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MOLECULAR CONFIRMATION ON THE PRESENCE OF *ANADARA KAGOSHIMENSIS* (TOKUNAGA, 1906) (MOLLUSCA: BIVALVIA: ARCIDAE) IN THE BLACK SEA

ANA-MARIA KRAPAL, OANA PAULA POPA,
ALEXANDRA FLORINA LEVARDA, ELENA IULIA IORGU,
MARIETA COSTACHE, FABIO CROCETTA, LUIS OVIDIU POPA

Abstract. The use of DNA barcoding in alien invasions has recently proved to be a powerful tool in delineating dispersal pathways and clarifying doubtful identifications. Morphological similarities between *Anadara kagoshimensis* (Tokunaga, 1906) and *Anadara inaequalis* (Bruguière, 1789) require the use of genetic markers in identifying the ark shell species that has recently invaded the Black Sea. The high genetic similarity (99.8-100%) hereby found between COI sequences obtained from the Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to this taxon.

Résumé. L'utilisation des codes-barres ADN dans les invasions étrangères s'est récemment révélé être un outil puissant dans la délimitation des voies de dispersion et de clarifier des identifications douteuses. Les similitudes morphologiques entre *Anadara kagoshimensis* (Tokunaga, 1906) et *Anadara inaequalis* (Bruguière, 1789) exigent l'utilisation des marqueurs génétiques pour identifier l'espèce d'arcidé qui a récemment envahi la Mer Noire. La similarité génétique élevée (de 99,8 à 100%) trouvée entre les séquences COI obtenus à partir des échantillons de la Mer Noire et les japonais *A. kagoshimensis* confirme au niveau moléculaire que l'espèce bivalve de la Mer Noire roumaine fait partie de ce taxon.

Key words: *Scapharca*, alien species, Black Sea, Romanian coast, COI, DNA barcoding.

INTRODUCTION

Anadara kagoshimensis (Tokunaga, 1906) is a bivalve species, belonging to Arcidae Lamarck, 1809, family frequently consumed in Japan, where it was introduced in several coastal areas in order to increase local food production soon after the end of the World War II (Tanaka & Aranishi, 2014). In Europe, this ark clam species was recorded since the early '60s in Ravenna area (Adriatic Sea), where it was thought to be introduced from the Indo-Pacific region with ballast water (Crocetta, 2012). It was initially identified as *Scapharca* (cf.) *cornea* (Reeve, 1844) (Ghisotti, 1973), although, only few years later, it was re-identified as belonging to *Scapharca inaequalis* (Bruguière, 1789) (Ghisotti & Rinaldi, 1976). This taxon was also recorded two decades later from the Black Sea (Gomoiu, 1984). Lutaenko (2006) first noticed morphological differences between *A. inaequalis* specimens from India and Philippines and those from the Black and Adriatic Seas, concluding that European specimens were, most likely, not *A. inaequalis*. Finally, Huber (2010) suggested that the “*S. inaequalis*” invading Europe was in reality *A. kagoshimensis* from Japan.

As a matter of fact, diagnostic characters differentiating *Anadara* nominal species are weak, and indeed *A. kagoshimensis* exhibits high similarities with *A. inaequalis*. Moreover, the native distributions of the two species partially overlap, with the former widespread in the South China Sea, Yellow Sea and Sea of Japan, whilst the latter living in the Indo-Pacific Ocean (India and Philippines), with the

exception of the Red Sea (Huber, 2010). Due to these similarities, a molecular confirmation of the correct identity of the anadardid species found in Europe should be mandatory.

MATERIAL AND METHODS

Twelve specimens from two different Black Sea sampling sites (Romania: Năvodari - 43°48'33.5" N, 28°35'13.8" E; Grindul Chituc - 44°10'43.1" N, 28°39'35" E) were sequenced for the COI (cytochrome oxidase subunit I) marker. Samples were collected by hand in shallow sandy bottoms and kept in 96% ethanol. Total genomic DNA was isolated from mantle muscle tissue, using Macherey-Nagel NucleoSpin® Tissue kit, according to producer's specifications. Partial COI sequence was amplified in a PCR reaction using the COI-4 primer pair (Tanaka and Aranishi, 2013). The PCR reaction was carried out in 30 µl final reaction volume containing 100 ng DNA template, 10 mM Tris-HCl (pH 8.8 at 25°C), 50 mM KCl, 0.08% (v/v) Nonidet P40, 2 mM MgCl₂, 0.2 mM of each dNTP, 0.1 µM of each primer, 1 U of Taq DNA polymerase 5U/µL (Fermentas UAB, Vilnius, Lithuania) and water up to final volume. The temperature profile of the polymerase chain reaction for the COI marker consisted of initial denaturation at 95°C for 2min, followed by 35 cycles at 94°C for 30s, 50°C for 1min, 72°C for 1min, with a final extension step of 5 min at 72°C. The amplified fragments were visualized on a 1.5% agarose gel stained with ethidium bromide, and then purified using innuPREP DOUBLEpure Kit (Analytik Jena AG, Jena, Germany). Single strand sequencing was performed on a Li-Cor 4300L platform using IRD700-labeled M13 primer HCO2198 and DNA Cycle Sequencing Kit (Jena Bioscience GmbH, Jena, Germany). The obtained sequences were aligned using CodonCode Aligner 3.7.1 (CodonCode Corporation, Dedham, MA, USA), manually edited and then used as a query to the CoreNucleotide collection of GenBank database (<http://www.ncbi.nlm.nih.gov/nucleotide/>).

RESULTS AND DISCUSSIONS

To date, with the sole exception of *Anadara transversa* (Say, 1822) (Albano et al., 2009), no genetic analysis have ever been performed on European *Anadara* species, and only morphology has been used to address the *A. cornealinaequivalvis/kagoshimensis* taxonomic question. Huber (2010) most recent suggestion, despite widely accepted, was exclusively based on shell characters (shape, ligament, inequivalvity, number of ribs, rib sculpture) and color. Ten COI sequences (4 from Năvodari and 6 from Grindul Chituc) were finally obtained from our samples, all exhibiting the same haplotype (GenBank Accession Numbers: KM267562 and KM267563). This was used for querying the CoreNucleotide collection of GenBank database, returning a species match with *Anadara kagoshimensis* at similarity levels between 100% and 99.84% (9 matches).

The COI molecular marker is a highly conserved region of the mitochondrial genome, frequently used in discriminating closely related species and uniformly chosen as the best DNA barcode (Hebert et al., 2003 a; Hebert et al., 2003 b). The high genetic similarity hereby found between COI sequences obtained from Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to *Anadara kagoshimensis* (Tokunaga, 1906).

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CONFIRMAREA MOLECULARĂ A PREZENȚEI SPECIEI *ANADARA KAGOSHIMENSIS* (TOKUNAGA, 1906) (MOLLUSCA: BIVALVIA: ARCIDAE) ÎN MAREA NEAGRĂ

REZUMAT

Utilizarea tehnicii ADN barcoding în studiul speciilor invazive s-a dovedit a fi un instrument puternic în delimitarea diferitelor căi de introducere și clarificare a unor determinări incerte. Similaritățile morfologice dintre *Anadara kagoshimensis* (Tokunaga, 1906) și *Anadara inaequalis* (Bruguière, 1789) impun utilizarea markerilor genetici în identificarea taxonomică a speciei care a invadat recent Marea Neagră. Similaritatea foarte înaltă identificată între secvențele de COI obținute de la probele din Marea Neagră și cele existente pentru *A. kagoshimensis* din Japonia, confirmă, la nivel molecular, că specia care a invadat sectorul românesc al Mării Negre aparține acestui taxon.

