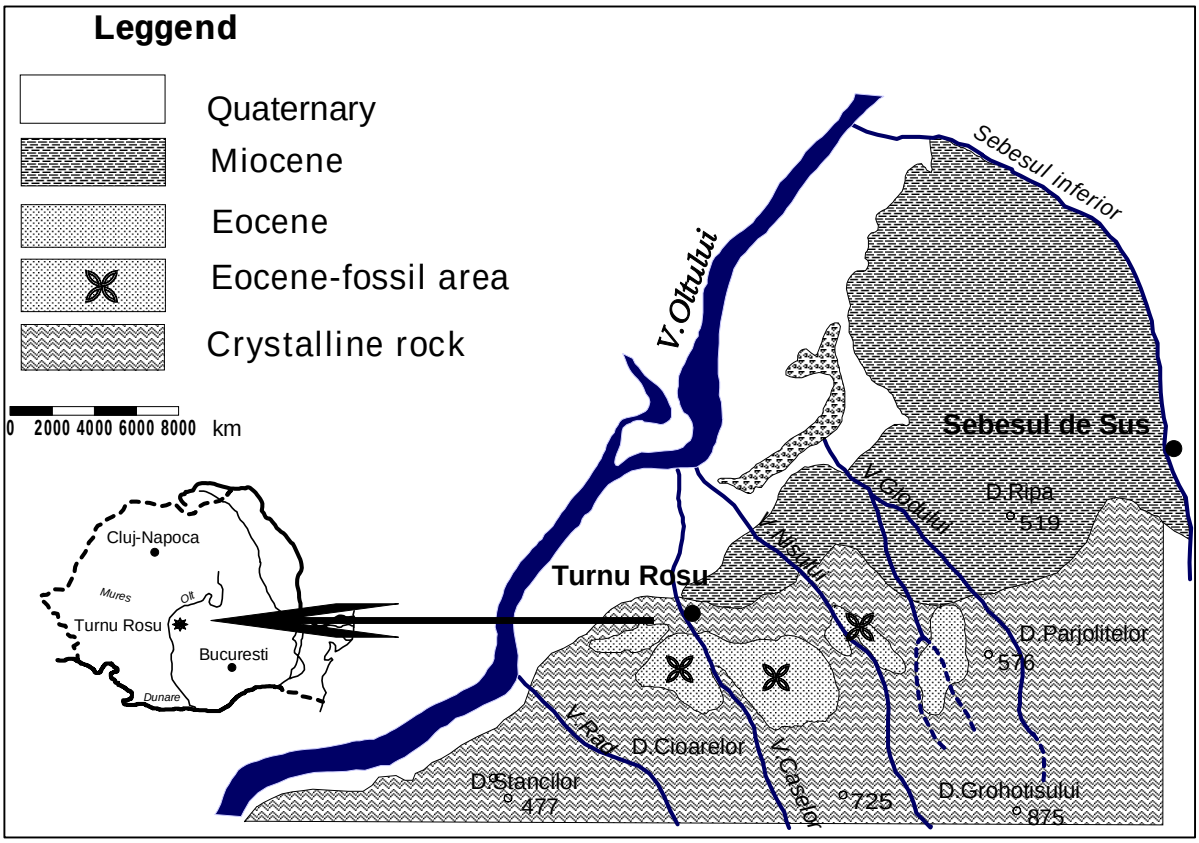


Fig.1. Geological map from Turnu Roşu palaeontological reserve (adapted after Tătărâm, 1970)

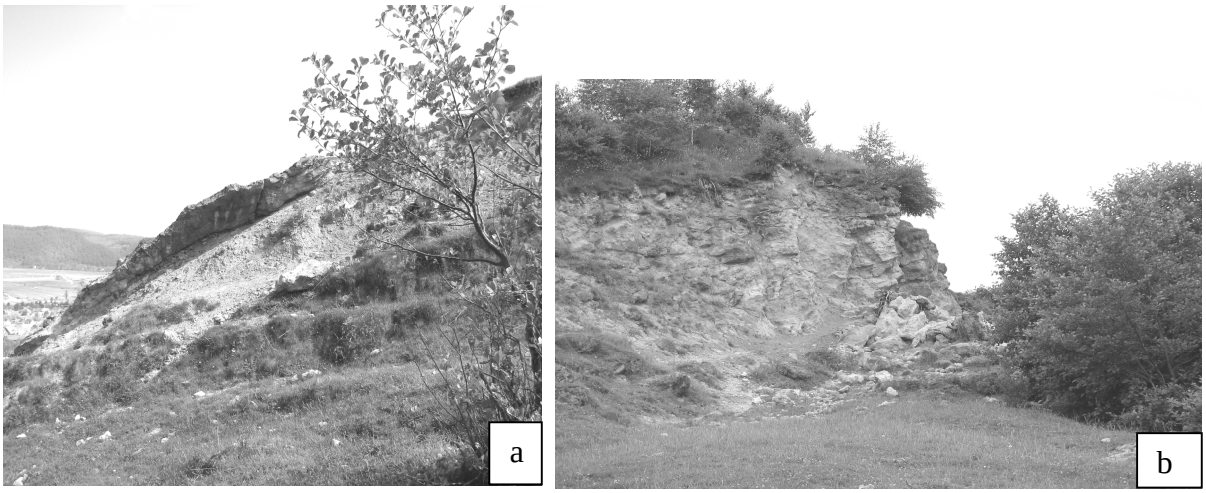
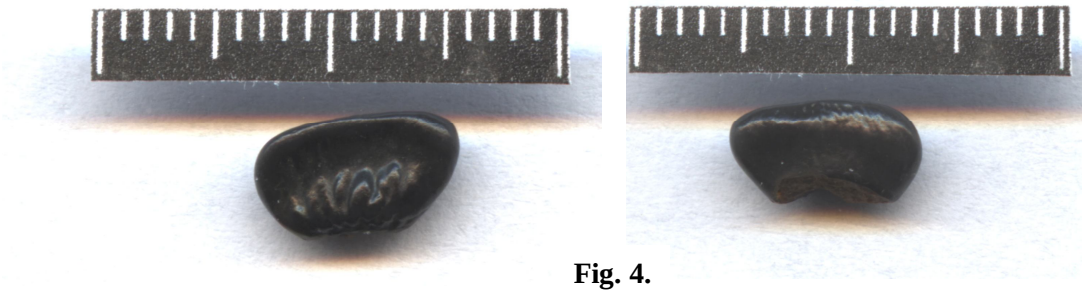


Fig.2. Eocene Limestone from Turnu Roşu (a-V.Caselor; b-V. Nişului)

Fig. 3.



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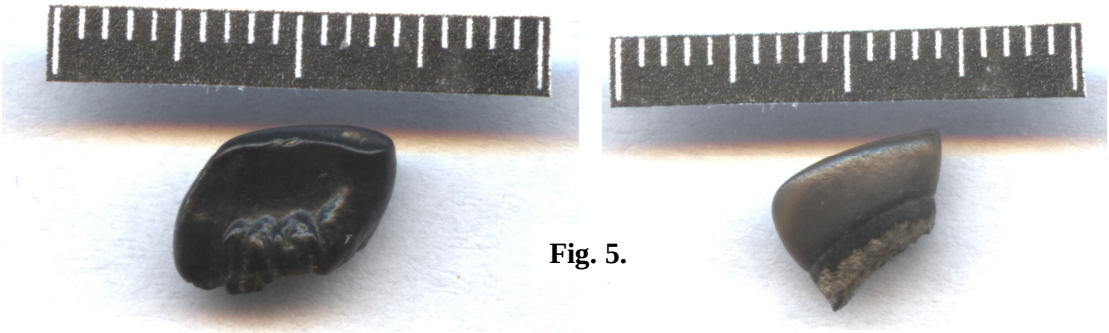

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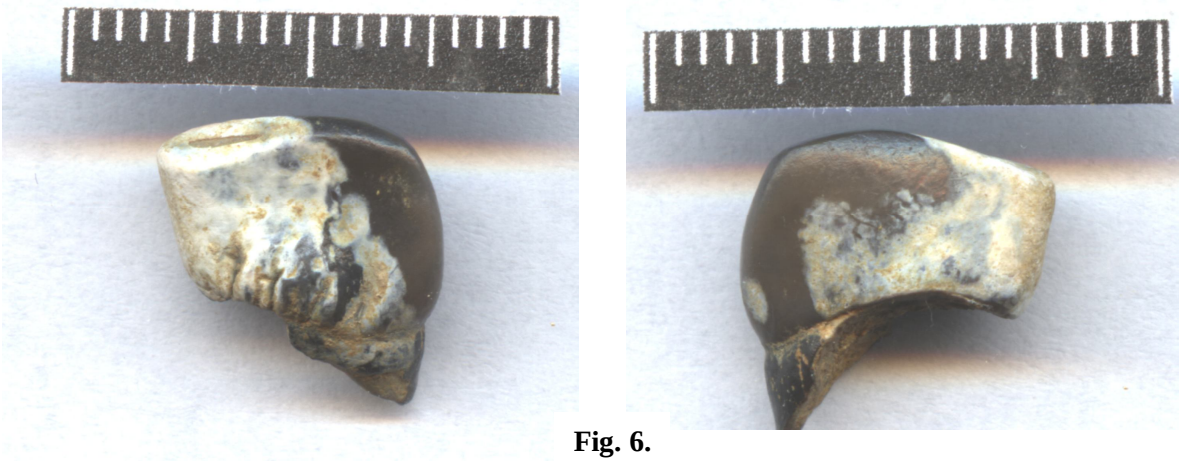


Fig. 6.

Fig. 7.

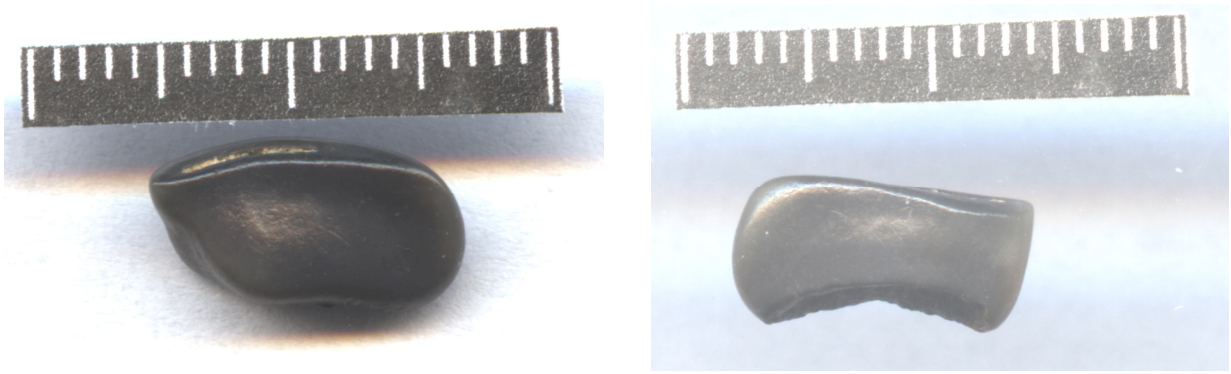
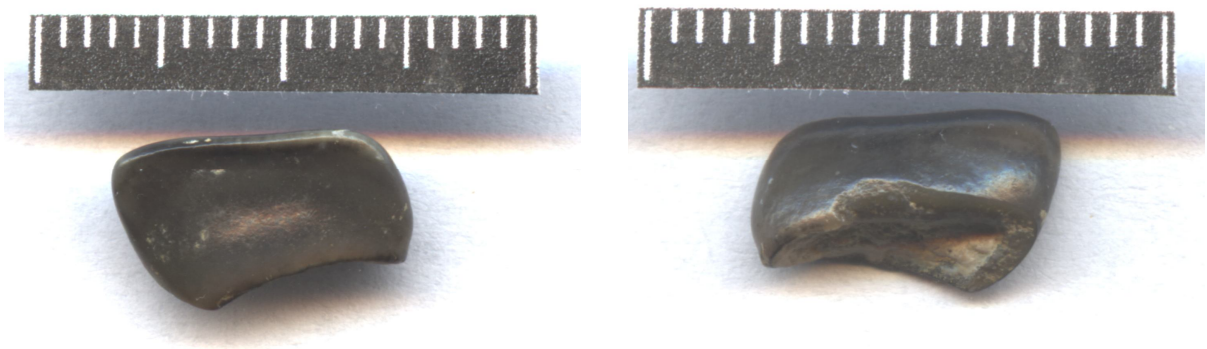


Fig. 8.



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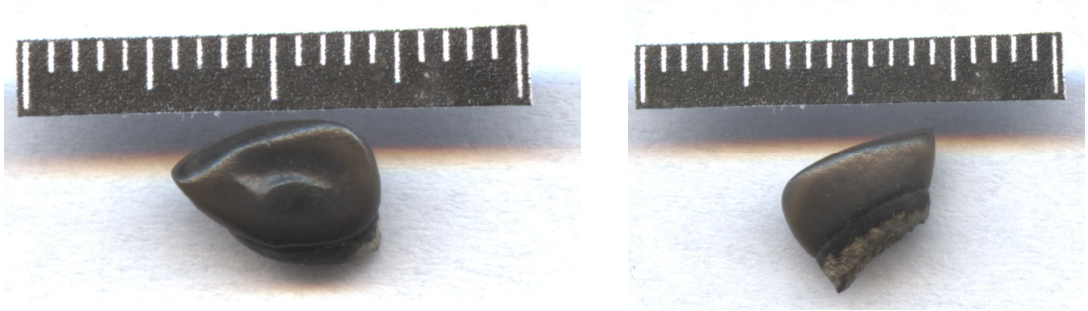

Fig. 10.

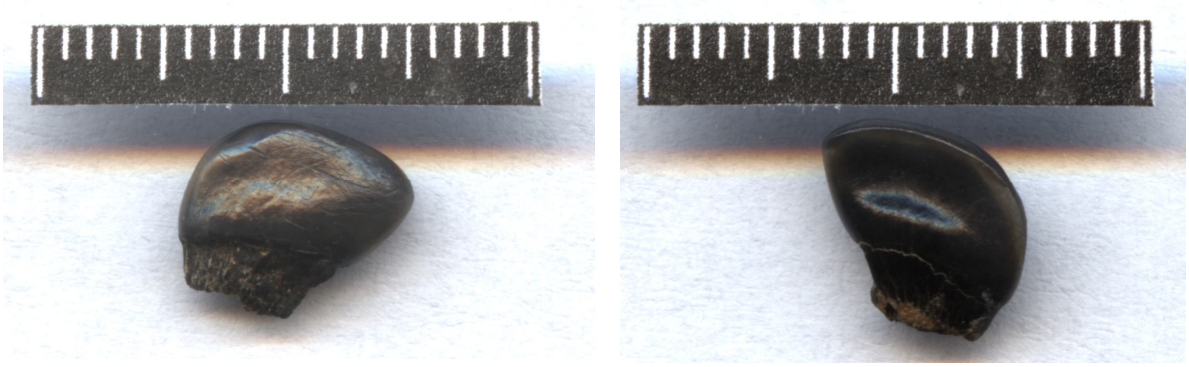

Fig .11.