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**TWO NEW SPECIES OF THE GENUS *Calozodion* GARDINER
(CRUSTACEA: TANAIDACEA: APSEUDOMORPHA)
FROM THE ADRIATIC SEA AND THE INDIAN OCEAN,
AND THE RECLASSIFICATION OF *C. DOLLFUSI* GUȚU, 1989
IN THE GENUS *JULMARICHARDIA* GUȚU**

MODEST GUȚU

Abstract. Two new species, *Calozodion bogoescui* (from the southeast coast of Italy) and *C. tanzaniense* (from Tanzania waters), are described and illustrated. *C. bogoescui* n. sp. represents the first record of the genus *Calozodion* Gardiner, 1973 in the Mediterranean Basin. The main morphological features by which *C. bogoescui* differs from all others of the genus consist in the small number of uropodal endopod articles (only seven, compared to 13-16) combined with the short chelipedal merus (in contrast with the carpus length). *C. tanzaniense* n. sp. is characterized by the following combination of morphological features: (1) antennule first peduncular article with three spiniform apophyses on outer side, (2) antenna with nine articles, (3) pereopod II basis with long plumose setae only on dorsal margin, (4) pereopods III and IV basis with a midventral spiniform apophysis, and (5) pereopod VII merus with five long plumose setae on dorsal side. Also, some comments are made on morphological features belonging to the males of *C. dominiki* Bochert, 2012 and to the status of species *C. dollfusi* Guțu, 1989 (= *Julmarichardia dollfusi*, comb. nov.). An identification key of the currently recognized species of the genus *Calozodion* is presented.

Résumé. On décrit et illustre deux nouvelles espèces, *Calozodion bogoescui* (de la côte sud-est de l'Italie) et *C. tanzaniense* (dans les eaux de la Tanzanie). *C. bogoescui* n. sp. représente le premier mention du genre *Calozodion* Gardiner, 1973 dans le bassin méditerranéen. Les principales caractéristiques morphologiques avec lesquelles *C. bogoescui* diffère de tous les autres espèces du genre consistent dans le petit nombre d'articles de d'endopode uropodale (seulement sept, comparativement à 13-16) combiné avec le merus chelipedal court (en contraste avec la longueur de la carpe). *C. tanzaniense* n. sp. est caractérisé par la combinaison suivante de caractéristiques morphologiques: 1) premier article pédonculaire de l'antennule avec trois apophyses spiniformes sur le côté externe, (2) antenne avec neuf articles, (3) base du péréiopode II avec longues soies plumées seulement sur la marge dorsale, (4) base des péréiopodes III et IV avec une apophyse spiniforme médio ventrale, et (5) merus du péréiopode VII avec cinq longues soies plumées sur la face dorsale. En outre, certains commentaires sont faits sur les caractéristiques morphologiques appartenant aux mâles de *C. dominiki* Bochert 2012 et le statut d'espèces *C. dollfusi* Guțu, 1989 (= *Julmarichardia dollfusi*, comb. nov.). On présente une clé d'identification des espèces actuellement reconnues du genre *Calozodion*.

Key words: Tanaidacea, Apseudomorpha, *Calozodion*, *Julmarichardia*, Adriatic Sea, Indian Ocean.

In the tanaidacean material which remained unstudied by the late Prof. Mihai Băcescu, I have discovered two females of the genus *Calozodion* Gardiner, 1973, each representing an unknown species. One of these which came from the Adriatic Sea (south-east Italy), was collected by the research vessel “Calypso”, during the campaign of the French oceanographer Jaques-Yves Cousteau in his research on pollution of the Mediterranean Basin in 1977. The second species was collected from West Indian Ocean by the members of the expedition initiated and led by Mihai Băcescu, along the coasts of Tanzania, during in 1973.

If for the Mediterranean Basin it is the first report of the genus *Calozodion*, the species from the eastern coast of Africa was reported for the first time (Guțu, 2006: 209) as *Calozodion* cf. *wadei* Gardiner, 1973.

The descriptions of these two new species and discussion of the status of *Calozodion dollfusi* Guțu, 1989 (which was re-classified in the genus *Julmarichardia* Guțu, 1989) and on several morphological particularities of the males of *Calozodion dominiki* Bochert, 2012 are presented herein. With this contribution, the number of the species classified in the genus *Calozodion*, increases to eleven, as can be seen in the identification key.

Family Metapseudidae Lang, 1972
Subfamily Chondropodinae Guțu, 2008
Genus *Calozodion* Gardiner, 1973

***Calozodion bogoescai* n. sp.**
(Figs 1-3)

Material: one female with oostegites, Adriatic Sea, Southeast of Italy, adjacent to the town of Bari, collected in shallow waters by the “Calypso” Expedition, 1977 (without other data).

Holotype, female with oostegites (dissected), preserved in the Collections of the „Grigore Antipa” National Museum of Natural History, Bucharest, No 250015.

Etymology. The specie was named in memory of Prof. Dr. Constantin Bogoescu, from the Biological Faculty of Bucharest.

Description of the female

Body (Fig. 1 A) dorsoventrally flattened, six times as long as wide; standard length, 2.85 mm.

Carapace 1.2 times as long as broad. Rostrum short, rounded, with a small median denticular prominence and some tubercles on its sides. Ocular lobes well defined; eyes pigmented.

Pereon 2.8 times as long as carapace. First pereonite shortest, rounded laterally, 2.6 times as wide as long. Second pereonite a little shorter than each of following three pereonites, but as long as the last pereonite. Third pereonite slightly shorter than the fourth pereonite. Fifth pereonite shorter than the fourth pereonite. Pereonites 3-6 narrower anteriorly, with a small tubercle on half anterior sides and two-three short setulated setae.

Pleon 1.5 times as long as carapace, decreasing in width from the first pleon to pleotelson. Each pleonite short. Pleotelson, as long as last two pleonites together, pointed terminally and with one rounded conspicuous prominence on lateral margins. Pleonites and pleotelson with some setulated short setae on lateral margins.

Antennule (Fig. 1 B) about as long as carapace and first two pereonites combined. First peduncular article four times as long as wide, with some setae and two spiniform apophyses on each side. Second article, narrower than the first article, twice as long as wide, with several unequal broom and simple setae. Third article narrower and shorter than the second. Common article of flagella slightly longer than the first article of outer flagellum. Inner flagellum, as long as first three articles of outer flagellum, with two thin but long articles; terminally with three long simple setae. Outer flagellum with seven short articles, some of them having one to four unequal setae; fourth and sixth articles with an aesthetasc.

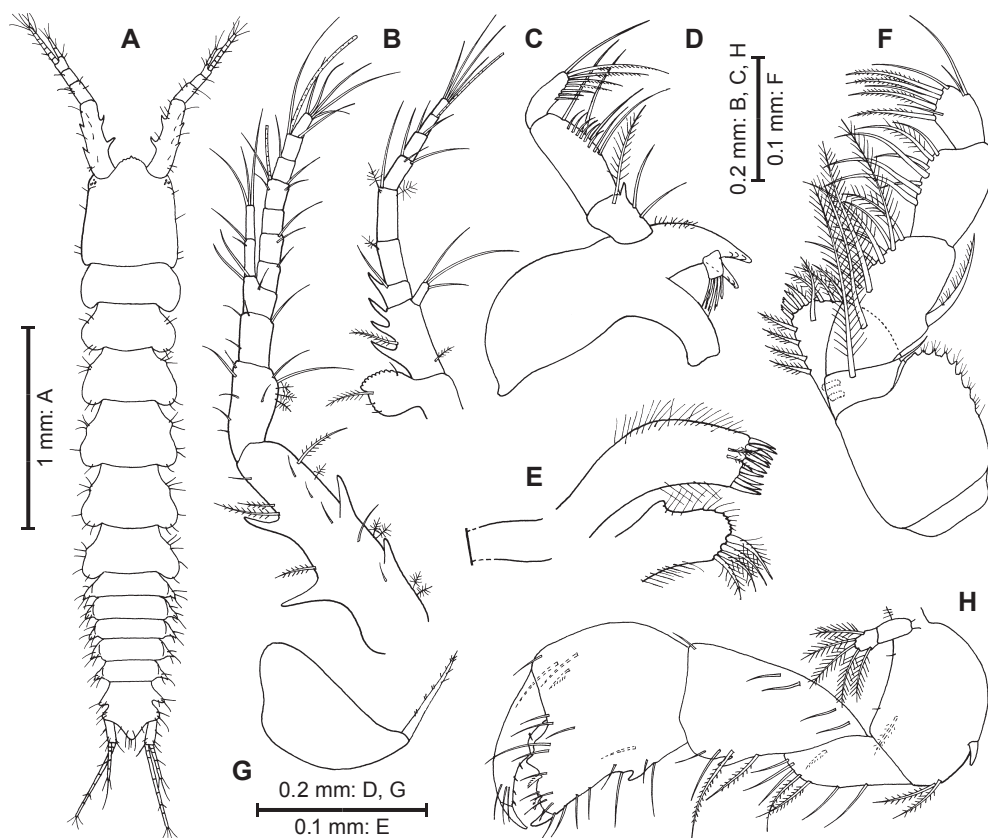


Fig. 1 - *Calozodion bogoeskui* n. sp., female, holotype: A, body, dorsal; B, antennule, right; C, antenna, right; D, mandible, left; E, maxillule, palp unshown; F, maxilliped, right; G, epignath; H, cheliped, left.

Antenna (Fig. 1 C) of nine articles; first article with a large rounded inner expansion having a long setulated seta; second article twice as long as wide, with three (or four?) long denticles and a setulated seta on the outer side; squama small, with three simple setae; third article shorter than squama, with a spiniform apophysis and a simple seta, distoinnerly; fourth article twice as long as third article, about twice as long as wide; fifth article slightly longer than preceding article, with two broom and one long simple setae, distally. Last four articles as long as previous three articles together; sixth, seventh and ninth articles with two-three simple setae; penultimate article with one simple seta and a long aesthetasc.

Epistome well developed, acute.

Mandibles (Fig. 1 D) with well developed pars molaris. Pars incisiva and lacinia mobilis of the left mandible with four and three teeth, respectively. Setiferous lobe with five long furcate setae. Palp three-articled; first article short, with one distoinner denticle and three setae; second article approximately 1.8 times as long as first article, with four long simple and about seven short ciliate setae; third article as long as first article but narrower, with eight unequal setae on distal half of inner margin and terminally. Right mandible with four-denticled pars incisiva.

Labium as in other species of genus. Terminal lobe triangular, with numerous long setulae on sides and one long setiform spine in top.

Maxillule (Fig. 1 E) with two-articled palp; number of terminal setae unknown (broken at time of dissection). Inner endite with four distal setulated setae and long setulae on both sides. Outer endite with numerous setulae on sides, two subterminal setulated setae and ten distal stout spines.

Maxilla unstudied.

Maxilliped (Fig. 1 F) as in other species of genus. Coxa short. Basis a little longer than wide, with some conspicuous denticles and numerous setulae on distoexternal corner. Palp four-articled; first article short, with one very long circumplumose seta on distoinner corner and other one distoexternal, simple and short; second article 1.8 times as long as wide, with five circumplumose setae (three very long) and five simple, short, on the inner margin, and one very long midouter ciliate spine; third article about 0.65 times as long as previous article and 1.4 times as long as wide with one long circumplumose and six simple setae (three relatively short) on inner margin; fourth article of palp with nine long simple and ciliate setae. Endite well developed, with about nine different setae on rostral side, four plumose setae on inner margin, and two blunt couplers; distoinner seta well developed, plumose.

Epignath (Fig. 1 G) cup-shaped, with a long spinulate spine, as illustrated.

Cheliped (Fig. 1 H) well developed. Exopod present, with five long plumose setae. Basis stout, 1.5 times as long as wide, with a median robust spine and two distal circumplumose setae on ventral margin; distally, on inner face, also with a circumplumose seta. Merus rounded distoventrally, much smaller than carpus, having seven long setae on ventral margin. Carpus enlarged distally, 1.6 times as long as maximum width; ventrally with one denticle and four setae, and dorsally with five setae. Propodus large, as long as wide (excluding fixed finger); proximoventrally with one denticle and some simple setae, and three setae near dactylus joint; fixed finger short and thick with a large dentiform expansion on midinner margin and some short setae; claw stout. Dactylus, much thinner than fixed finger, curved, with a small median apophysis and five spinules on inner margin; distolaterally with three simple setae; claw well developed, slightly longer than that of fixed finger.

Pereopod II (Fig. 2 A) thick and strong. Exopodite present, with five long plumose setae. Coxa small, with several short circumplumose setae. Basis thick, two times as long as broad, with one long and one short proximodorsal spiniform apophyses, and a row of seven long plumose setae, dorsally; distoventrally with a seta and one spine. Ischium very short, with two ventral setae. Merus, wider distally, much longer than carpus; distodorsally with one long spine and one long seta; ventrally with around of nine unequal setae and one distal robust spine. Carpus short and thick; dorsally with nine setae and one distal robust spine but ventrally with four setae and one distal stout spine, as figured. Propodus narrower but longer than carpus, 1.8 times as long as wide, with two short and three long simple setae, and one stout spine on dorsal side and four simple setae and three spines on ventral margin; distally with a ciliate seta, near dactylus joint. Dactylus stout, slightly shorter than carpus, curved, with one dorsal seta and one ventral spine; unguis shorter than last ventral spine of propodus.