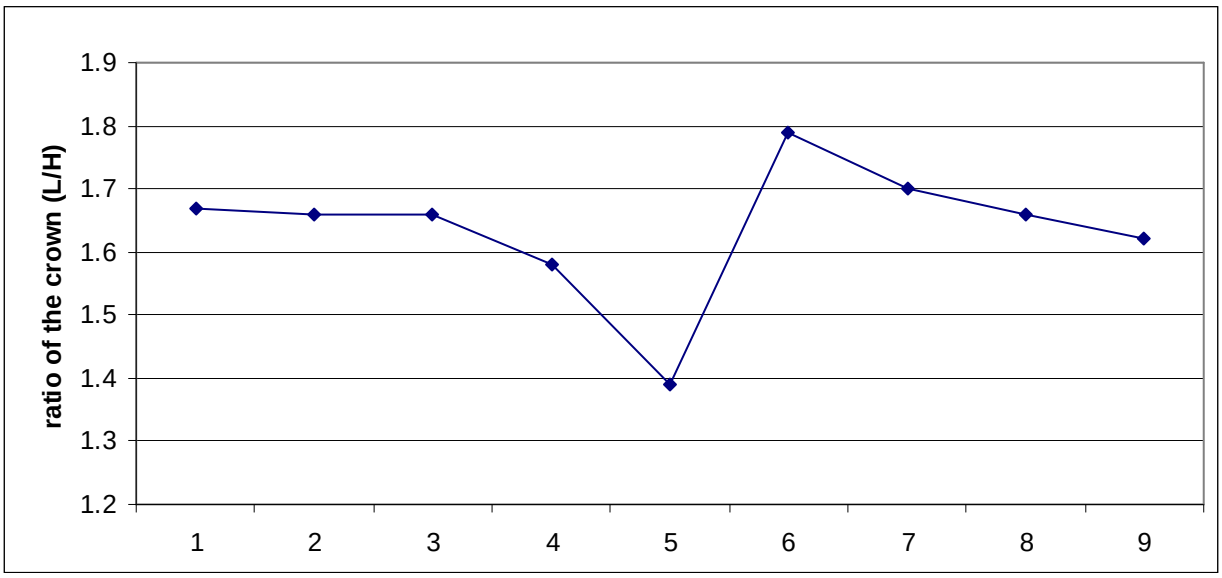

Fig. 12. Length/height Ratio

Tab. 1. Dimensions preserved of analyzed teeth (mm)

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Crown length (L)	12,2	9	10,5	13,5	9,5	11,3	12,3	8,3	8,4
Crown height (H)	7,3	5,4	6,3	8,5	6,8	6,3	7,2	5,0	5,2
Crown width (G)	5	5,4	5,2	7,2	3,6	5,7	5,1	4,3	4,3
L/H	1,67	1,66	1,66	1,58	1,39	1,79	1,70	1,66	1,62

REGIONALIZATION OF PRESENT MODELLING PROCESSES AND THEIR RISK CHARACTER. CASE STUDY: SIBIU COUNTY

Marioara COSTEA*

Abstract. *The general traits of Sibiu County's relief and south-north layout of well individualized geomorphologic regions (mountains, hills, plateaus) are the consequence of the manifestation and co-action in time and space of various conditions or morphogenetic factors. The action of internal factors (tectonic, rock, structure) imposed a distinct evolution to the relief in Sibiu County, subordinated to the evolution of Southern Carpathians and the Transylvanian Depression. The large range of altitudes from the Târnava Mare corridor to the high ridges of Făgăraş Mountains imposes, differentiated on relief units, the engraftment of the external factors' action, which contributed and still contribute to the present outlook of the relief. The processes in act in the present day on the relief in Sibiu County used to act also during the geological past, but through their non-uniform and gradual manifestation during long periods, are capable of essential changes of the present geomorphologic landscape. The aggressiveness of the climatic conditions is accentuated by the irregular alternation of dry periods with excess of humidity intervals, torrential rains and extreme temperatures, on the background of the land use, differentiated both as exploitation intensity and as land use category.*

Key words*: modelling conditions, geomorphological processes, hazard character, Sibiu County, Romania*

Rezumat. *Trăsăturile generale ale reliefului judeţului Sibiu şi desfăşurarea de la sud la nord a unor regiuni geomorfologice bine individualizate (munţi, dealuri, podişuri) sunt consecinţa manifestării în timp şi spaţiu a unor condiţii sau factori morfogenetici diferiţi şi a conlucrării acestora. Acţiunea factorilor interni (tectonică, rocă, structură) a impus o evoluţie distinctă a reliefului la nivelul judeţului Sibiu, subordonată evoluţiei Carpaţilor Meridionali şi a Depresiunii Transilvaniei. Desfăşurarea altitudinală între culoarul Târnavei Mari (sub 300 m altitudine) şi crestele înalte ale Munţilor Făgăraşului impune, diferenţiat pe fondul unităţilor de relief, grefarea acţiunii agenţilor externi, care au contribuit şi contribuie la definitivarea aspectului actual al reliefului. Procesele care acţionează asupra reliefului judeţului Sibiu în momentul de faţă au acţionat şi în trecutul geologic, însă prin tendinţa lor de manifestare, neuniformă şi graduală în timp îndelungat, sunt capabile de schimbări esenţiale ale peisajului geomorfologic actual. Agresivitatea condiţiilor climatice este accentuată de variabilitatea neperiodică a temperaturilor şi precipitaţiilor care relevă alternanţa neregulată a unor intervale de uscăciune sau chiar secetoase cu intervale cu exces de umiditate, cu ploi torenţiale şi valori termice extreme, pe fondul unei utilizări diferenţiate atât ca intensitate a exploatării cât şi ca diversificare a categoriilor de folosinţă a terenurilor.*

Cuvinte cheie*: condiţii de modelare, procese geomorfologice, character de hazard, Judeţul Sibiu, România*

Factors that condition the relief modelling

Having a surface of 5575 km^2, Sibiu County is situated in the central part of Romania and belongs to the Central Region for Development. The geographic position at the limit between the Southern Carpathians (which occupies the southern part of the county) and the Transylvanian Depression (which occupies the central and northern part) and its large extension in the two tectonic-structural units give Sibiu County the aspect of an amphitheatre opened northwards. The increase of height from north to south, between 279 m in the plateau, on Târnava Mare Valley, and 2535 m on Negoiu Peak in Făgăraş Mountains, causes a levelling of relief forms and implicitly of the present geomorphologic phenomena and actual processes.

The relief's evolution is subdued to the Carpathian chain represented on the county's territory by Făgăraş, Cindrel and Lotru mountains. The hardness of the rocks and their resistance to erosion favoured the development of a massive relief, representing thus a typical mountain area (Velcea, Savu, 1982). The interfluves are sharp with glacial ridges and crystalline erosion outliers over 2500 m in Făgăraş Mountains, or have a rounded aspect, with mild summits and cupola shaped, erosion outliers that hardly surpass 2200 m,

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presenting glacial relief forms (cirques, glacier valleys, moraines) modelled by quaternary glaciers, in Cindrel Mountains. The massifs interfluves and prolonged summits that detach towards north converging towards the strongly incrustated valleys (400-600 m) of Sebeş, Cibin, Sadu, Lotru rivers. On the level of these summits, especially in Cindrel Mountains, are kept the most representative sculptural complexes as some of extended interfluvial bridges. They descend from south to north and from west to east (Borăscu, 2200 – 1750 m; Râu Şes, 1700 – 1200 m; Gornoviţa 1200 - 800 m), proving the uninterrupted evolution and the succession of some modelling phases exerted by external factors stimulated by the tectonic movements and of the continuous change of some local or general base levels (Geografia României, 1987). The Carpathian valleys fragment the mountain mass and represent totally or partially trans-Carpathian axes (the Olt, Sebeş, Bâlea valleys) or penetrating corridors of mountain units (Cibin, Sadu, Avrig, Porumbacu, etc.). The very rich fossil and present periglacial (cryonival) morphology (scree, roche moutonnée, rock streams and rock glaciers) is representative in these mountains (especially in Făgăraş) and is favoured by the climatic stress and the accentuated schistosity of the rocks.

The Transylvanian Basin, a major structural and genetic unit, occupies the central and northern part of Sibiu County. It is represented from geographic and geomorphologic point of view by the submontane contact depressions and by the Târnavelor Plateau. The configuration of interfluves and valley corridors reveals genetic aspects and permits the individualization of these territorial subunits. The relief fragmentation is accentuated, being directed by the two hydrographical axes that function as erosion local base levels: the Mureş River at Alba Iulia (in west, outside Sibiu County) and the Olt River at Turnu Roşu (in the southern part of the county).

The submontane corridor Făgăraş – Sibiu – Sălişte – Apold, situated at the northern border of the mountains, is disposed as a quasi-central stripe from east to west. It is a depression area at morphologic and structural contact between mountain and plateau, of tectonic-erosive nature (Popescu, 1990; Sandu, 1998), characterized by an evident asymmetry due to a stepping succession of the relief forms and to the scarp slope cuesta's development of the plateau. Thus, there is an altitudinal succession from south to north of the submontane hills (600 – 800 m), piedmonts, glacises, followed by the terraces and floodplains of the rivers that drain these depressions (Olt, Cibin, Sălişte, Secaşul Mare), which can be used as agricultural land. The contact depression – plateau is marked by an abrupt corresponding to the stratum edges (scarp slope of cuesta), permanently subdued to some changes conditioned by the slope processes and lateral erosion exerted by the surrounding rivers (Popescu, 1990; Sandu, 1998; Costea, 2005).

The Târnavelor Plateau occupies the northern part of the county. The interfluves and the valleys present an evident asymmetry introduced by the geological structure and an adaptation to the structure and lithology, with forms of direct and reverse concordance: scarp faces of cuesta, structural surfaces (back slopes), subsequent and obsequent valleys, dome's buttonhole etc., on which slope processes are develop. The altitude decreases from south to north and from east to west, causing the general direction east-north-east – west-south-west of the representative valleys network oriented towards the local subsidence area at Alba Iulia westwards from Sibiu County (Costea, 2005) or towards the hydrographical convergence area at Turnu Roşu. The deepening of valleys network with 200-300 m compared to the initial surface of interfluves lead to the fragmentation of Târnavelor Plateau and to the delimitation of its subdivisions. Among these in Sibiu County are found: almost the entire Hârtibaciu Plateau (with the exception of its eastern extremity), Secaşelor Plateau in the western part and partially the Târnave Hills northwards from Târnava Mare River.

The field researches permit the grouping of causes that lead to the amplification of present modelling processing in Sibiu County into two large groups, namely: natural and anthropic causes.

Besides gravity, *the natural factors* are those that regard the petrography and structure, morphometric and morphodynamic characteristics, climatic and hydrologic conditions.

The geologic substratum is characterized by diversity and complexity. In the mountain sector dominant are the hard meso- and catametamorphic rocks (gneisses and paragneisses, amphibolites, micashists, suffusion with limestone intercalations, granitic intrusions) that belong to the Getic Nappe with maximum development in Cindrel and Lotru Mountains (Sebeş-Lotru Series) and the very hard geologic forms that belong to the Supragetic Units, which form the Făgăraş Mountains (micashists, gneisses, paragneisses, amphibolic schists, limestone intercalations and crystalline dolomites). The plateau units and the submontane depression corridors have a geologic substratum formed of sedimentary deposits (clay, sand, weakly cemented

grit stones), predominant pannonian, sarmatian, and insular badenian and quaternary deposits on the valleys that fragment the plateau, with alternating permeable and impermeable horizons. The monoclinal structure specific to the plateau, with inclination towards north and east generate cuestas alignments with predominant southern and western exposure. The intercalation of anticlinal and synclinal folds, of uffus folds and domes complicates the geological structure and it is transposed in the relief by specific forms.

The relief's morphometric and morphographic characteristics are important in modelling through the undulated configuration of interfluves, through the steep slopes in mountain sector, but also on the scarp slopes from the plateau and through their considerable length, conditioning thus a proportional volumetric increase of the rocks dislocated by gravitational processes. The different petrography and the tectonic and structural influence associate in vertical and/or horizontal plane generating surfaces non-homogenous from morphodynamic point of view. In consequence, the slopes' morphodynamic potential is differentiated depending on the surfaces' size with different morphometric characteristics and physical-chemical properties, being oriented towards mechanical fragmentation (medium and high hardsness rocks: grit stones, conglomerate, crystalline schists), gravitational movements (clays, marls with high degree of plasticity) and dissolution – subsidence (salt) (Ielenicz, Pătru, 2005, Costea, 2007 b).

The meteo-climatic conditions influences the relief's modelling through the predominance of oceanic circulation, with a more prolonged precipitations regime during transition seasons. Significant for the modelling intensity are: the alternation of these periods with intense droughts at the end of summer, torrential rains at the end of spring and during the first part of summer, with the development of the torrential nucleus in the middle or the second part of the rain, the intense insolation of slopes with south and south-western exposure causing the forming of some deep cracks in the mountainside, these being later overtaken by water precipitations or snow melting.

The hydrologic conditions are characterized by differentiations depending on the relief units, with a constant and relatively high debit of the autochthonous Carpathian hydrographical network and low debits in case of autochthonous plateau network, but with an accentuated torrential character of flow during the transitional seasons. The greatest slope disequilibrium is introduced by very high seasonal fluctuations of debits and levels. Besides, the existence of springs on the stratum edges or even on the stratum planes detached by erosion, which generate swampy surfaces at the slopes base, between the landslides waves or in the longitudinal depressions between the monticles alignments (Noiştat – Movile, Cornățel, Apoldu de Sus, Apoldu de Jos, etc.).

The anthropic factors have multiple manifestation forms, being especially related to the land use (inadequate agricultural practices – plough along the slope line, overgrazing), change of land use category through past massive deforestations in order to gain agricultural or grazing land, the lack of concern for the arrangement of some slopes, the abandonment of some arrangement works or even the accomplishment of inappropriate works, effectuation of some regularization works that had not the anticipated effect. Herbay (1963) mentions the inefficiency or even the risk of some regularization works done on Hârtibaciu River through the artificial deepening of the riverbed, which accelerated the erosion on its tributaries from the Agnita Hill through deepening and regressive action and lead to the slope degradation through ravine and torrential erosion.

The processes can be grouped in two categories takes place in the geologic, bio-pedo-climatic and anthropic conditions of Sibiu County. The first category is represented by the permanent processes (fluviatile processes) that have a slow and equilibrated development, being related to the evolution of the hydrographical network, found in a dynamic equilibrium in comparison with to the base level (the Mureş or Olt rivers). The second category is represented by the seasonal processes, with a rapid evolution, whose periodicity and spasmodic manifestation regime have effects of terrain degradation and lack of equilibrium. These represent hazard geomorphologic processes (gully erosion, torrential erosion, landslides, collapses, diapiric processes, etc.), dependent on the climatic regime and the human intervention and take over the structural and lithologic background previously modelled through the rhythmic deepening of the valleys' network.

The distribution of present geomorphologic processes on relief units

The external factors – rainfall, running water, snow, wind, frost-thaw, act on the pre-existing relief through elementary or complex modelling processes. The geomorphologic processes in Sibiu County are grouped on relief units with significant differences between each other, due to the variety of geological substratum, the intensity and acting

rhythm of the factors as well as their association pattern in time and space (Fig.1).

The mountain units from the southern part of the Sibiu county – Făgăraş Mountains, Lotrului Mountains, Cindrel Mountains, at altitudes of more than 600-800 m, are made up of hard rocks that generate high altitudes, of more than 2200 m (2535 m Negoiu Peak, 2244 m Cindrel Peak, etc.), and a high relief energy. The high crests and the main ridges are generally oriented east-west; from there secondary ridges descend northwards. The diversity of their exposure to the solar radiation during the day or to the circulation of air masses and the different inclination of the slopes lead to a different reception and conversion of heat and as a result, to a territorial differentiation of modelling processes. In areas with a general northern exposure and a climatic stress (with low temperatures and rich precipitations, mostly as snow) the cryonival modelling processes are dominant, with a higher intensity above 1750-1800 m, where the vegetation is poor (alpine pastures and subalpine shrubs), contributing to the alpine character of the mountain level and the accentuation of glacial relief forms modelled in quaternary.

The intensity of these present processes is proven by the presence of some characteristic forms: solifluction terraces at the superior levelling surfaces (Borăscu) and at the level of high mountain ridges (Făgăraş Mountains) the gelifraction contributed and still contributes to a residual relief with pikes, towers, portals, etc. The frost-thaw associated with the gravitational processes (collapses) generate scree cones discharged on the slopes by stone torrents, large areas of scree at the slopes base, areas covered with stones on the surfaces of contact with less steeper slopes. The scree masses disposed in different shapes on the slopes have a pronounced instability. In high Carpathian zone important avalanches can occur in the conditions of large quantities of snow accumulated and high mobility of the scree. These phenomena jeopardize the tourist circulation and the high altitude transcarpathian communication routes: the Transfăgărăşan, or the "Queen's Road".

In the mountainside level the present processes are subordinated to the action of running waters from precipitations. The strongest disequilibrium are registered as the effect of torrential processes in the mountain areas on the slopes that were deforested or on those occupied with secondary grasslands used as pastures. The concentration of the flow on the torrential organisms and the accumulation of some significant liquid debits (from rainfall or melting snow) lead to the erosions accentuation, the dislocation and transport of some large amounts of rocks or wood along the steepest line of the slope. The discharge of the materials takes place suddenly at the modification of the slopes angle and produces damages and material losses (blocked forest roads), even the destruction of some households (V. Sebeşului, 1998) (Costea, 2005).

The valleys of Sebeş, Cibin, Sadu, Olt, Avrig, Cârţişoara, etc. are subdued to a permanent travail exerted by the running waters. The river modelling exerted through erosion, transport and accumulation registers an alternation of processes in time depending on the debit fluctuations during a year (seasonal), but also along the rivers through the progressive accumulation of the tributaries debits. In consequence, the geomorphologic risk is amplified in the intra-mountainous depression areas, at confluences or at torrential convergences, where the contribution of the hydrographical network is maximum, especially that these areas are inhabited from ancient times (Râul Sadului, Râul Vadului). In the Olt gorge, or in the Sebeş gorge (at the western limit of the county) the rock-fall and the torrential erosion represent very active processes, that block the communication routes with important quantities of rocks from the mountainside and jeopardize the lives of traffic participants (the Olt Defile at the limit between Sibiu and Vâlcea counties, 2005, 2006, 2007)

Submountain depressions – Făgăraş, Sibiu, Sălişte and partly Apoldului Depression are characterized by present geomorphologic processes induced by the lithologic and structural contact between the crystalline of the Southern Carpathians and the sedimentary deposits of the Transylvanian Plateau, as well as by the autochthonous and allochthonous hydrographical net, against a background formed of gravel, sand, marl and clay, with harder nucleuses.

The slope processes generated by pluvial denudation dominate: superficial erosion due to raindrop and rainsplash erosion, rill erosion, gullying, torrential erosion. The processes of erosion, transport and accumulation also take place along the valleys, allochthonous rivers with significant debits discharge at the exit from the mountain area large quantities of materials as dejection cones or colluvial-deluvial glacis, whereas the autochthonous hydrographical network, with variable debits, contributes to the fragmentation of these accumulative constructions and to the degradation of the interfluvial surfaces and slopes, through the springs' regressive retreat on Ist and IInd order catchments areas (Cojocariu,

Contor, 2002-2003).

In the riverbeds accumulation occurs at the convex banks, while the concave banks are eroded, causing the slopes undermining and the starting of some slope processes (slidings, collapses). It is the case of Dobârca and Apold valleys – in Apoldului Depression, Mărăjdia, Valea Rogojinii, Valea Sărăţii, as well as the inferior orders tributaries of Cibin and Sadu rivers in Sibiu Depression (Sandu, 1998). In the Făgăraş Depression these processes from autochthonous inferior order river basins (Valea Greşilor, Lişcovul, Sărata, Opătul, Seaca, Gârlăţelul, etc.) contribute to the fragmentation of the Olt River terraces and the degradation of piedmont glacis at the foot of the Făgăraş Mountains (Popescu, 1990).

Along the main valleys (Olt, Cibin), the depression corridors are found under the direct influence of the river courses and the slope processes from the surrounding areas (the cuesta of Hârtibaciu Plateau or Secaşelor Plateau, through Amnaşului Plateau), with high geomorphologic risk due to the great slidings, collapses and floods.

The plateau units (Hârtibaciu Plateau, partly Secaşelor Plateau and Târnavelor Hills) that occupy the central and northern part of Sibiu County are too subordinated to some seasonal processes, but with a higher intensity than in the contact depressions. These are favoured by the petrographic structure of plastic rocks (predominant clays, sandy clays) with a high morphodynamic potential, but also by the monoclinal structure, by modelling of some slopes with different structures and inclinations. On the scarp faces of cuesta a higher number of deep landslidings, as "glimee" or "movile" (Cornăţel, Noiştat, Apoldu de Jos) are recorded, while on the structural surfaces the rill erosion, gullying and torrential erosion occur, generating advanced degradation forms (Grecu, 1992).

The contribution of fine material (clay, mud) from the slopes contribute significantly to the riverbeds' suffusion (Visa, Hârtibaciu, Secaşul Mare), to the forming of some marshy areas or even to the silting of some lakes created for fishery (Mândra). As well, the instability of the banks and their dynamics are controlled by the torrential character of the flow. The regressive erosion processes that cause the spring areas' retreat, the enlargement of some catchments areas in the disfavour of others and a great sinuosity in surfaces of watersheds, are present also in the plateau regions. The degradation of the terrains takes place through the association of present modelling processes on the little catchments areas directly or indirectly afferent to Târnava Mare (Mălâncrav, Richiş, Moşna, Şeica, Şoroştin) (Costea, 2007 b), Visa (Calva, Şoala, Mighindoala), to the two Secaş rivers and Hârtibaciu (Zăvoiul, Ghijasa, Zlagna, Săsăuş).

The lateral erosion in the riverbeds leads to a strong meandering of the Târnava Mare river course in the Hoghilag – Mediaş sector and of Hârtibaciu River course in the Cornăţel – Mohu sector. In case of Târnava Mare, the lateral erosion causes a permanent retreat of the right slope through the acceleration of rock-falls and landslidings along the entire slope (Josan, 1979). These processes are increase by the vegetation degradation in Mediaş-Copşa Mică sector, as a response of the system to the air pollution through the inter-conditioning of the geographical components (Grecu *et al*., 2002-2003).

The salt deposits, concentrated at the southern limit of the Plateau, with a maximum development at Ocna Sibiului, accelerates the modelling processes through the chemical and physical behaviour of the rock (the salt) to the action of external factors. Against the background of some ancient exploitations as bell mines, the association of gravitational processes (rock-falls, subsidence, suffusion and landslides) and the diapirism and anthropic action generated the salt lakes. The lake basins have a dynamics subdued to the water level oscillations and the precipitations regime. The lakes slopes conserve the hydrostatic level oscillations through the multilevel dissolution and erosion niches and have a chaotic morphology due to the landslides and slopes collapse (Costea, Ciobanu, 2009). On the salt horizons brought to the surface appear forms of rill erosion, dissolution and suffusion. The range of present geomorphologic processes is completed and sometimes amplified by anthropic processes caused by human actions: deforestations, intensive grazing, embankments and blocking of river courses, exploitation of building material from the slopes (Mohu, Guşterița, Bazna) or from the riverbed (Cibin, Olt, Târnava Mare), as well as the exploitation of subsoil gas reserves (Bazna, Mediaş, Nou, Copşa Mare, Ilimbav etc.). These actions lead to the modification of slopes and riverbed morphology and to the intensification of some present geomorphologic processes, to their association, getting even a risk character.

The hazard/risk character of modelling processes and their spatial distribution

The destructive potential of the present geomorphologic processes confer them a hazard character (ISDR, 2002, quoted by Sandu and Bălteanu, 2005). The geomorphologic hazards are

represented by periodical manifestations of some intensity, duration, frequency and weight, capable to produce disequilibriums in the functioning of morphohydrographic system, to determine degradation of environmental conditions, the disturbance of human activities, destruction of human settlements and roads, and even loss of human lives. In Sibiu county the present modelling processes that have a significant hazard character are the result of some combinations of processes specific to pluvial denudation (rainsplash and rill erosion, gullying, torrential erosion) and the gravitational movements (landslides and rock-falls) on the background of vulnerable slopes, due either to the geological substratum, or to the intensive human use in some ways (Costea, 2007 a).

The interpretation of present geomorphologic processes of a specific intensity in Sibiu County started from the direct observation and survey of the forms and the detailed morphometric analysis made previously on the relief (Velcea, Costea, 2006). According to the tendentious approach our studies are based, the factors that caused the past and present evolutions of the relief will act also in the future in the same direction. The graphics and maps obtained, the extrapolation of past and present tendencies of the modelling and their completion taking into consideration the sure changes that will appear in the future in the Sibiu county's geographic space use, offer us the possibility to identify some areas/zones subdued to the modelling processes with hazard character and make possible to delimit some sectors with a rapid dynamics (Fig. 2). The most part of the county's territory however, present a high stability of the relief forms and a low or moderated geomorphologic risk. The exceptions are represented by the slopes with high risk to landslides, those affected by rill, gullying and torrential erosion. In these areas, situated in the mountains, but especially at the contact mountain-depression and depression-plateau, the natural factors that conditionate the modelling and the active dynamics of the relief are overlapped on the anthropic impact exerted by a habitat pressure and by the uncontrolled use of natural resources.

The human interventions modified the natural flowing regime of the rivers and the accumulations on their courses modified the erosion base and in the same time, through the retention of large water volumes modified the rhythm and weight of modelling processes, functioning as real water reservoirs that regulate the debit downstream. The dam lakes have a very important role in the reduction of flooding waves during the rainy periods both in the Carpathian sector (on Sebeş River at Oaşa and Tău-Bistra, on Cibin River at Gura Râului, on the Sadu River at Negovanu) and the depression and plateau sector (Săcel, Mândra-Visa, Râura-Visa, Săcădate-Scoreiu-Porumbacu on the Olt River, Ighiş, Brădeni on Hârtibaciu). These actions lead to the modification of slopes and riverbeds geometry and to the intensification of some present geomorphologic processes, to the association of hazard processes.

The immediate effects and the dysfunctions generated on long term by the present geomorphologic processes, including the anthropic changes that occurred and still occur in the riverbeds and on the slopes as consequence of the human activities, give us the possibility to delimit in Sibiu County some areas with different degrees of susceptibility to the production of geomorphologic processes with hazard character. By susceptibility we mean the capacity of a geomorphologic system, either riverbed or slope, to suffer some changes due to the influence of the internal or external agents that generate at the relief's surface hazardous processes (Grecu, 1996; Sandu, 1998; Costea, 2010).

The surfaces with low to moderate susceptibility to geomorphologic hazards comprise especially the mountain region but also the alluvial plains from the depressions or plateaus. In the mountain regions the hard geological substratum causes a high stability of the relief and a low morphodynamics.

However, very frequently torrential processes occur, with large discharges of solid material at the confluences or at the slopes base. We mention also the high stability surfaces of the high floodplains and the terraces from the plateau and depression sectors along the Olt, Cibin, Târnava Mare, and Secaşul Mare rivers. They have a relatively reduced morphodynamics, with subsidence processes induced by a high human pressure due to the habitat and traffic, with medium capacity to produce superficial erosion, rill erosion and gullying of terraces and of glacis accumulations.

The surfaces with medium to high susceptibility to geomorphologic hazards comprise the surface of the main rivers floodplain, the low floodplains of the tributaries and landslide glacis situated at the cuesta's base of the Hârtibaciu Plateau or the Târnava Mare Hills, the variable sized surfaces at the level of terraces and piedmont plains.

The terrains use is diversified (hayfields, households, industrial areas). They are frequently associated with humidity excess due to the phreatic water fold situated near the surface and the springs, or to the reduced permeability of the soil (gleyzation and pseudogleyzation processes

specific to Făgăraş, Sibiu and Sălişte depressions). This area is directly subdued to the river courses influence (outflows, floods) and to riverbed and slope processes: accumulations, meandering, lateral erosion, excavation of riverbeds, bank and slope collapses.

When works of embankment, riverbed regularization, torrent arrangement lack or are neglected, in these area the vulnerability of the terrains to the flood and the risk of riverbed sedimentation are high. We mention also the high susceptibility of the slopes from the plateau and submountain hills to moderate to strong erosion and the reactivation of landslides and torrential erosion in case of land use change.