Pereopod III (Fig. 2 B) slender. Coxa short, with several circumplumose short setae. Basis three times as long as wide, with five ventral and four dorsal small setae; proximodorsally with a curved spiniform apophysis. Ischium with two ventral setae. Merus, about twice as long as ischium, with two distoventral spines,

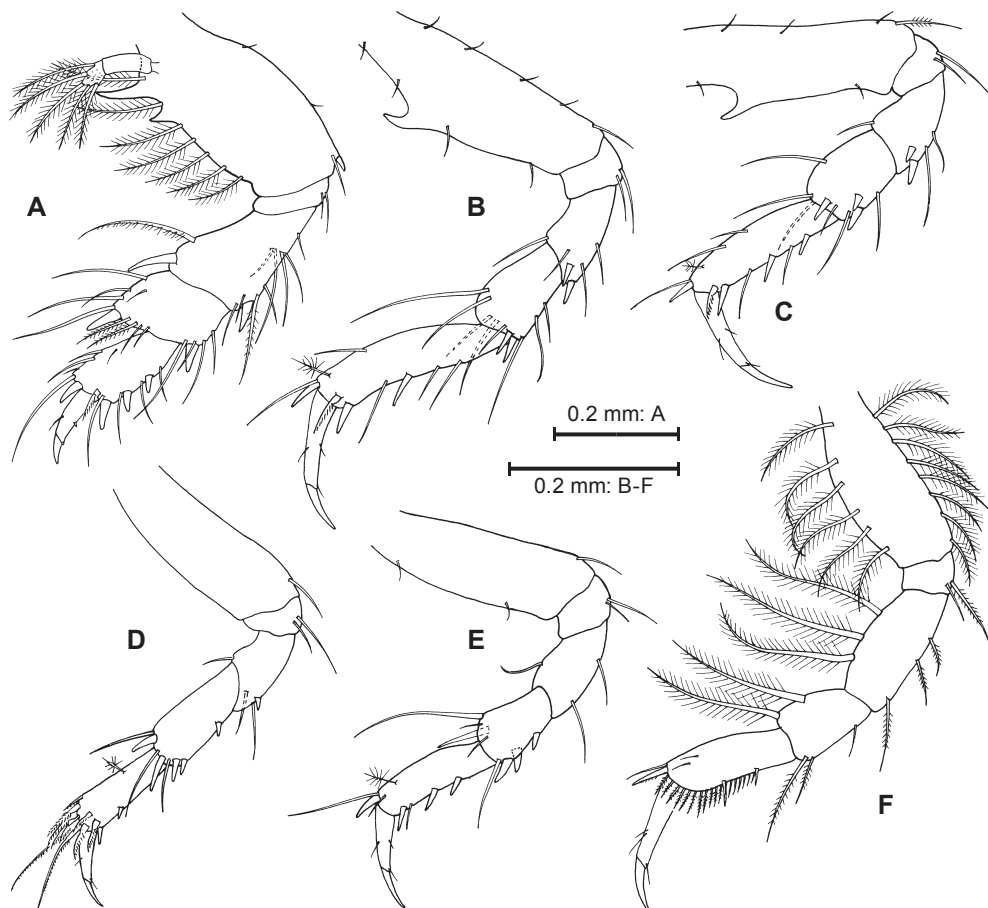


Fig. 2 - *Calozodion bogoeskui* n. sp., female, holotype: A-F, pereopods II-VII, respectively.

one distodorsal, two ventral and one distal setae. Carpus, slightly longer than merus, with eight setae and two spines, as illustrated. Propodus slender, curved ventrally, about as long as merus and carpus together, with two stout spines and three setae on ventral margin and one distal spine and three setae on dorsal side; distally, near dactylus joint with a ciliate seta. Dactylus long and thin, curved, with two ventral and one dorsal short setae; unguis well developed, acute.

Pereopod IV (Fig. 2 C) similar to pereopod III, excepting some features of carpus and propodus; carpus with six setae and three spines and propodus with two setae and three spines on ventral, tergal and distal margins, as figured.

Pereopod V (Fig. 2 D, 3A) as long as pereopod IV. Basis three times as long as wide, with a distoventral seta. Ischium with two setae. Merus one third as basis length, with one spine and two setae, distoventrally, and a distotergal seta. Carpus, 1.8 times as long as merus; midventrally with a small spine and distally with four unequal spines and three setae. Propodus as long as carpus, with two ventral spines; distally with ten setae, eight of them short and ciliate and other two very long, as illustrated. Dactylus similar to that of pereopod III or IV, but smaller.

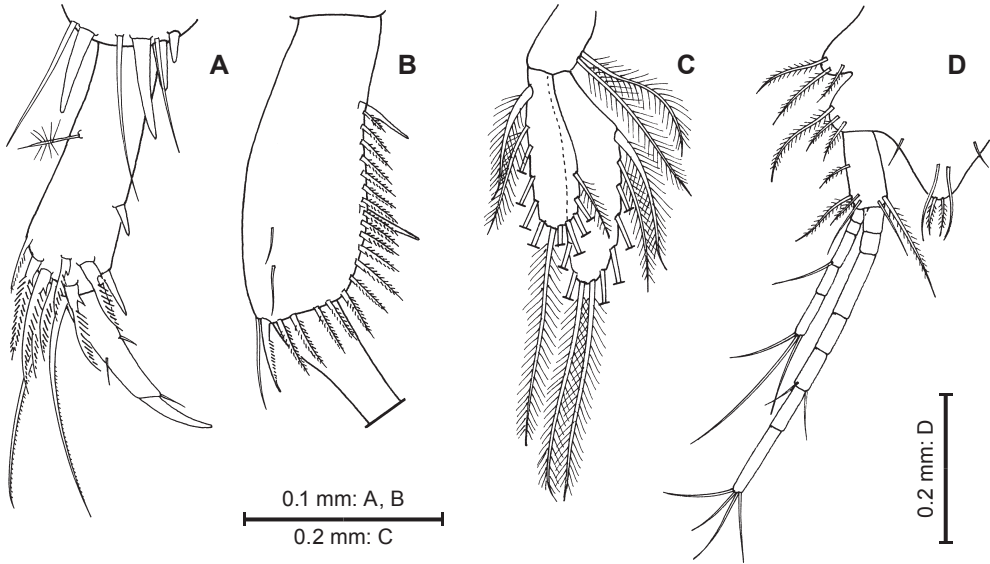


Fig. 3 - *Calozodion bogoescui* n. sp., female, holotype: A, pereopod V propodus and dactylus; B, pereopod VII propodus; C, pleopod; D, pleotelson, left half, and corresponding uropod.

Pereopod VI (Figs 2 E) relatively similar to pereopod III or IV. Basis without ventral spiniform process. Merus with three setae. Carpus, as long as merus, with three spine and one seta, ventrally, and two short and one very long seta and one spine, distodorsally. Propodus, 1.3 times as long as carpus; ventrally with three spines and one small seta and distodorsally with one broom and two simple setae (one of them very long) and one spine. Dactylus as in previous pereopods.

Pereopod VII (Figs 2 F, 3 B) slightly stonger than pereopods III-VI. Basis 2.5 times as long as wide, with six and eight long plumose setae, dorsally and ventrally, respectively. Ischium with two setae. Merus, 2.1 times as long as wide, with three very long and three short plumose setae, dorsally and ventrally, respectively. Carpus much shorter than merus, with two long plumose setae on dorsal margin and three short but unequal, on ventral side. Propodus, as long as merus, with a row of 18 short ciliate setae, three spines and one short seta, as figured. Dactylus as in pereopods III-VI.

Pleopods (Fig. 3 C) well developed, biramous, in five pairs. Basal article 1.5 times as long as wide, with two long plumose setae on the outer side. Endopod twice as long as basal article, but shorter than exopod, with twelve plumose setae of various lengths. Exopod with ten plumose setae.

Uropod (Fig. 3 D) biramous. Basal article stout, with six setae. Exopod as long as pleotelson length, four-articled, with one and three setae on second and last articles, respectively. Endopod 2.2 times as long as exopod, with seven articles; fifth and seventh articles with two and four simple setae, respectively.