Surfaces with high and very high susceptibility to the hazard processes include the Olt River Defile in Boiţa-Câineni sector, important surfaces in the plateau: the western and southern slope of Hârtibaciu Plateau in Ocna Sibiului – Şeica Mare, Sibiu – Tălmaciu sectors, along the Olt River, the northern slope of the Târnava Mare and Secaşul Mare rivers.

This area is characterized by a low stability due to the steep slopes and the high relief energy. It has a very active morphodynamics sub-ordered to the processes of mass-movements (rock-falls, landslides), gullying and torrential erosion, and a high potential of reactivation due to the rich precipitations and the presence of springs on the slopes.

Nucleuses of high risk are dispersed in the county, caused by human activities: industrial exploitation of clay (Guşteriţa Hill at Sibiu), methane gas exploitation (Ilimbav, Copşa Mare, Mediaş etc.), the use of salt balneal potential (Ocna Sibiului, Bazna), industrial activities with collateral effects of the pollution (Copşa Mică), heavy traffic (E 81 – Olt Valley, DN 1 in Aciliu-Apold sector, DN 14 in Şura Mare – Slimnic – Ruşi sector) and the pressure of buildings.

Conclusion

The present geomorphologic processes that take place at the level of Sibiu County's relief units, especially those at the riverbeds and slopes' level are widespread and their intensity and frequency offer them a hazard character. Through their permanent and gradual impact the human activities have imposed new conditions of morphodynamic equilibrium. In these cases the geomorphologic system cannot revert to the equilibrium estate before the disturbing process or complex of processes, being found in a state of chaos and non-equilibrium – a phase of transition to a new equilibrium.

In this context, is needed an intensification of direct field observations, an appreciation and a qualitative and quantitative report of geomorphologic hazards in time and space. The extreme geomorphologic processes can start chain reactions at the level of the other geographical components, generating associated hazards: hydrological, ecological, social, economical etc. The forms of manifestation impose a continuous monitoring of the environmental conditions, mapping and studies, based on which to emit prognosis of evolution and to elaborate a program for the optimization of the afferent geographic space. In this direction, the prognosis of the geomorphologic phenomena is based on detailed studies that aim to delimit the potential factors, to evaluate the present and relict forms, the evolution in time and space of the phenomena, the sustainability capacity of the substratum, and the restriction and adaptability categories of the land. The equilibrium's regulation and maintenance can be achieved in an anthropic way, through a series of measures for prevention and attenuation of these processes' effects. However, their effects can be observed for a long time, being needed a reconversion of the terrains and a rational management of soil and subsoil resources, the within the sustainability limits of the environment.

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LIST OF ILLUSTRATIONS

Fig.1. The actual geomorphologic processes map of Sibiu County

1. The mountain supperior level with cryonival processes associated with gravitational processes (rock-falls) and wind erosion, on the massifs interfluves and prolonged summits (Cindrel and Lotru Mountains) and on the sharp interfluves with glacial ridges (Făgăraş Mountain), with screes and residual relief forms.
2. The mountain level of wooded versant, subordinate to the fluviatile processes (linear erosions, transport, accumulation in the depressionary areas or at the confluences), with a moderate rate of expression.
3. The mountain level of versant with secondary pastures and modelling processes due to pluvial denudation
4. The mountain level of versant with secondary pastures, subordinate to intense pluvial denudation processes: splash erosion, rill erosion, intense gullying, accentuate torrential erosion, against the background fated to pastoral activities, which require a balanced management and rehabilitation measures.
5. Submontane depression corridor subordinate to fluviatile modelling, with a predominant agricultural utilization of land, with slighty denudational processes and mass-movement.
6. Submontane hills with frequent torrential processes, gullying, regressive erosion of the spring areas which lead to the slope and interfluves degradation.
7. Scarp slope of cuesta, situated to the limit of the submontane depression, with slope processes subordinate to the gravitational movement (landslides, rock-falls), with a moderate and intense rate of expression, associated with gullying and torrential erosion; local active areas due to clay exploitation (Gusterita, Mohu).
8. The forestry plateau hills with moderate character of present geomorphologic processes, subordinate to the geologic substratum (predominant clay with monoclinal structure) and to forest utilization, predominant superficial mass-movements (landslides, mud flows), associated with a moderate torrential erosion, rill and splash erosion.
9. The plateau units developed on the monoclinal structure and domes, characterized by very high gravitational processes, predominant rock-falls and deep landslides ("glimee" at Cornatel, Noistat, Apold), associated with an intense pluvial denudation and regressive developed of torrential reception basins.
10. Large valley corridors with frequency of coluvial, proluvial and alluvial accumulating processes, and active fluviatile processes in the riverbeds.
11. Areas developed on the diapir folds with an association of gravitational processes (rock-falls, subsidence, suffosion and landslides) and the diapirism and anthropic action, subordinated to the hydrostatic level oscillations and to the temperatures and precipitations regime.
12. Riverbeds with alternating fluviatile processes (deposition, transport and erosion) and meandering, locally due to anthropic exploitation of sand and gravel (Cibin to Orlat and Vestem).
13. Active processes of regressive erosion and spring areas' retreat on Ist , IInd and IIIrd order catchments.
14. Active processes of scarp slope of cuesta, developed on the clayey deposits and monoclinal structure, predominant landslides and rock-falls, associated with gullying and torrential erosion.
15. Active processes of gorges steep slopes, developed on the hard rocks (gneisses, amphibolites, crystalline shists), predominant gravitational processes like rock-falls.
16. Meandering processes with frequent riverbed mutations due to flow oscillations.
17. Hydrographical network.
18. Administrative limit of county.

Fig.2. The map of the Sibiu county land susceptibility to the geomorphologic risks.

1. Surfaces with low to moderate susceptibility to geomorphologic risks and accentuate stability, due to geological substratum (on the hard rocks) or small inclination of slopes (depressions, valley corridors).
2. The surfaces with medium to high susceptibility to reactivation of landslides, outflows and floods or to humidity excess.
3. The surfaces with high susceptibility to torrential erosion, with high instability and regressive retreats of spring areas, due to rainfall and to changes of land use.

4. Areas with high and very high susceptibility to landslides, with accentuated instability and nuclei of severe reactivation against the background of anthropogenic activities of resources exploitation
5. Stable areas but with high susceptibility to dampness, due to water stagnations, a result of the reduced permeability of soil (gley soils, stagnogley soils), to the permanent or periodic saturation by water of soils in the absence of drainage or to freatic level lifting.
6. Areas with high susceptibility to floodings due to overflowings or to torrential flows
7. Riverbeds with minor to moderate susceptibility to fluvial processes: accumulation, meandering and erosion of the river channel and sides.
8. Landslides.
9. Solution, suffosion and settle processes developed on salt deposits
10. County's residence town.
11. Residence town.
12. Towns.
13. Administrative limit of the county.

LISTA ILUSTRAȚIILOR

Fig.1. Harta proceselor geomorfologice actuale din județul Sibiu

1. Etajul montan superior cu procese crionivale asociate cu procese gravitaționale (prăbușiri) şi eoliene pe culmi rotunjite şi prelungi (M.Cindrelului şi M. Lotrului) şi pe creste alpine (M. Făgăraşului), cu formare de grohotisuri şi relief rezidual.
2. Etajul montan de versant împădurit, subordonat proceselor fluviatile (eroziune liniară, transport şi acumulare în bazinete depresionare sau la confluențe) cu ritm moderat de manifestare.
3. Etajul montan de versant cu pășuni secundare cu procese moderate de pluviodenudare.
4. Etajul montan de versant cu pășuni secundare subordonat proceselor intense de pluviodenudare: spălare în suprafață, ravenare puternică, torențialitate accentuată, pe un fond destinat activităților pastorale, care necesită măsuri de reabilitare.
5. Culoar depresionar submontan subordonat modelării fluviatile şi utilizării predominant agricole a spațiului geografic, cu slabe procese de şiroire şi spălare în suprafață asociate cu deplasări gravitaționale.
6. Dealuri submontane cu frecvente procese de eroziune torențială, ravenare, retragere de obârşii, cu degradarea intensă a suprafețelor interfluviale şi a versanților.
7. Fronturi de cuestă la limita depresiunilor submontane, cu procese de versant subordonate deplasărilor gravitaționale (alunecări, prăbuşiri), cu un ritm moderat şi intens de manifestare, asociate cu ravenare şi torențialitate; local sunt legate de exploatările de argilă (Guşterița, Mohu).
8. Dealuri de podiş caracterizate prin procese geomorfologice actuale subordonate alcătuirii petrografice (predominant argile) şi utilizării forestiere, cu un ritm moderat de manifestare: predominant deplasări gravitaționale (alunecări, curgeri noroioase) cu caracter superficial, asociate cu eroziune torențială moderată şi spălare în suprafață.
9. Unități de podiş dezvoltate pe structură monoclinală şi domuri, caracterizate prin procese gravitaționale severe, predominant prăbuşiri şi alunecări masive, frecvent glimee (Cornățel, Noiştat, Apold), asociate cu pluviodenudare intensă şi dezvoltarea regresivă a bazinelor de recepție torențiale. 10. Culoare largi de vale cu frecvente procese de acumulare coluvială, proluvială şi aluvială şi procese fluviatile active în albiile minore.
10. Areale salifere cu procese de disolvare, sufoziune, tasare, diapirism, dezvoltate pe sâmburi diapiri, sub incidența variabilității condițiilor climatice (oscilații termice şi pluviometrice) şi a oscilațiilor nivelului apei din lacurile antroposaline.
11. Albii de râuri cu procese de albie cu manifestare alternantă: acumularea malurilor convexe, eroziunea şi prăbuşirea malurilor concave; local dirijate de exploatările antropice de nisipuri şi pietrişuri din albiile râurilor (Cibin la Orlat, Veştem).
12. Procese active de eroziune regresivă şi retragere a obârşiilor pe bazine torențiale de ordin inferior (I, II, III).
13. Procese active de versant abrupt – front de cuestă, dezvoltat pe roci argiloase şi structură monoclinală, cu predominarea alunecărilor de teren, asociate cu ravenarea şi torențialitatea.
14. Procese active de versant abrupt de vale (defileu) dezvoltat pe roci dure (şisturi cristaline, gnaise), cu predominarea proceselor gravitaționale de tipul prăbuşirilor
15. Procese de meandrare a albiei minore cu frecvente mutații de albie subordonate fluectuațiilor de debit.
16. Rețea hidrografică.
17. Limita administrativă a județului.

Fig.2. Harta susceptibilității terenurilor din județul Sibiu la riscuri geomorfologice

1. Suprafețe cu susceptibilitate slabă spre moderată la hazarde geomorfologice şi stabilitate accentuată datorată fie substratului geologic (roci dure) fie pantelor reduse (depresiuni, culoare de vale).
2. Suprafețe cu susceptibilitate moderată spre mare la reactivarea alunecărilor de teren, inundații, exces de umiditate.
3. Suprafețe cu susceptibilitate mare la torențialitate, cu instabilitate ridicată şi retrageri regresive de obârşie, datorate precipitațiilor bogate şi schimbării categoriilor de folosință a terenurilor.
4. Suprafețe cu susceptibilitate mare şi foarte mare la alunecări de teren, cu instabilitate accentuată şi nuclee de reactivare severă pe fondul unor activități antropice de exploatare.

5. Suprafeţe stabile dar cu susceptibilitate ridicată de supraumezire din cauza stagnării apei ca urmare a permeabilităţii reduse a solului (gleizare, pseudogleizare) sau a ridicării nivelului freatic.
6. Suprafeţe cu susceptibilitate ridicată la inundaţii datorate revărsărilor sau scurgerii torenţiale.
7. Albii minore cu susceptibilitate moderată la procese de albie: acumulări, meandrare, eroziune şi subminare de maluri.
8. Alunecări de teren.
9. Procese de disolvare, sufoziune, tasare dezvoltate pe depozite salifere.
10. Municipiu reşedinţă de judeţ.
11. Municipiu
12. Oraşe.
13. Limita administrativă a judeţului.