Remarks. *Calozodion bogoescui* n. sp. is distinguished from other species of the genus by the combination of two features: chelipedal merus much smaller than the carpus (Fig. 1 H) and the uropodal endopod with only seven articles (Fig. 3 D). *C. bogoescui* resembles *C. suluk* by its distinctively short uropod (Bamber &

Shader, 2005, fig. 5 f) and with the two species belonging to genus *Vestigiramus* Guțu, 2009 (Guțu, 1996, 2009), a genus related to *Calozodion*.

***Calozodion tanzaniense* n. sp.**

(Figs 4, 5)

Calozodion cf. *wadei* Guțu, 2006: 209

Material: one female with oostegites, Western Indian Ocean, Mbudya Island (coast of Tanzania), collected in shallow waters; December 1973; Leg. Romanian Expedition leading by Prof. Mihai Băcescu.

Holotype, female with oostegites (dissected), preserved in the Collections of the „Grigore Antipa” National Museum of Natural History, Bucharest, No 250016.

Etymology. After the collected place.

Description of the female

Body (Fig. 4 A) dorsoventrally flattened, five times as long as maximum width; length, 2.75 mm.

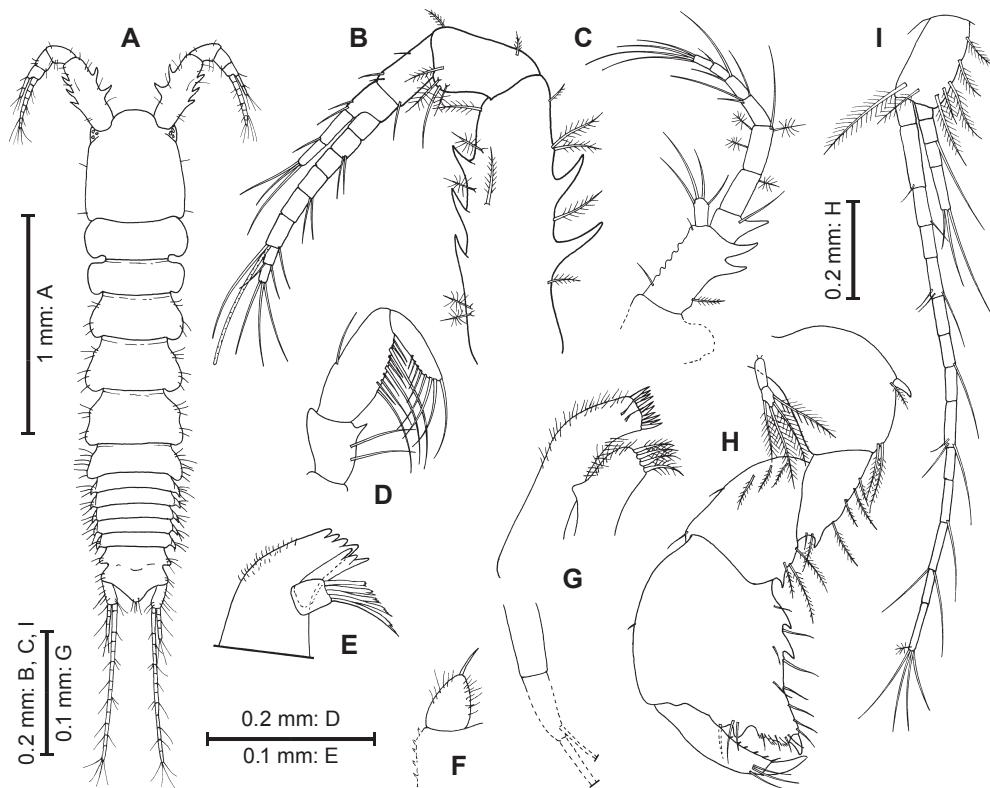


Fig. 4 - *Calozodion tanzaniense* n. sp., female, holotype: A, body, dorsal; B, antennule; C, antenna; D, mandible palp; E, pars incisiva, lacinia mobilis and setiferous lobe of left mandible; F, labium terminal lobe (schematic); G, maxillule; H, cheliped, left; I, uropod, right.

Carapace, 1.1 times as long as broad, with two short setae on each side. Rostrum short, rounded and smooth anteriorly. Ocular lobes well defined; visual elements pigmented.

Pereon about 2.4 times as long as wide and 2.1 times as long as carapace length. First pereonite rounded laterally, 2.7 times as wide as long. Second pereonite slightly shorter than the first pereonite. Third, fourth and fifth pereonites narrower anteriorly, approximately equal, each being a little longer than first pereonite. Sixth pereonite shortest. Each pereonite with a few short setae on lateral margins.

Pleon, about 1.2 times as long as carapace, decreasing in width from the first pleon to pleotelson; laterally with short circumplumose setae. Each pleonite very short, all together as long as last two pereonites. Pleotelson, approximately as long as last three pleonites together, pointed terminally and with one rounded conspicuous prominence on lateral margins.

Antennule (Fig. 4 B) as long as carapace and first two pereonites together. First peduncular article stout, 3.3 times as long as median width, with three spiniform apophyses and some broom and two circumplumose setae on outer side; inner margin with two spiniform apophyses (larger than the same of outer margin) and four circumplumose setae. Second peduncular article, about one third as long as first article and 1.5 times as long as wide, with two and several broom and circumplumose setae on inner margin and distoexternal corner, respectively. Third article shorter and narrower than second article, with one distoextern simple seta and other three on inner margin. Fourth article short. Outer flagellum, one half as long as first three peduncular articles combined, with eight short articles; second, fourth, sixth and seventh articles with two and eight one with three simple setae; sixth article with one very long aesthetasc. Inner flagellum, a little longer than first three articles of outer flagellum with one and three simple setae on first and second articles, respectively.

Antenna (Fig. 4 C) nine-articled, as long as first two peduncular articles of antennule. First article short, with a large inner rounded expansion. Second article twice as long as wide with two proximal setae, several tubercles on outer side and two spiniform apophyses on distoinner margin; squama small, with four setae. Third article very short with one seta and one spiniform apophysis on inner corner. Fourth article 1.5 times as long as third article but narrower, with one distoinner broom seta. Fifth article as long as fourth article, with one distoinner long simple and several broom setae. Each of following four articles thin and short, with one to four simple setae, as illustrated.

Epistome well developed, acute.

Mandibles (Fig. 4 D, E) with pars incisiva four-denticulated. Lacinia mobilis of left mandible with three denticles. Setiferous lobe with five furcate setae. Pars molaris without special features. Palp three-articled; first article one half as long as second article, with two simple setae and one dentiform process on distoinner side; second article 2.5 times as long as wide, with one simple seta on outer side, and four long and seven short setae on inner margin; third article 1.3 times as long as first article but narrower, with eight unequal setae.

Labium (Fig. 4 F) as in other species of the genus. Terminal lobe triangular, with a long setiform spine in top and numerous long setulae on inner margin.

Maxillule (Fig. 4 G) with two-articled palp, second article having two simple setae, one of them very long. Outer endite with many long setulae on sides and ten distal stout denticles. Inner endite with long setae on outer margin and four terminal setulated setae.

Maxilla without special features.

Maxilliped and *epignath* similar to those of the previously described species.