Fig. 1. THE GEOMORPHOLOGIC PROCESSES MAP OF THE SIBIU COUNTY

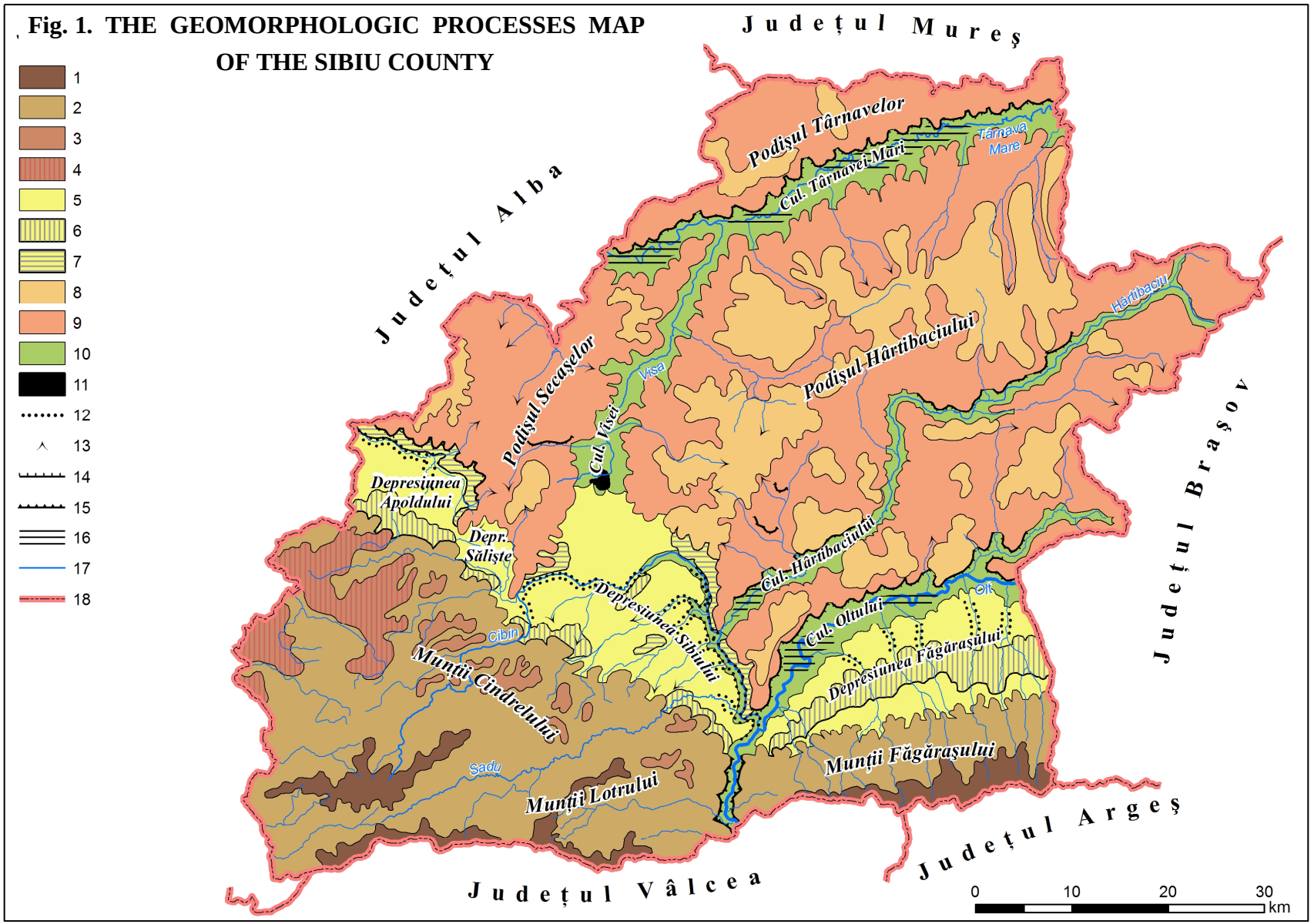
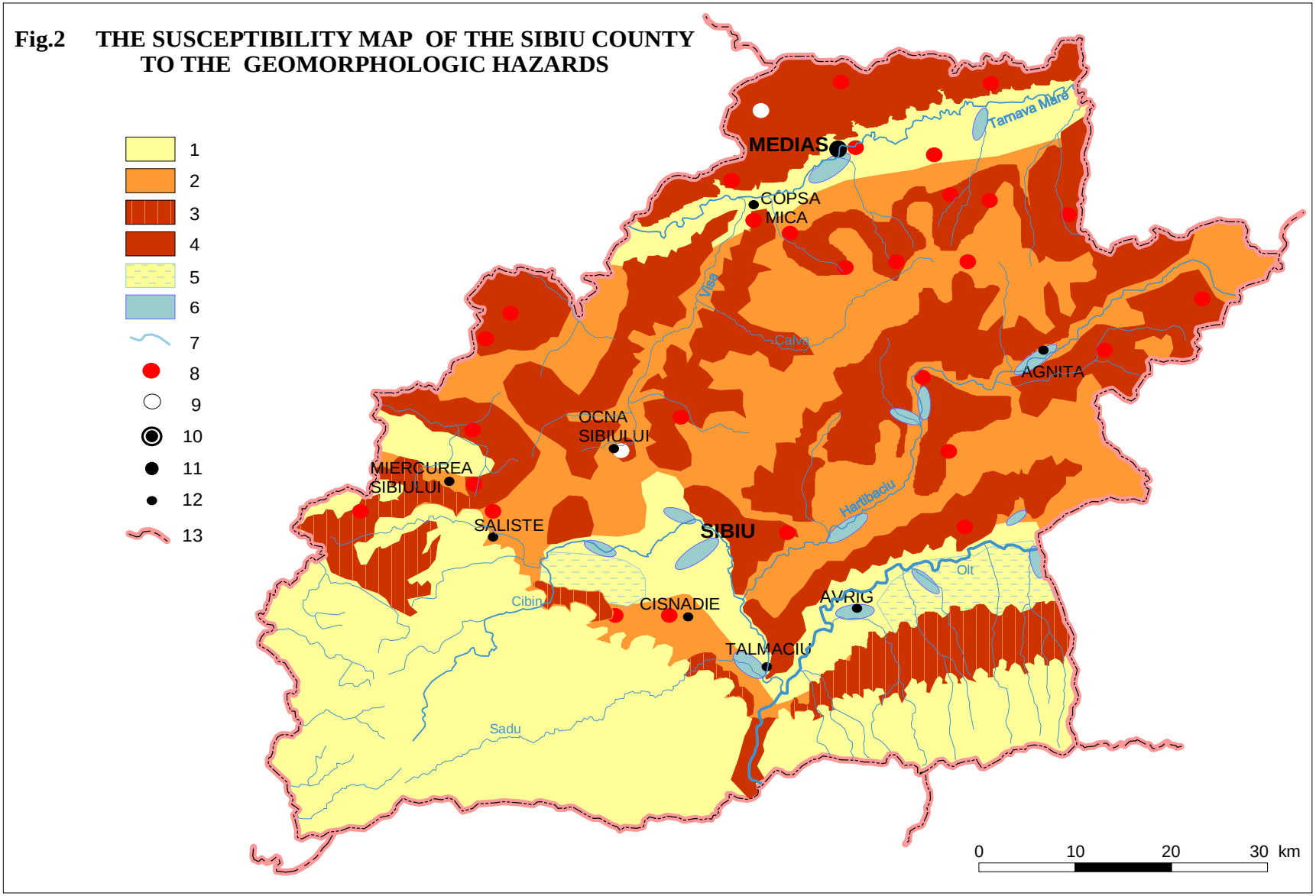


Fig.2 THE SUSCEPTIBILITY MAP OF THE SIBIU COUNTY TO THE GEOMORPHOLOGIC HAZARDS



EDUCATIONAL ACTIVITIES FOR PRIMARY SCHOOLS HELD AT THE NATURAL HISTORY MUSEUM FROM SIBIU (2009-2010 SCHOOL YEAR)

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Ghizela VONICA[**]

Abstract. *Museum education has an important role (in society cultural development) that increased especially during the recent years. Starting with the school year 2008-2009, Brukenthal National Museum became actively involved in the local students educational process through a museum educational programme entitled "Discovering the Museum". The Natural History Museum, part of the Brukenthal National Museum, was involved in this programme by developing and running specific educational activities. The aim of the programme held at the Natural History Museum was to familiarize students with scientific aspects from different areas of study like biology, ecology, environmental protection, geography, paleontology and pharmaceutical history. The programme offered students the possibility to discover new species of animals and plants, minerals, fossils, to better understand animal behaviour and other complex aspects from the living world. In this paper the authors present the educational activities developed during the school year 2009-2010 for primary school students as part of the "Discovering the Museum" programme. As a result, 162 activities, covering 5 themes from the project, were attended by 3060 students from 17 schools from Sibiu and Sibiu County (2 schools).*
Key words*: museum pedagogy programme, primary school, educational activities, thematic projects, Natural History Museum from Sibiu.*

Rezumat. *Educaţia muzeală reprezintă una dintre cele mai importante funcţii ale muzeului care a început să se dezvolte tot mai mult în ultimii ani. În perioada anilor şcolari 2008-2009 şi 2009-2010, Muzeul Naţional Brukenthal a început să se implice activ în procesul de educaţie al elevilor, printr-un program educativ special de pedagogie muzeală intitulat "Descoperind Muzeul". În cadrul acestuia, Muzeul de Istorie Naturală şi-a pus amprenta în educaţia copiilor prin specificul activităţilor educaţionale desfăşurate. Programul desfăşurat la Muzeul de Istorie Naturală a încercat să familiarizeze elevul cu numeroase aspecte din domeniul biologiei, ecologiei, protecţiei mediului, geologiei, cinegeticii (vânătorii) şi din domeniul farmaciei; oferind elevului posibilitatea de a cunoaşte numeroase animale şi plantele, precum şi numeroase aspecte legate de modul de viaţă al animalelor, comportament, etc.; despre cunoaşterea mineralelor şi a fosilelor; despre cunoaşterea unor aspecte din domeniul farmaciei; perceperea unor problemele complexe ale mediului înconjurător. În această lucrare, autorii prezintă activităţile educaţionale derulate în anul şcolar 2009 – 2010 dedicate elevilor din ciclul primar din cadrul programului de pedagogie muzeală "Descoperind muzeul". În cadrul activităţilor dedicate ciclului primar au avut loc un număr de 162 de activităţi, în cadrul a 5 module tematice, la care au participat 3060 de elevi din 17 instituţii şcolare din Sibiu şi din judeţ 2 şcoli).*
Cuvinte cheie*: program de pedagogie muzeală, ciclul primar, activităţi educaţionale, proiecte tematice, Muzeul de Istorie Naturală din Sibiu*

Introduction

Today, numerous institutions, associations or NGOs are involved in a true competition in the planning, development and implementation of community educational activities, the winners will be those who can adapt the educational process from a rigid form to a better form of understanding and discovering. Museums are factors in society that seek to influence and get involved in the educational process of the local communities.

Museum education was introduced for the first time in several museums of the world in the late 70's, to improve and change the traditional education model, guided tours, in museum (Weiden, 1999). Thus, various museums in the world, run o series of educational or pedagogy

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programs oriented for children and the general public. Museum education became one of the most important functions of museums that began to grow increasingly in the recent years (Slack, 2010). The aim of museum education is to encourage and contribute to the public and self-education process conducted in a pleasant environment offered by the museums.

Brukenthal National Museum is one of these museums, getting involved in public education throughout its educational programme. The Museum developed and implemented starting from 2008 an educational programme called "*Discovering the Museum*", that included all of the departments (P.R., Marketing and Education, Art Galleries, Natural History Museum, History Museum, Brukenthal Library). For this program the Museum received, as a result in 2010, the European Union Prize for Cultural Heritage/Europa Nostra Awards, the 4th category: Education, Training and Awareness-raising with the museum pedagogy programme "*Discovering the Museum*" (Hrib, 2010).

Prior to this, during 2006-2008, Brukenthal National Museum, was subject to a spectacular transformation, all the buildings in its administration were renovated "while about 85% of the exhibitions were reconsidered" (Hrib, 2010, 163). During the restoration, the Natural History Museum, part of the Brukenthal National Museum, started to prepare a special room dedicated to museum activities, being the first renovated space opened since the renovation from the entire Museum (Hrib, 2010).

From 2008, Brukenthal National Museum was active involved in the educational process of the local community. Because of the renovation process, there were arranged special rooms for educational activities where proper educational activities could be held starting with the school year 2008-2009. Before 2008 and especially "before 2006 the museum educational activities were random" (Hrib, 2010, 163). The majority of the educational activities were guided tours, and a need for more complex and interactive activities arise.

The special museum pedagogical programme "*Discovering the Museum*", prepared for local community schools, was for the first time launched in the school year 2008-2009 by the Brukenthal National Museum (Hrib, 2010). The general purpose of the programme "*Discovering the Museum"* was to encourage "students of different groups of age to become familiar with the museum through recurrence in visiting, to discover it step by step, having the possibility of learning, being creative and enjoying in recreation; creating events dedicated to children and teenagers, involving teachers, parents, press, other institutions; serving as model for other museums in Romania, in order to form through today's children and students the future museum-oriented public, which at the moment doesn't exist at the national level" (Hrib, 2010, 164). These aspects were made possible through practical activities that consisted in basic guided tours for schools, ethnic and special schools with disable children and their parents; thematic presentations; thematic projects; workshops; contests; exhibitions held in the museum educational rooms and other museum spaces; scientific documentary films screening . All these activities were prepared and oriented for the participants specific age helping them to see the museum as a place of discovering, accumulation and thoroughgoing study, which stimulates their creativity and encourage the development of their practical abilities and facilitates interrelation between humans.

Throughout the programme "*Discovering the Museum"*, Brukenthal National Museum encouraged the collaboration between the museum and teachers and training centers during the projects. One example was the collaboration between the Natural History Museum and the *"Zentrum für Lehrerfortbildung in deutscher Sprache"* represented by Adriana Hermann who coordinated a training programme dedicated to primary school teachers where all the classes are taught in the German language, which was held at the Natural History Museum (Hermann, 2010). Following the training, the participant teachers demanded to carry out some educational activities with students in collaboration with the museum, which should be related to understanding of the living world. Thus, various educational activities have been proposed by teachers, and have been developed and adapted for classes taught in German. All these activities were part of a thematic project included in 2009 in the museum educational programme "*Discovering the Museum"*.

A significant contribution in implementing and developing the museum pedagogical programme, addressed according to specific ages of the participants, came from the curators of the Natural History Museum. Through their involvement, they have contributed in various activities as thematic presentation, guided tours in the museum exhibitions, creating and helping in realization of handmade objects during thematic workshops, preparing educational materials for activities and students guide in the museum exhibition.

Because of the high demand, for running educational activities, came from teachers of the primary school, the curators of the Natural History Museum thought to create a special educational thematic programme oriented for primary school in 2009.

This paper is presenting the special educational thematic programme for primary schools that was launched and performed during the school year 2009-2010.

The educational thematic programme for primary school

Young children are very enthusiastic when it is talked about the living world. They are very open and whiling to learn, hear and discover new things related to this subject. Their interest is board and they like to reach many subjects which are related with nature, plants, animals, Earth, dinosaurs and so on.

The primary school educational programme had thought to be a complex of activities that will involve and attract the children attention and will help them in understanding and gain knowledge regarding the nature and the living world. The educational programme had thought in reaching these through the following objectives which were establish on short term (the school year 2009-2010) and on long term:

- primary school children will be involved in a complex educational programme,
- thematic activities focusing on living world, health, ecological education, environment, plants will be presented in a relaxed way at the museum.
- on long term the museum would like to create the young museum oriented public through the involvement in their education form a young age.

The coordinators of the programme organized and created 5 thematic projects which were held in Natural History Museum in the school year 2009-2010. Each modules focused on specific themes develop in order to comprise a broad range of subject.

- the first project entitled *Understanding the environment by primary school* (Fig. 1 a, b), aimed to develop the participant's interest for environment, plants, and animals, and help children to understand the importance of environment protection. This module was created to encompass a wide range of topics. Another objective was to develop and enrich the children vocabulary related to the natural science area. First the students were familiarized with the museum through guided tours in the main exhibition followed by discussions and little games. In the main exhibition children could recognize and observe the animals and could learn them through performing games. After the guided tours the student participated at activities in which were held thematic presentations (power-point) followed by discussions upon the presented theme meant to help students to better assimilate the new information. For the first and second grade the themes were focused on learning about: animals (domestic, wild animals from different parts of the world), dinosaurs, plants, human body, seasons and natural phenomenon and environmental education.

For the third and fourth grade the themes were more developed and comprised topics as: animals' behavior, plants (basics concerning their growth and development, their distribution and ecological relationships), environmental education and basics related to health education. The students took part in interactive games about developing stage of bees, plants developing stages, observing different habitats (wood, desert, oceans).

The materials used during the activities for this module were cards with pictures representing animals (for the activities held in exhibitions, contests), crosswords, interactive game in the main exhibition (called museum rally), work booklets about animals, biological material (for observation), magnifiers, binocular, written hand guides (Ciobanu, 2010, 120; Cuzepan, Ciobanu, 2009, 116), pedagogical magazine edited by Editura Edu. The module was attended by a large number of students, summing 2076 participants who took part at 105 activities. During the project partnerships with 11 schools from Sibiu were closed, from which 2 were from outside.

- The museum wanted to support also the School Centers for children with special needs (disabilities). In this regard, the Museum has developed a thematic project entitled *Understanding the environment for special schools*. The themes of the project have been adjusted in accordance with the understanding capacity of these children and where focused mainly on learning about domestic animals, plants and vegetables through thematic presentations, discussions and interactive games. It was a challenge in working with children with disabilities, but with the teachers help we succeeded to left our mark in the educational process of these children. This module involved 23 participants from 2 schools, during 6 activities.

- *Symbols of spring at the Natural History Museum* was a project (Fig. 2 a, b), that promoted society environmental education by recycling through its activities undertaken. Trinkets out of recycled

materials and different ornaments and decoration for Easter, were created in collaboration between students and museum curators. There were organized several workshops (during the period February – March 2010) for students. During workshops, there were used recycled materials as: plastic, paper, cardboard, cotton and thread of different colors, beads, textiles. All the recycled materials were brought by the participants at the workshops. The 28 workshops held involved the participation of 551 students from 13 primary schools.

- *The story book of the Natural History Museum* project involved the participation of one class, the 4th grade students from the School no.6 from Sibiu which were accompanied by the teacher Teodora Gălbinuş. Practical activities were designed in order that participant students will discover the living world (plants, animals). Students could observe, with the help of magnifier and binoculars, insects' body structure of different species, mushrooms and moss structure, the structure and components of rocks, minerals, plants and animals. Aspects regarding minerals, rocks and fossils were encompassed and some materials were observed and analyzed with the help of museum curator (Fig. 3 a-c).

The participant students were help in the learning process by the interaction with biological materials. There were held thematic presentations in a story context. For this project 4 thematic activities were attended by 24 students.

- The project "*Museum education for classes taught in German*" (Fig. 4 a, b) was a module for students attending German language teaching schools. The project was collaboration between German school teachers and museum curators. The project aimed to help primary school students to better develop and practice the ability to communicate both in German and Romanian regarding different areas approached (in this case the living world).

The subjects were developed according to different age groups and divided as follow:

1. For the first grade students, the activities wanted to familiarize them with the museum specifics, they were first guided through the exhibitions and then they perform a game which helped them to learn the animals seen in the museum exhibition.
2. Second grade students were involved in an interactive game in the main exhibition (called museum rally) which was designed as a competition. It consists in leading the students through the museum exhibitions with different observational task, perform interactive games.
3. The third grade students participated in more complex activities created for them to understand the animals' behaviors in various habitats, through observing and analyzing animals habitat (in exhibition, from documentary film screening), completing worksheets.
4. The four grade students were involved in activities that were focus on studying a particular animal (his behavior along the entire year and his habitat).

The materials used in this module were diverse and adapted according to each grade: individual worksheets; the educational materials „*Mein Tierbüchlein*" (My booklet with animals), „*Der Braunbär*" (The Braun bear), „*Tiere im Winter*" (Animals in winter) and „*Das Reh und der Fuchs*" (The deer and the fox), *Museumserkundung mit Kreutzworträtsel* (Museum information in crossroads) for the crosswords activity, „*Säugetiere und Vögel*" (Mammals and birds), *Körperbau und Rolle der Körperteile* (The body structure) „*Das Donaudelta*" (the Danube Delta), *Mit unseren Bären durchs Jahr* (With the bear along one year) which were prepared by Adriana Hermann (collaborator from the *"Zentrum für Lehrerfortbildung in deutscher Sprache"*).

Some thematic activities from the *Museum education for classes taught in German* project were performed at the Hunting Museum (one of the Natural History Museum department). The activities undertaken for the children imply observation and recognition of different animals.

This project included the participation of 386 students in 17 thematic activities. 20 German school teachers attended 2 training sessions meant to accommodate and prepare them for running educational activities in museums.

The activities within the museum educational programme took place in the museum educational room and in the museum exhibitions (temporary and main exhibition).

Results and discussions

In the youth educational programme *"Discovering the Museum"*, the Natural History Museum has left its mark in the education process through the specific educational programme undertaken. All the activities held during the educational programme were performed in the museum ambiance which offered the primary school students a new and a different approach in learning.

Through the interactive educational activities perform as part of the Brukenthal National Museum pedagogical programme, the Natural History Museum, offered the participants the

opportunity to perceive the complex issues of the environment, forming a knowledge base regarding the environment, plants, animals, fossils, rocks and minerals in a word environmental education, and provide knowledge regarding the museum cultural environment.

During the educational programme held at the Natural History Museum for the primary school, 162 thematic activities took place attended by 3060 students. The educational museum program dedicated for the primary school succeeded to get involved and collaborate with 17 schools from Sibiu and Sibiu County, 49 teachers and 1 trainer in 5 thematic projects.

The thematic project with the largest number of activities held (Fig. 5) and also the largest number of participants (2076 students Fig. 6) was *Understanding the environment by primary school* project. This project covered a wide range of themes and brought its contribution in completing the primary school curriculum. These activities succeeded to determinate the participation of a large number of children of all ages from the primary school.

Learning in museum could be considered a complex process, in which a variety of teaching methods can be used: oral communication, practical activities and dialog. The main activities performed in the primary school educational programme focused on: thematic guided tours in the exhibitions, workshops, power-point presentations, documentary film screening, completing worksheets.

Taking into account that "museum learning is frequently focused on objects" (Hooper-Greenhill, 1999, 21), there were used several biological materials and museum pieces form the collections, arousing curiosity and stimulating the student's interest for discovering and learning. In museums object oriented learning is recommended because "children appreciate the opportunity to work directly with objects from a surprisingly young age" (Hooper-Greenhill, 1996, 21). In this regard during activities were used biological materials for direct observation regarding the structure and components of animals, plants and minerals. These materials are museum pieces without inventory number, and could be manipulated by children: mushrooms, moss, insects, mollusk, minerals, rocks and fossils. The materials used for the activities held in German have been adapted and subsequently were used also for the activities held in Romanian.

The success of the educational museum programme for primary school was determinate also by the participation of the teachers that get involved in the activities run in the museum, and by the collaboration between the teachers and the museum curators. Classes of students that first participated in the museum educational programme for primary school during the school year 2009-2010, were pleased by the diverse and complex theme approached and continued to participate in the museum educational programme.

To obtain a qualitative result from the learning process, it is necessary that teachers prepare the students in advance before their visit to the museum and subsequent to fix the fresh knowledge gained by students also in the classroom.

For the different educational activities, the museum curators have developed numerous educational materials, games, observational exercise. Some of them were tested for the first time, and could be improved and receive feed-backs.

All the activities were held in a relaxed and friendly environment.

One of the desired and expected effects of the programme was to create the future museum-oriented public.

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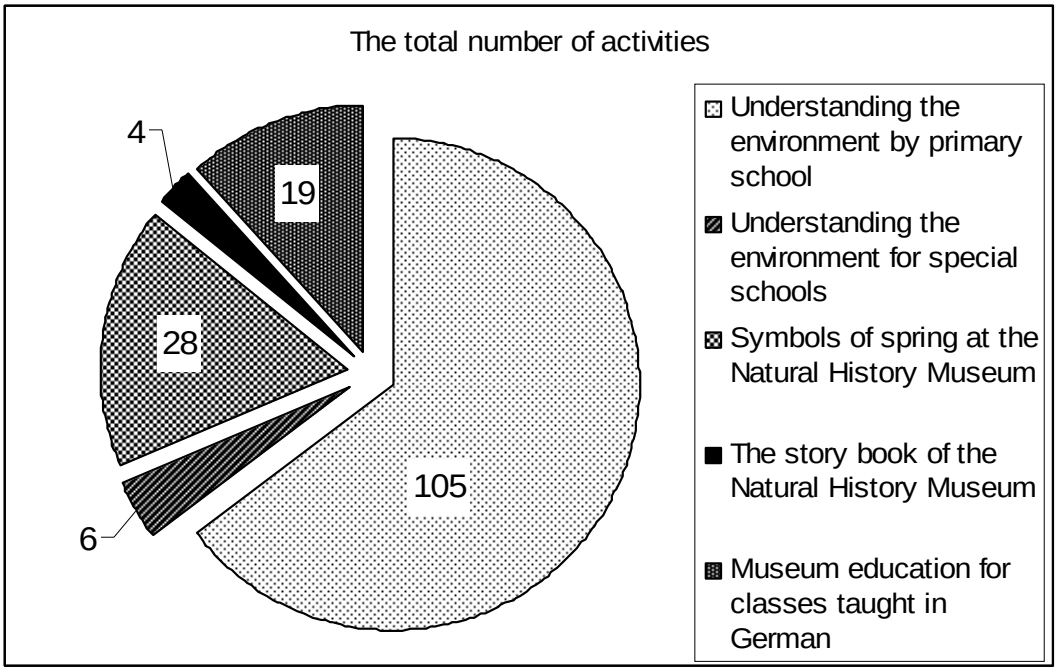

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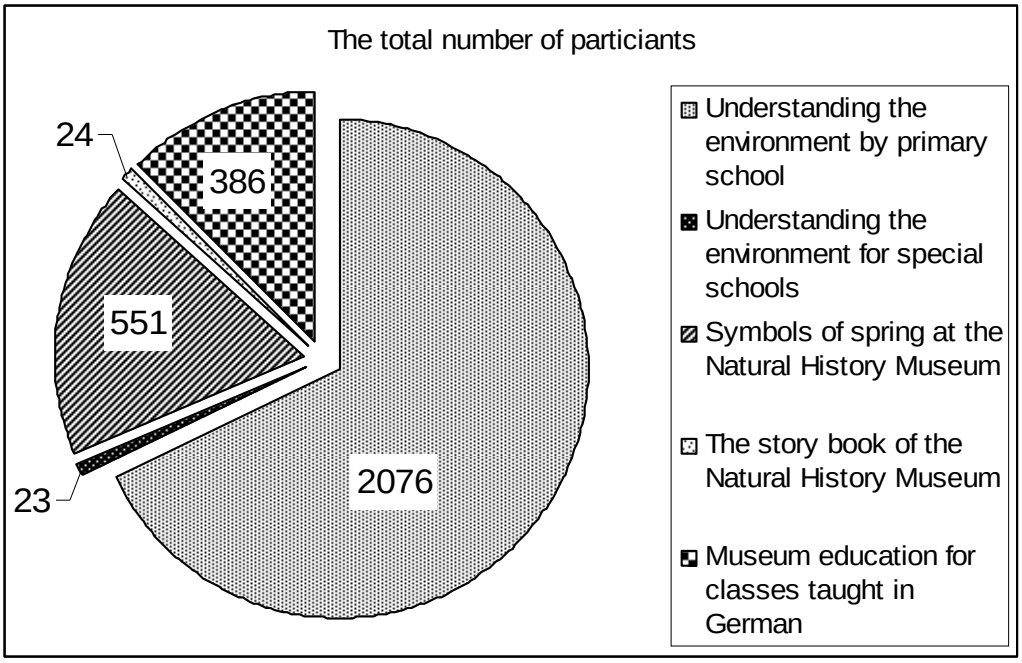

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GEOEDUCATION AND THE CULTURAL HERITAGE

Rodica CIOBANU*

Abstract. *This paper analyses the role of geological education – called geoeducation – within the Natural History Museum from Sibiu. Geoeducation at the Natural History Museum, can be achieved through: the basic guide to the general exhibition, temporary exhibitions, educational activities and publications. Cultural heritage is not confined to what is treasured in the museum, but also in the buildings. We propose as case study presentation for the 11 buildings positioned in the vicinity of the Brukenthal Palace point of view of geoeducation. For the 11 proposed cultural sites we have made a prior geological diagnosis filtered and adapt to the type of public.*
Key words*: geoeducation, cultural heritage, Natural History Museum, Sibiu*

Rezumat. *În lucrarea de față ne propunem să analizăm educația geologică – numită geoeducația – în cadrul Muzeului de Istorie Naturală din Sibiu. Geoeducația în Muzeul de Istorie Naturală, se poate realiza prin: ghidaje în expoziția de bază, expoziții temporare, activități educaționale şi publicații. Patrimoniul cultural nu se limitează doar la ceea ce este tezaurizat într–un muzeu, ci şi în clădirile care – într–un oraş cu un centru muzeu cum este Sibiul– aparțin patrimoniului cultural local, național şi nu numai. Propunem ca studiu de caz 11 obiective culturale aflate în jurul Palatului Brukenthal, prezentate din punct de vedere al geoeducației. Pentru cele 11 obiective culturale am realizat în prealabil diagnoza geologică filtrată şi adaptată pentru tipul de public.*
Cuvinte cheie*: geoeducație, patrimoniu cultural, Muzeul de Istorie Naturală, Sibiu*

Introduction

During the last century, in the period that preceded the 80's, most museums dedicated less time or not at all to education. Although, even before the Second World War, specialists in education envisioned the possibility that museums could provide education for the masses. Common method of education in museums represents the traditional guide. There was a gap between the curator, which often channelled his attention to the scientific aspects of the collections and not towards the people involved in education, if there were any (in very few cases). As a result of these scientific guides, the young and adult audience, untrained in the field, and even the educators, avoided visiting the museum.

The economic aspect marked, at the beginning, the museum activities that were expressed in revenue and the purpose was to improve and to diversify the quality of these activities. Thus, there is:

1. The professional / museum, scientific approach – the classical museum onset, everything is related to the collections,
2. A thematic approach – by choosing topics for the guides according to the museum profile, theme exhibits, the level of compelling reported to the targeted public etc. Sometimes, due to an exaggerated attention conferred to the lessons held in museums, for different age groups, education in museums is often confused with the one held in schools. The goal of the museum education is not to replace the school education but at the same time, the school cannot substitute the museum.
3. The social approach – the museum through its activities must address and incur not only the public involved in some form of education, but also the adults who otherwise would not visit the museum.

Currently, in the Romanian museums, education work becomes widespread. Each museum developed educational departments that transform the museum into "cultural enterprise" in which the activity is measured by: the number of visitors and store profit. In this sense museums have shifted their care from the collections towards the visitors, so that is visitor–centred, the predominant role is to face the visitor needs and level of education, adapting to these conditions. The museum is no longer the prerogative of the elite, but a powerful way to communicate and educate the masses (Ciobanu, 2003).