Cheliped (Fig. 4 H) with exopod having four long plumose setae on last article. Basis large, 1.3 times as long as broad; ventrally with one robust spine and a short seta, and distroventrally with three unequal circumplumose setae. Merus, relatively triangular, with ventral free margin longer than that of carpus, having a distovetral spiniform apophysis and five circumplumose setae. Carpus broad, as wide as median length; ventrally with a spiniform apophysis and three circumplumose setae, and dorsally with three circumplumose and two simple setae. Propodus palm as long as wide; proximoventrally with two spiniform apophyses and several simple setae; fixed finger short, much wider proximally, with several setae on outer and inner sides; also, the inner side with a rounded proximal apophysis; claw stout. Dactylus

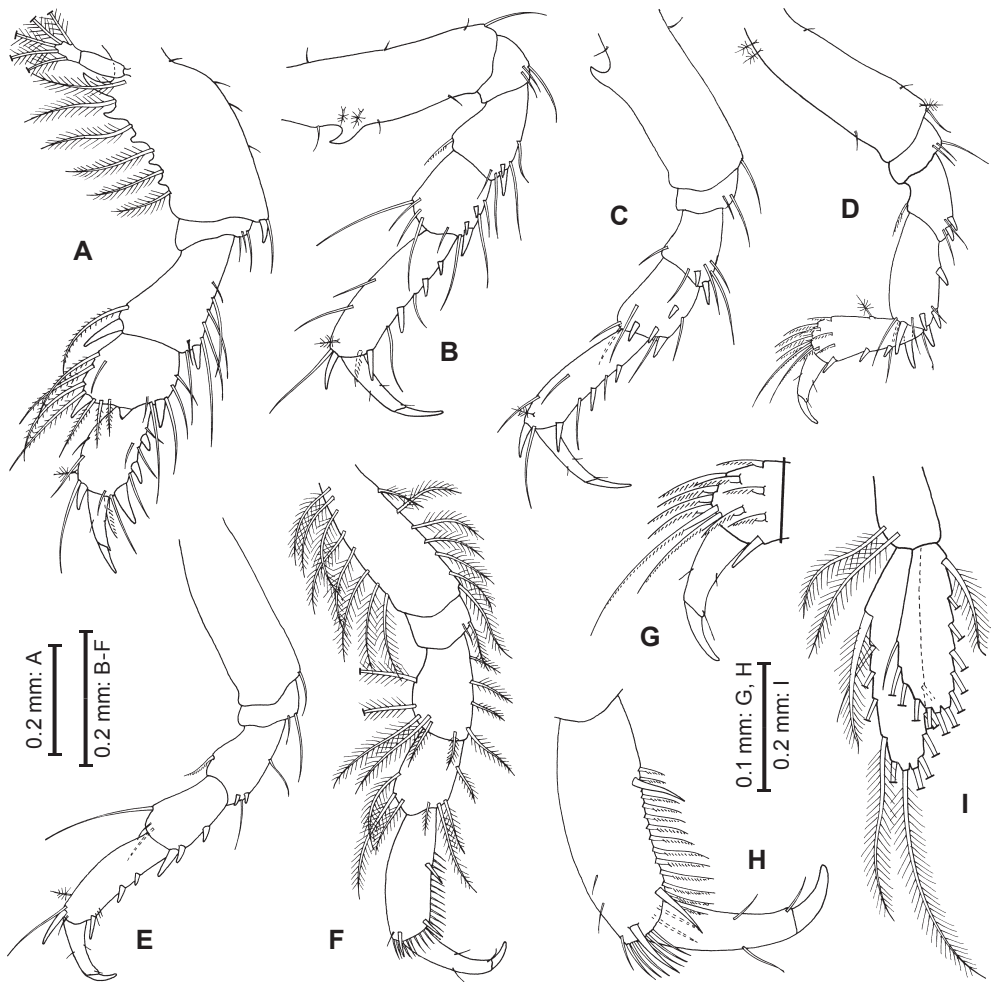


Fig. 5 - *Calozodion tanzaniense* n. sp., female, holotype: A-F, pereopods II-VII, respectively; G, distal part of pereopod V propodus and dactylus; H, pereopod VII propodus and dactylus; I, pleopod.

curved, thin, approximately four times as long as median width, with six spinules on inner margin and three distal setae; claw curved, longer than that of fixed finger.

Pereopod II (Fig. 5 A) larger than following pereopods. Exopodite present, with five plumose setae on last article. Coxa small, rounded distally, bearing several short circumplumose setae. Basis thick, 2.2 times as long as wide; dorsally with six long plumose setae and five spiniform apophyses; ventrally with four short simple setae and distoventrally with one spine and one simple seta. Ischium very short with three setae. Merus wider distally, twice as long as median width, with seven setae and one stout spine on ventral margin and one spine and one circumplumose seta on distodorsal corner. Carpus much shorter than merus and slightly wider than long, with three spines and 13 setae, as illustrated. Propodus 1.3 times as long as carpus but narrower, with three stout spines, one ciliate and six simple setae on ventral margin; dorsally with one broom and three simple setae, and one robust spine. Dactylus curved, about twice shorter than propodus, with one dorsal seta and two ventral spinules; unguis as long as distodorsal spine of propodus.

Pereopod III (Fig. 5 B) much thinner than pereopod II, with a small coxa, bearing several short circumplumose setae. Basis three times as long as wide, with a curved proximodorsal spiniform apophysis and several short setae on both margins. Ischium with three setae. Merus 2.5 times shorter than basis, with five setae and two spines. Carpus about as long as merus with four distodorsal setae; ventrally with three spines and four setae. Propodus slender, curved ventrally, about as long as merus and carpus combined, with four stout spines, two simple and one ciliate setae on ventral margin; distodorsally with one broom and three simple setae, and a robust spine. Dactylus long, slightly curved, with two ventral and one dorsal setulae; unguis curved, acute.

Pereopod IV (Fig. 5 C) relatively similar to previous pereopod. Carpus with five setae and four spines. Propodus with three spines and two setae, ventrally, and one spine and four setae on dorsal margin.

Pereopod V (Fig. 5 D, G) basis 3.5 times as long as wide, with several broom and simple setae. Ischium with three setae. Merus short, one third as long as basis; distoventrally with two spines and two setae, and distotergally with a ciliate seta. Carpus, 1.8 times as long as median length of merus, with four spines and five setae. Propodus as long as carpus, with three ventral spines; dorsally with a broom seta and distodorsally with two long and nine short ciliate setae. Dactylus similar to that of pereopods III or IV.

Pereopod VI (Fig. 5 E) relatively similar to pereopods III or IV, as illustrated.

Pereopod VII (Fig. 5 F, H) not stronger than pereopod VI. Basis with eight and seven long plumose setae on dorsal and ventral margins, respectively. Ischium with two setae. Merus, 1.5 times as long as wide, with five dorsal and five ventral long plumose setae. Carpus about as long as merus, with three and four plumose setae, dorsally and ventrally, respectively. Propodus 1.5 times as long as carpus, with a row of about 24 short ciliate setae and three spines, as figured. Dactylus as in other pereopods.

Pleopods (Fig. 5 I) biramous, in five pairs. Basal article with two long plumose setae on the outer side. Endopod ovate, three times as long as broad, with 13 plumose setae of various lengths, around. Exopod, about 1.3 times as long as endopod and 4.4 times as long as wide, with 12 plumose setae.

Uropod (Fig. 4 I) biramous. Basal article stout, with eight circumplumose setae, as illustrated. Exopod four-articled, about as long as first three articles of endopod, with one and three setae on second and last articles, respectively. Endopod

slightly longer than last pereonite and pleon combined, with 14 articles; several articles with one to three setae; last article with one broom and four simple setae.