Education is one of the driving forces of a museum but at the basis of all its activities are and

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should remain the collections. Curators must be bought coordinators of the collections and museum educators. They have to manage the museum heritage as a common property of the entire community. An efficient participation at the cultural act implies pre–existence of knowledge and information. In this sense educational activities facilitate the access of the general public to information regarding the museum heritage and natural sciences. Today the museum has become an extension of the school, as a result of the many thematic activities developed, adapted to the community educational needs.

This paper analyses the role of geological education – called geoeducation – within the Natural History Museum from Sibiu.

In terms of geological information, by a simple analysis of the school curriculum is possible to note the absence of geological subjects during the first 12 years of school. Geological concepts are found in geographical specialties. Because of the reduced time assigned to these lessons, and sometimes the poor training of the geography teacher related to geologic notions, the lack of geological collections, these notions remain misunderstood and ultimately not assimilated by the students of all ages.

With the frequency of catastrophic events on Earth increasing, geological education can contribute saving lives and material goods.

Therefore we highlight in this paper how the museum as a cultural institution can be involved and even compensate for the lack of information ascribed to some institutionalized educational systems.

The Natural History Museum from Sibiu, part of the Brukenthal National Museum, was opened as an institution and established as seat of its founding Society (*Siebenbürghische Verein für Naturwissenschaften zu Hermannstadt*) on 12 May 1895 (Schneider, Stamp, 1970).

Even in the second half of the nineteenth century in the Museum of Natural History was applied already a form of education in museums; this method was practiced until the end of the XXth century. Thus, there was a sustained concern within the Society on behalf of its general activities but also on the effectiveness of the teaching process in schools. Society members realized that the quality of future research in natural sciences depends upon the educational process. For example, in 1890, the Society Committee organized an exhibition of teaching aids, teaching material for science (Bielz, 1890). Also, to facilitate access to the Society's libraries the members held "reading rooms" ("Lesezimmer"), that served the purpose of exposing the general public to nature studies. (Bielz, 1891). In fact, one of the original goals of the Society and of the museum as a cultural institution was to increase the level of knowledge related to natural sciences, no matter what the social category of the public was.

Geoeducation at the Natural History Museum, can be achieved through: the basic guide to the general exhibition, temporary exhibitions, educational activities and publications.

a. Classic Guides

The classic guides, done in the general exhibition, are the starting point in spreading the minimum level of information. The Natural History Museum in Sibiu allotted to geology a small space in which the convection of information is a combination of relaxation and education. In this area the minerals and rocks exposed are considered ornamental and aesthetic capturing the visitor's attention. The Paleontological sector, reduced in three showcases, exhibits large vertebrate fossils, where the guide through pedagogical skills and knowledge in the field can transmit various information (from paleogeographical reconstructions to compared zoology).

b. Temporary Exhibitions

Temporary exhibitions represent, in our museum, the major means of spreading geological information. Thus, in 2009 from the five temporary exhibitions organized three had a geological theme. Experience has shown that the museum exhibitions related to a geological domain or aspect – can be successful only with a guide that facilitates the assimilation of information. Visitors – especially those participating in some form of education – have a positive reaction to such an exhibition only after overcoming the difficult scientific terminology barrier, after understanding the texts, etc. and this is possible in connection with their daily life, events, phenomena that surrounds them. Therefore, we tried a new approach to the subjects, namely by introducing the geological information as part of the landscape together with the other components of the natural environment: plants, animals. For example, in the temporary exhibit "*The Romanian Carpathians in the museum collections*" (Fig.1) were present almost all the elements that define the biological, physical–geographical aspects of the Carpathians: rocks and minerals – to define the physical and geographical aspects of the area, photos of a famous photographer E. Fischer – for the mountain scenery, animals and plants.

Statistically, from the visitors that attended this exhibition, aged between 12 and 18 years, 70% said it was the first time they have seen rocks that are part of the Carpathians, 10% remembered the names of the rocks and 85% believe that after the visit and following the guide it will be easier to understand the geologic concepts taught at school.

For the modern visitor, whose time is short, with multiple opportunities for information sources by a simple click of the mouse, exhibits that gather objects and specimens from a wide range, appear attractive and pleasing. Considering this observation at the museum was organized an exhibition of "*Precious stone – from mineral to gem*" (Fig.2) where we laid out alongside minerals the jewellery made from these precious and semiprecious stones. Although most questions were related to the connectivity stone – zodiac sign, through specialized guides the questions could be answered at a scientific level. The message of this exhibit was that the geological "products" are present in all activities surrounding us every day, and that the notions and pointers concerning these stones are useful to us in our daily activities.

c. Educational Activities

The new scheme of the Natural History Museum includes an educational activity room. The technical equipment (microscopes with transmission display, video projectors), the museum specimens found in storage, enable the setup of temporary exhibits and educational activities to enrich the knowledge gained by students in a relaxing and enjoyable form, different from the institutional education system. The vast majority of the educational activities have as a starting point the general exhibit and temporary exhibits that, differentiating the museum approach in education from the one practiced in schools. For the geology field exciting educational activities, which attracted a large number of participants, were the ones that had exciting themes even for the scientific world such as dinosaurs (Fig.3, 4).

d. Publications

The Natural History Museum can be approached by the scientific community through a scientific journal ("Brukenthal. Acta Musei"), which includes in each issue, together with papers from a wide range of fields, articles on geology topics. In the museum general printed guide and in the student printed guide information on the geological meaning are presented to the students and the public without special training, in an approachable way. Students have access to basic notions on rocks, minerals, fossils and by means of publications they will be drawn to discover the hidden properties of these elements.

At the Museum of Natural History from Sibiu there has always been a tradition regarding this aspect. In the past, active members of the Society, who founded the museum, have sought, through their research, by the conferences held not only to bring new members into the society, but also to attract the general public to join them and to visit the museum. Their works were addressed, for bought professionals and amateurs, for every one who had a common passion for geology. Analyzing the contents of the museum's journal "Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für naturwissenschaften zu Hermannstadt" (1850–1945, 95 volumes) we can point out that in the publications for specialists determinations were made at European level, and by means of details concerning the collecting sits and even the exaggeration in describing fossils these works were used by collectors, those without specialized training in the geology field.

Cultural heritage is not confined to what is treasured in the museum, but also in the buildings. In a town like Sibiu where the centre of the city is a museum itself, the buildings belong not only to the local cultural heritage but also to the national and international patrimony. Taking in account these aspects we propose that geoeducational activities should not be limited to the museum. These activities can begin in the museum but can also transcend its limits. Since the medieval centre of Sibiu is not only the point of cohesion for the museums, as cores of culture heritage, these buildings can be important and could be proposed as examples of geological urban education, being a route that can be done in a relatively short time (correlated with time allocated to a class). We propose as case study the buildings positioned in the vicinity of the Brukenthal Palace and in doing so the duration of the activities will be similar to a common educational activity in the museum. Urban geological education activities include brief information about the history, the heritage and architectural evolution of the building – without exceeding the level of detail proposed by the theme, followed by geological data that can be observed from its structure. For the 11 (Fig.5–16) proposed cultural sites we have made a prior geological diagnosis (Table 1) so that the information submitted is scientifically accurate, filtered and adapt to the public. For the geological information to be understood as such, geological education activities will follow the urban–themed activities to review the level of comprehension and to set the

basics of this field pointing out the classification system of the rocks.

Conclusions

Outstanding scientific results in the field of geology may also exist in museum work, but they are not proportional to the level of knowledge accumulated by those who visit the museum or the number of those who return to the museum. Balancing recreation – education – scientific information is possible by promoting public understanding of science, as is the case of geology, to educate and entertain by using techniques involving participation (contests, games, workshops, etc.). We believe that the texts accompanying the geological exhibits should not be difficult to read or too long. The museum, however, cannot replace school education but can help the school in the dispersal of geological information and could cultivate higher education in the geology domain, by encouraging the passion and commitment of those who want to pursue a career in this field. Before reaching a university level, in terms of education in the field of geology, natural science museums could play an important role in reaching this goal. Furthermore science museums that have an important geological heritage can overlook geology education.

It was ascertained that educational activities with exciting themes, which have attracted a large number of participants were opportunities for bought curator and participants to present the results of geological research in Romania, and to commemorate Romanian personalities that worked in this field. Also, using the museum's popularity and attraction young people could learn about the importance of museums, the significance of preserving a unique geological heritage, unlike any other in a community.

Acknowledgments

I would like to thank geologist Viorel Ciuntu for his help in completing the cultural establishments geological characterization/ diagnosis.

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Tab. 1. Geological diagnosis of the cultural objectives

Cultural objective	The elements considered geologically	Geological diagnosis – report
Brukenthal Palace 1778–1788 (P.ta Mare, no. 5) Fig.5	– columns and the porch with coat of arms, (Fig.1a)	Dacite tuff – Perşani Type – fine–grained, irregularly broken, sometimes with impregnations of iron hydroxide and chlorine. These prints greenish–yellow colours to the rock. Pyroclastic rock type– vitro and cristaloclastics structure with amphiboles (prevail), pyroxenes, feldspars and quartz.
	–atlantes (Fig.1b)	
Romanian Art Gallery, Blue House XIV th century, 1783 (P.ta Mare, no. 4) (Fig.6)	– frame (left wall of the entrance) (Fig.6a)	Sedimentary limestone with sandstone enclaves.
	– frame (at the entrance to the floor) (Fig.7b)	Mediogranular sedimentary limestone with sandstone appearance
Hecht House ½ XV, XIX th century (P.ta Mare, no. 8) (Fig.7)	– ornamental frame (on the left wall of the entrance) (Fig.7a)	Micrograngular sedimentary limestone compact, yellowish gray colours.
Haller House XV, XVI, XX th century (P.ta Mare, no.10) (Fig.8)	– portal entrance decorated with heraldry, (Fig.8a) –portal entry to the first floor, (Fig.8b)	Compact sedimentary limestone with micrograngular structure, yellow–white colours.
	– stairs to first floor a railing with columns. (Fig.8c)	Gray sandstone.
Evangelical Consistory XIX th century (P.ta Mare, no. 14) (Fig.9)	– at the entrance columns and balcony	Micro and mediogranular sandstone with limestone cement
Roman – Catholic Church 1726–1733, 1738 (P.ta Mare squere, no. 14) (Fig.10)	–ornamental belts surrounding the building –Sub–portal bell (Fig.10a)	Compact sedimentary limestone, slightly fossiliferous, cream–colored, with reduced pores and microcrystalline calcite matrix. Slightly increased compactness and presents iron metals. Is the limestone of Ighiu type.
	– floor of the church (Fig.10b)	Sedimentary limestone with nummulites
	– columns inside the church	Yellowish–white sedimentary micrograngular limestone
The Altemberger House – The Museum of History XIII, XIV, XV th century (Mitropoliei street, no. 2)	–entrance frame and stairs (Fig.7a)	Micrograngular sedimentary limestone, with yellowish–gray sandstone
	– support column	Sandstone limestone with artificial cement

(Fig.11)	(Fig.11b)	
Evangelical Church 1726–1733, 1738 (Mitropoliei street, no. 1) (Fig.12)	– frame elements	Medio granular sandstone limestone and fine granular compact sandstone of sedimentary origin
Reformed Church XVIII th century (Mitropoliei street, no. 9) (Fig.13)	– external portal frame	Calcareous sandstone, medio–granular, gray–yellow collared
	–windows frame (Fig.13a)	
	–treptele de la intrare (Fig.13b)	
The House with Caryatids (Mitropoliei street, no.13) (Fig.14)	– two caryatids	Dacite tuff of Perşani type, greenish yellow,
The Orthodox Cathedral ”Sf.Treime” 1902–1906 (Mitropoliei street, no. 33) (Fig.15)	– ornaments placed on the pillars of the gate (Fig.15a)	Sandstone limestone and sandstone with schistose appearance
	– frames and exterior balcony (Fig.15b)	Sedimentary limestone compact, yellowish–white, with microgranular structure
”Andrei Şaguna”Faculty of Theology 1913–1914 (Mitropoliei street, no. 20) (Fig.16)	– entrance and window frame elements	Sedimentary limestone compact with micro to mediogranular, white–gray colours

Fig.1.

Fig.2.

Fig.3.

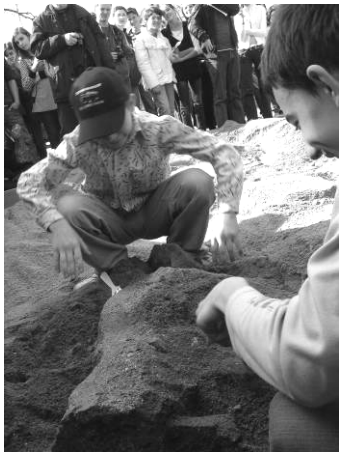

Fig.4.

Fig.5.

Fig.5a.

Fig.5b.

Fig. 6.

Fig. 6a.

Fig. 6b.

Fig. 7.

Fig. 7a.

Fig. 8.

Fig. 8a.

Fig .8b.

Fig. 8c.

Fig. 9.

Fig. 10.

Fig. 10a.

Fig. 10b.

Fig.11.

Fig.11a.

Fig.11b.

Fig. 12.

Fig.13

Fig.13a.

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Fig. 14.

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Fig.16.

Silvia BURNAZ, ***MACROLEPIDOPTERA OF ŞUREANU MOUNTAINS,*** Edited by Tipografia Astra Deva, Deva, 2008, 328 pages, 51 figures, 8 colour plates, 11 tables.

Gabriela CUZEPAN*

The printed version of the "*Macrolepidoptera of Şureanu Mountains*", published in 2008, is representing the PhD thesis of the author Silvia Burnaz, which is the result of a comprehensive study conducted over a period of 14 years (from 1986 till 2000).

Her work covers 328 pages, divided into nine chapters, with: preface, introduction, conclusions and references, 8 color plates representing several Macrolepidoptera species of butterflies and moths images. The thesis is entirely written in Romanian, but the author had made it accessible for the specialists by adding a summary of the work in English. The preparation of the entirely work of the author was done under the guidance of Nicolae Tomescu coordinator, science professor at the Univ. "Babes-Bolyai" Cluj-Napoca, Faculty of Biology-Geology.

The foreword of the work belongs to Professor László Rákosy from "Babes-Bolyai" University of Cluj-Napoca, Faculty of Biology-Geology, Department of Ecology and Taxonomy, which situates the systematically research run by Silvia Burnaz regarding the Macrolepidoptera fauna of Şureanu Mountains in the context of "knowledge of the characteristic Lepidoptera fauna of the Carpathians".

As it is mentioned in the thesis introduction, Şureanu Mountains were less studied and researched by specialists in regard with their flora and fauna, and through her contribution is filling a gap about the Lepidoptera fauna of these mountains and thereby of the entirely Carpathians fauna. The work is not a study done after several field campaigns; the author has been involved in researching the Şureanu Mountains zone, over a period of 14 years. The data regarding the Lepidoptera fauna from the Şureanu Mountains presented in the author thesis are published for the first time. Also, the author specified and presents the directions of her research throughout the entirely study and period. \

The 1st chapter, ***The history of geological, geographic and biological researches in Şureanu Mountains***, gave the author the possibility to present the history of the Lepidoptera researches in Romania, in which are listed both chronologically and by typology of study the researchers that have brought their contribution for the studied Lepidoptera fauna of Romania. Also, the author made reference to the Lepidopterological Society of Romanian, mentioning its contribution and activity since its foundation in 1990. A brief review of the research history, including the geological, geographic, botanic and other entomological researches, of the studied area in Şureanu Mountains was integrated in this chapter.

Chapters 2, ***The physical-geographical and ecological characterization of Şureanu Mountains,*** contain a comprehensive overview of the followings: geographic localization and limits, geology, relief, climate data, hydrography, soil characteristics. \

Chapter 3, ***The general characterization of the flora and vegetation of Şureanu Mountains***, is closely related with the previous chapter as the author states "the physical-geographical particularities and the climatic conditions of the Şureanu Mountains are **favorable** for the development of vegetation units characterized by a large variety of flora." There are also described the vegetation assemblages indicating the specific plant associations found in **phytocenosis**.

The Chapter 4, ***Describing the analyzed stations***, is allocated to the presentation of the 14 representative stations chosen for the systematically, faunal and bio-environmental researches on the Macrolepidoptera from Şureanu Mountains. The studied stations are located on the administrative territory of Alba and Hunedoara Counties. It is worth to appreciate the detailed description compiled for the 14 stations which include the following aspects: geographical localization, altitude, geological substrate, the annual temperature average, medium annual rainfall, soil types, the characteristic ecosystems and plant associations described for the analyzed habitats. The study area chosen by the author included areas as: Ponor-Ciclovina area, Cheile Crivadiei, Cheile Taiei, Grădiştea Muncelului, Băniței-Dealul Bolii Corridor found on the

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territory of Hunedoara County which represent natural and archeological areas included in the Grădiştea –Muncelului Ciclovina Natural Park.

\Choosing the studied stations, the collected material analyzed, sample procedures, the stationary and transect research, the conservation methods, laboratory research and the statistical methods used are presented in chapter 5, ***Material and research methods.*** The author contribution is remarkable by the fact that her research has "focused on areas of limestone and subalpine and alpine mountain areas, from the Sebeş Valley and Cugir Valley (which are representing the crystalline part of the massif), parts which were very little documented by the researchers". Equally remarkable is the biological material studied, a number of 9.550 specimens which belong to 729 species, prepared, determinate and labelled, was included in the scientific heritage of Dacian and Roman Civilization Museum of Deva, thus increasing the national patrimony value. Silvia Burnaz compassed in her studies aspects regarding the biology, ecology, zoogeography, larval and adult feeding of Macrolpeidoptera.

Chapter 6, ***The Macrolepidoptera fauna form Şureanu Mountains; zoogeographical characterization and the altitudinal distribution of the species***, it is the most consistent part of the thesis (111 pages) with new data regarding to Lepidoptera fauna. It is included the checklist of the Macrolepidoptera species identify with additional notes related to species as: the investigated stations, altitude and geographical distribution, ecological requirements of the species, ecosystems, and the fidelity to the ecosystems, larval feeding source and observation. The chapter is completed by numerous aspects in regard with the Macrolepidoptera studied: the distribution species analyzed on the studied stations; zoogeographical characterization of the species; the altitudinal distribution of Macrolepidoptera fauna; the Carpathian endemic species; the boreo-alpine, tundra-alpine and subalpine elements from the studied area; very rare species, or with sporadic appearances in the Romania fauna collected in the ecosystems of the Şureanu Mountains; and information regarding the butterflies biology and ecology. The material sampled, in relation with the total number of Macrolepidoptera species recorded so far in Romania, is representing 51 %. Important evidence of butterflies species are given by the author: 8 taxa (out of 58 endemic species and subspecies in Romania) which are geographical races and endemic in the Romanian Carpathians were identified in natural ecosystems in mountain and subalpine areas of Şureanu Mountains *Psodos canaliculata schwingenschussi, Photedes captiuncula delattini, Apamea rubrirena, Apamea maillardi carpatoburnnea, Erebia epiphron transsylvanica, Erebia medusa psodea, Erebia manto trajanus* and *Parnassius mnemosyne transsylvanica*; there were identified 71 species and subspecies considered very rare, rare or with sporadic occurrence in Romania fauna which majority are "xerothermophilous, thermophilic elements characteristic for the natural ecosystems from western, south-western and north-eastern Şureanu Mountain", these species "infiltrated in these regions because of the conditions of a favorable climate." A detailed presentation is made for 30 taxa, from nine families, which have a special importance for the scientific and biogeographical Romanian fauna including: the collected material, the biology of the species, their distribution in Romania fauna and in Şureanu Mountains. Also the author mentioned 6 **Lepidoptera** species, collected from the massif with a short description, these species are considered to be common in other regions of Romania, but in the sampled area they are rarer. There are listed 57 species with low population effective or with sporadic occurrence in the studied area.

Mrs. Burnaz study is completed thorough a detailed analysis in regard with the species ecology in Chapter 7, ***The ecology of the Macrolepidoptera species of Şureanu Mountains***. The approached aspects were: the phytocenologic characterization of natural ecosystems studied, the Macrolepidoptera species distribution in the natural ecosystems and their preferences for the habitats; the trophic supply of larvae analysis. The author selected 18 types of natural ecosystems, distributed at different altitudes, from the 14 representative stations which she analyzed. The chapter is completed by the analysis on the Macrolepidoptera species fidelity in the main natural ecosystems studied; the similarity degree of the investigated ecosystems in correlation with the Macrolepidoptera communities was estimated by using the ecological similarity Index Jaccard and the matrix of similarity; the ecological character of the Macrolepidoptera species was analyzed by taking into account "their requirements in accordance with the main environmental factors: temperature and humidity". A significant part of this chapter is allocated to several studied stations in which the author has made systematic samplings, here she analyzed the frequency and flight period of the Macrolepidoptera species captured, using light lamp traps, and listed 96 species sampled from Şureanu Mountains (subalpine area) in the

period 1995-1996 and 147 species sampled from Oaşa station in the period 1994-1995. The flight period of species is represented in a graphic form for: 7 species (mountain and subalpine) from the mountain area Oaşa (1280 meters), and for 8 species from the alpine-subalpine area of Şureanu Mountains (1750 meters). For 357 species from the Ponorici-Cioclovina station, the author revealed their frequency, flight period and the generation numbers per year in the period 1995-1996.

Chapter 8, ***The flight period, life cycle, frequency and the food supply of adult Macrolepidoptera diurnal species (S.ord Rhopalocera, Ord. Lepidoptera) sampled from Ponorici-Cioclovina station (1995-1999),*** presents aspects about the adult Macrolepidoptera species, sampled from this area, in regard with their flight period, frequency and food supply. There are given information for 91 adult species sampled.

Following the results gathered throughout the study, the author in Chapter 9, ***Macrolepidoptera species proposed for conservation in the natural habitats of Şureanu Mountains,*** was able to indicate and estimate "the current state of the Lepidoptera fauna from the Şureanu Mountains" and identified numerous species (76 species) that are listed and proposed for conservation and protection under the conventions and laws in Romania, and which have proposed them for preservation and protection also on the territory of Şureanu Mountains after the reasons mentioned for this area in the thesis.

The author conclusions compiled and presented at the end of her thesis prove her merits and implication along her important contribution for the Lepidoptera fauna researched in Şureanu Mountains area and for Romania fauna.

As it was mentioned at the beginning of this review, the author thesis is the result of many years of field studies and documentation. A great evidence of her documentation is the 730 reference titles, revealing once again the complexity of her research.

The thesis is concluded with a summary in English, making her research accessible to other specialists. 8 colour plates representing images of several Lepidoptera species sampled, prepared and displayed are an added part of her thesis.

The author work is a model of research with complex studies carried on and approached. Mrs. Silvia Burnaz, through her thesis makes a significant contribution to the knowledge of the Macrolpeiodptera fauna of Şureanu Mountains, which has been less studied, and her main contribution is the completion of new data related to Lepidoptera fauna from this area. The work can be distinguished by an accessible language, information treated in detail, a rich references list and a comprehensive work done along 14 years which deserves to be fully appreciated and known by many researchers

Frink József PÁL, *GRASSLANDS OF THE ARIEŞ RIVER VALLEY BETWEEN LUPŞA AND TURDA,*
Edited by Cluj-Napoca University Press, Cluj-Napoca, 2010, 224 pages,
25 figures, 32 colour plates, 28 tables.

Ghizela VONICA*

Emergence of scientific papers in any field of science it would be welcomed for scientists, because it can introduce new elements, viewed from another angle. The book of Dr. József Frink has the results of the research based on his PhD thesis, and it represents grassland of the Aries-River Valley characterized from a phytosociological point of view. In fact, this research is needed because treating pastures in terms of diversity conservation and promoting best practices for conservation and sustainable use.

Professor Vasile Cristea from Babes-Bolyai University of Cluj-Napoca prefaced the book, and he expressed his sympathy with appreciation that was an advisor to a "loving young plants".

The book "Grassland of the Aries-River Valley between Lupşa and Turda" is mingled in five chapters where introduction, bibliography and appendices are added.

The introduction shown some fundamental aspects of semi-natural grassland, it is shown ways to use them in the age of industrialized agriculture and is specified need to be studied the grasslands.

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The first chapter, "The Aries Valley physical-geographical description", the author introduces us in to the natural wonderland of the Aries Valley, describing the landforms, geology, hydrography, soils but also the climate of the research area. The second chapter, "General Characterization of Vegetation", the author reviewed the history of flora and vegetation studies in this area, beginning with Baumgarten (1816) and finishing with Hodisan (1966-1970) adding recorded floristic data from many scientists of the research area. The reader will find in this section an overview of meadows also, the author characterizing only the woody vegetation, saxicolous vegetation, ruderal and segetal vegetation.

"Syntaxonomy and eco-cenotic structure of grasslands" (chapter three) describes the methods applied to determine the grassland communities of the research area, how did award to different plant communities, but also plants communities epitome.

Based on his personal research grafted in documentary work, he described a total number of 18 grassland communities (associations), 4 sub-associations, 10 facies, were included in 3 vegetation classes, highlighting a wide diversity. In the same chapter are recorded 372 species of which 22 taxa are included in the National Red List and 2 taxa are included in Bern Convention.

I would like to draw your attention to chapter for, "The relationship between floristic composition of grassland and some ecological factors", where the author examines a new trend seen in such works. The direct and indirect multivariate analysis (ordinations) techniques used in this book have been less discussed on plant ecology from Romania than the other countries. These techniques were tried multivariate analysis of the relationship between species composition of the grassland communities and environmental variables. The method shows the variation in floristic structure from one to another phytocenosis depending on environmental factors variation.

The purpose of this paper is motivated by protective considerations of the last chapter "Suistenable management and biodiversity conservation of grassland" where highlighted the main methods of grassland management, requires maintaining biodiversity, making some practical recommendations for their conservation, sustainable development and usage of grasslands of EU interest.

Bibliography includes 174 titles of scientific articles and monographs most are acutely recent. The annex of the book included biological forms, elements of flora and ecological indicators UTR abbreviations used to describe the phytocenosis, Annex with acronyms of taxa names used in multivariate tests, annex with rare, endangered and endemic taxa list and also with associations epitome identified in the research area.

It may be noted that the graphics shape of this book, image quality and accuracy in presentation are remarkably proficient.

It can be say that this book completes the botanical data of Transylvania and it is addressed to students and specialists of botany and agriculture fields. We gladly recommend this new appearance in botanical literature from Romania, believing that the reader will here find a significant source of fun and informative notes with readability even for enthusiasts.

IN MEMORIAM

DR. DINU AUREL SEVER PARASCHIVESCU

Ioan TĂUŞAN*
Bogdan TOMOZEI**

Born on 6 September 1931 in Bucharest, Dinu Paraschivescu graduates the "Oituz" Theoretical High school from Bacău. After two years attending the Pedagogical Institute of Bucharest he returned to Bacău, where he taught for a while. He then, traveled to Bucharest, where he continued his university studies in Biology graduating in 1955. His first job was at the Academy Institute of Agronomic Research – Phytopathology Department, under the guidance of Academician Traian Săvulescu. After three years, he was transferred to the Taxonomy and Ecology Department under the supervision of Professor Mihai Ionescu and Academician Wilhelm Karl Knechtel. In 1965, Dinu Paraschivescu defended his PhD Thesis "Systematical, ecological and ethological research on some ant species from Romania". In 1967 he received the "Al. von Humbold" scholarship at the Würzburg Z.I. led by Karl Goswald. Here, Dinu Paraschivescu accomplished himself as a myrmecologist working alongside great researches like Arnoldi, Pisarski and Konigsmann. He was named member of honor of the German Zoological Society and of the Hygiene Forest Society of Bavaria. He was also a member of the International Union for the Study of Social Insects.

Besides myrmecology, D. Paraschivescu has also taken interest in wasps, compiling a list containing 49 Vespoidea species. He also had contribution in study of bumblebee species of Romania.

His research on myrmecology was focused both on theoretical and practical aspects.

D. Paraschivescu also invented two methods for experimental studies both in laboratory and field work. He compiled the first list of ant species from Romania that included 76 species. Since 1960 almost yearly, he published at least one article on regional faunas or ecological problems until the end of the 80's. Due to this hard work we have now data from all over Romania.

The relationship between homopterans and ants, the role of ants in transmitting the parasitic lancet fluke (*Dicrocoelium lanceolatum*) and the importance of ants in dealing with forest pests, were several subjects that aroused his interest. With great efforts he published more than 120 articles in Romania and Europe. Due to his sudden death in May 2001, he never got to finish one of his last scientific works: to compile a Romanian ants and wasps Fauna Volume.

His valuable contributions to the knowledge of the myrmecofauna of Romania are of great importance. We commemorate 10 years since he passed away by remembering the most important contributions to the scientific world.

We dedicate this humble tribute to his memory
May God rest his soul!

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