Remarks. *Calozodion tanzaniense* n. sp. belongs to a group of species (i. e., *C. bogoescui* n. sp., *C. dominiki* Bochert, 2012, *C. moyas* Menioui, 2013, *C. simile* Guțu, 2006 and *C. wadei* Gardiner, 1973) characterized by a mediodorsal spiniform apophysis on the basis of the pereopods III and IV. The differences between *C. tanzaniense* and these other five species are: (1) antennule first peduncular article with three spiniform apophyses on outer margin (other species have at most two apophyses; only *C. simile* in rare cases has three), (2) antenna with nine articles (ten in *C. simile*), (3) squama with four setae (three in *C. bogoescui* n. sp., *C. dominiki* and *C. wadei*), (4) pereopod VII merus with five long plumose setae on dorsal side (at most four setae in other species), and (5) uropod endopod with 13-16 articles (only seven articles in *C. bogoescui* n. sp. but relatively similar in other species).

Some remarks on Calozodion dollfusi Guțu, 1989 and *C. dominiki* Bochert, 2012

After a detailed analysis of the characteristic morphological features of the type species, *C. wadei* Gardiner, 1973, as well as other species within the genus *Calozodion* (based on the descriptions from literature: Bamber & Sheader, 2005; Bochert, 2012; Gardiner, 1973; Guțu, 1984, 1989a, 1996, 2002, 2006; Menioui, 2013), my attention was drawn by some specific particularities of the species *C. dollfusi* Guțu, 1989 and *C. dominiki* Bochert, 2012.

Thus, the main differences among the species of the genus *Calozodion* and that of *C. dollfusi*, which was described from a single manca (Guțu, 1989 a: 129), consist of (1) terminal lobe of labium with a single spiniform seta in top (three in *C. dollfusi*), (2) maxillule endite with four distal setae (five in *C. dollfusi*), (3) first article of maxillipedal palp with one very long distal inner plumose seta (absent in *C. dollfusi*), (4) second article of maxillipedal palp with one long spiniform seta on midouter side (two distally in *C. dollfusi*), (5) pereopod II carpus (or pereopod 1 as used by other specialists) with a single ventral spine (two in *C. dollfusi*) and (6) pereopod II propodus with a single distodorsal spine (two in *C. dollfusi*).

By the morphological features mentioned above (notably 1, 2, 5 and 6), the species *C. dollfusi* resembles those of the genus *Julmarichardia* Guțu, 1989 (Bamber & Sheader, 2005; Guțu, 1989 b; Ritger & Heard, 2007). Although these features might be considered unimportant for systematics by some specialists, their constant difference in the species of *Calozodion* and *Julmarichardia* is an undeniable fact. Moreover, in this situation it would have been enough to analyse only the terminal lobe of the labium, whose configuration is almost identical in the genera correctly defined (Guțu, 2006: 35). In conclusion *C. dollfusi* is here transferred to become *Julmarichardia dollfusi* (Guțu, 1989), comb. nov. In addition, the morphological features I referred should be considered amendments for the diagnoses of *Calozodion* and *Julmarichardia*.

The species *C. dominiki* Bochert, 2012 is in a special situation. If in the case of the female there is no doubt that it belongs to the genus *Calozodion*; however the situation is not the same for the male described by Bochert (2012). The male's obvious degree of sexual dimorphism in the carapace, rostrum, antennules, antenna and cheliped level is in contradiction with the characteristic features of *Calozodion*. By the great size of the rostrum, combined with the great length of the first article of the antennule peduncle and of the second article of antenna (Bochert, 2012: 47 and figs 8 A-F and 9 H, I), the male of *C. dominiki* resembles the species of

- 6 – Antennule main flagellum and antenna each with ten articles *C. simile* Guțu, 2006 (♀, ♂)
 – Antennule main flagellum and antenna with eight and nine articles, respectively *C. tanzaniense* n. sp. (♀; ♂ unknown)
- 7 – Pereopods III and IV basis with a median spiniform apophysis 8
 – Pereopods III and IV basis without a median spiniform apophysis 10
- 8 – Mandibles with an acute process on the first article of palp *C. moyas* Menioui, 2013 (♀, ♂)
 – Mandibles without an acute process on the first article of palp 9
- 9 – Cheliped propodus with acute processes on proximoventral margin *C. wadei* Gardiner, 1973 (♀, ♂)
 – Cheliped propodus without acute processes on proximoventral margin *C. dominiki* Bochert, 2012 (♀, ♂)
- 10 – Pereopod III with long plumose setae on twice margins, dorsally and ventrally *C. multispinosum* Guțu, 1984 (♀, ♂)
 – Pereopod III without long plumose setae on twice margins, dorsally and ventrally *C. singularis* Guțu, 2002 (♀; ♂ unknown)

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DOUĂ SPECII NOI DIN GENUL *CALOZODION* GARDINER
 (CRUSTACEA: TANAIDACEA: APSEUDOMORPHA)
 DIN MAREA ADRIATICĂ ȘI OCEANUL INDIAN ȘI RECLASIFICAREA
 SPECIEI *C. DOLLFUSI* GUȚU, 1989 ÎN GENUL *JULMARICHARDIA* GUȚU

REZUMAT

Sunt descrise două specii noi pentru știință, *Calozodion bogoescui* și *C. tanzaniense*, provenind din apele sud-estice italiene ale Mării Adriatice și, respectiv, cele tanzaniene ale Oceanului Indian. Prin descrierea speciei *C. bogoescui* n. sp. este menționată pentru prima dată prezența genului *Calozodion* Gardiner, 1973 în bazinul mediteranean. Principalele trăsături morfologice caracteristice speciei mediteraneene constau în numărul mic al articulelor endopodului uropodal (numai șapte, în comparație cu 13-16, cât au celelalte specii ale genului) și lungimea mică a merusului chelipedului (comparativ cu cea a carpului). Specia *C. tanzaniense* n. sp. se deosebește de celelalte cunoscute prin următoarea combinație de trăsături morfologice: (1) antenula cu trei apofize spiniforme pe marginea externă a primului articol peduncular, (2) antena formată din nouă aticule, (3) bazisul pereopodului II cu sete penate lungi numai pe marginea dorsală, (4) bazisul pereopodelor III și IV cu câte o apofiză spiniformă pe marginea dorsală și (5) merusul pereopodului VII cu cinci sete penate lungi pe marginea dorsală.

Totodată specia *C. dollfusi* Guțu, 1989 este transferată în alt gen, devenind *Julmarichardia dollfusi* (Guțu, 1989), comb. nov., iar în cazul masculilor speciei *C. dominiki* Bochert, 2012 sunt comentate unele particularități morfologice neîntâlnite la alte specii ale genului. În partea finală a lucrării este prezentată cheia de identificare a celor 11 specii ale genului *Calozodion*.

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FIRST RECORD OF *THEMIRA NIGRICORNIS* (MEIGEN, 1826) (SEPSIDAE: DIPTERA) IN ROMANIA

LAVINIA IANCU, CRISTINA PURCĂREA

Abstract. This report on the occurrence of *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) on Romanian territory represents the first record of this species within south-eastern Europe. Adults of *T. nigricornis* were collected in spring, in the second half of April, from an experimental setting placed in an urban location (Bucharest) in southern Romania. The bait consisted of domestic pig carcass in advanced decomposition stage, placed on soil ground and surrounded by vegetation. The visiting specimens were located around the posterior segment of the pig carcass. The registered abundance of adult individuals was relatively low, with 10 specimens distinguished during two weeks interval. The species was taxonomically characterized and identified. This study, documenting the presence of *T. nigricornis* in the southern part of Romania, expanded the Fauna Europaea distribution range record of this species, assigning the southernmost location of *T. nigricornis* in Europe.

Résumé. Ce rapport sur la présence de *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) sur le territoire roumain représente la première mention de cette espèce dans l'Europe du Sud-Est. Les adultes de *T. nigricornis* ont été recueillies pendant le printemps, dans la seconde moitié d'Avril, à partir d'un cadre expérimental placé dans un emplacement urbain (Bucarest) dans le sud de la Roumanie. L'appât consistait en une carcasse de porc en phase de décomposition avancée, placée sur le sol et entourée de végétation. Les spécimens en visite ont été trouvés dans le segment postérieur de la carcasse de porc. L'abondance enregistrée des individus adultes a été relativement faible, avec 10 spécimens démarqués au cours de deux semaines. Cette étude, en documentant la présence de *T. nigricornis* dans la partie du sud de la Roumanie, a élargi l'aire de répartition de cette espèce dans la Faune Europaea, par l'attribution de *T. nigricornis* au point le plus au sud d'Europe.

Key words: *Themira nigricornis*, first mention, pig carcass, Romania, distribution.

INTRODUCTION

The Sepsidae family, known as the black scavengers flies because of their coprophagous preference, comprises 37 genera and 318 species worldwide (Ozerov, 2005). The adults were found on dung (Snowball, 1944), animal and plant decaying material (Ozerov, 1989, 1999 a). These insects were predominantly located on human and animal excrements (Iwasa, 1980; Ozerov, 1991), playing an important role in faeces decomposition processes (Papp, 1971).

Species belonging to this family (Pont & Meier, 2002) are of relatively small size, reaching 6–12 mm in length. Morphologically, they resemble ants with narrow waist, the majority of individuals presenting pronounced sexual dimorphisms, of the legs and the male's 4th sternites. The forelegs of the male are used during courtship and mounting for holding onto the base of the female wing.

Themira species are characterized by the absence of supraalar seta (Pont & Meier, op. cit.). Adult males are easily recognized by the ornate fore-legs, and by the prominent form and colour that varies from black to yellow of the mid tarsomeres. The females are recognised by the absence of postpronotal setae, pruinose katepisternum, and partially yellow legs.

T. nigricornis, fully described and illustrated by Ozerov (1999 b), was first identified almost two centuries ago (1826) by Meigen, but no certain location and

holotype/syntype of female were indicated for this incidence (Ozerov, 2005). An earlier report of this species was recorded on American territory by Steyskal (1946). Since then, the presence of *T. nigricornis* was reported in western, central, eastern and northern European countries including Austria, Great Britain (Incl. Shetlands, Orkneys, Hebrides and Man Is.), Czech Republic, Danish mainland (Incl. Borhalm I.), Finland, French mainland, Germany, Hungary, Latvia, Lithuania, Norwegian mainland, Poland, Central, East, South and Northwest Russia, Slovakia, Sweden (Incl. Gotland I.), Switzerland, The Netherlands, Ukraine (Fauna Europaea, Version 2.6.2, de Jong, 2013) and Italy (Ozerov, 2005). So far, the south-eastern limit for the spread range of this species did not include Romania.

The current study reports the first occurrence of *T. nigricornis* on Romanian territory, in the southern part of the country, containing a brief description of the associated experimental settings, taxonomic identification of adult specimens collected from a pig decomposed carcass.

MATERIAL AND METHODS

Experimental setting

T. nigricornis specimens were identified during a forensic experimental model investigation in Bucharest, Romania. This urban site is located 100 m above sea level (44°27'10"N, 26°05'04"E) and belongs to a temperate climate region. The experimental setting consisted of a pig carcass weighing approximately 15 kg, placed on the ground, in a natural park area surrounded by spring vegetation (grass and trees), and protected by 50 cm x 100 cm metal cage against vertebrate scavengers (Fig. 1). The bait was exposed for approximately 5 months during cold period (December-February) and beginning of warm period (March-April). The spatial-temporal, environmental and experimental model features describing the occurrence of this species in Romania were summarized in table 1.

Sampling and taxonomical characterization

Insect sampling was performed using an entomological net, and the specimens were preserved in 75% ethanol at room temperature, until further investigations.

T. nigricornis taxonomic identification was performed according to the taxonomic keys for this species (Pont & Meier, 2002). The identification of main



Fig. 1 - Experimental setting for *T. nigricornis* appearance site. Pig carcass after 5 month exposure.

Table 1

Characteristics of experimental settings for *T. nigricornis* occurrence.

Characteristic	Experimental data
Location	Bucharest, Romania, 44°27'10"N L26°05'04"E
Period	15 – 30.IV.2013
Environmental temperature (°C)	20.05 ± 2.1°C
Relative humidity (%)	57.06 ± 8.0%
Precipitation (mm)	0.53 ± 0.09 mm
Experimental model	Pig carcass in advanced decomposition stage after 5 months of outdoor exposure in a park type setting
Environmental conditions	Arboreal vegetation (<i>Aesculus hyppocastanum</i> , <i>Tilia</i> sp., <i>Ulmus</i> sp.), rich cover of small plants and shrubs
Abundance	10 specimens (7 males and 3 females)

diagnosis characters was performed using a stereomicroscope Stemi2000 (Zeiss) at 3 x (1.9 to 225x) magnification scale.

DNA barcoding

T. nigricornis genomic DNA was extracted from two different adult individuals using DNeasy Blood & Tissue Kit (Qiagen), following an adapted protocol that included an additional initial cellular disruption step. The insect habitus suspended in 200 µl TE was disrupted at 20°C using a Cell Homogenizer SpeedMill PLUS (Analytik Jena), by applying continuous 50 Hz-power for 12 minutes at 20°C, in the presence of 5 Zirconia Beads II per tub (Invitex). After centrifugation of the cell extract at 10.000 x g for 1 min, the soluble fraction was further purified following the manufacturer procedure. The concentration and purity of the resulted DNA were measured with a NanoDrop1000 (Thermo Scientific).

DNA barcoding was performed based on PCR amplification of cytochrome oxidase subunit I (COI) mitochondrial gene fragment (Folmer et al., 1994). PCR amplification was carried out using a Mastercycler ProS System (Eppendorf). The reaction mixture contained 200 ng insect genomic DNA, 100 pmols of forward (LCO1490: 5'-GGTCAACAAATCATAAAGATATTGG-3') and reverse (HC02198: 5'-TAAACTTCAGGGTGACCAAAAAATCA-3') invertebrates' COI gene specific primers (Folmer et al., 1994), 1 unit of Taq DNA polymerase (Thermo Scientific), 1x Taq buffer, 2.5 mM MgCl₂, 0.1 mM dNTP (Thermo Scientific), in a total volume of 50 µl. The amplification reaction consisted of an initial incubation step of 1 min at 94°C, followed by 5 cycles of 30 sec at 94°C (denaturation), 1.5 min at 45°C (annealing) and 1 min at 72°C (extension), followed by 35 cycles of 30 sec at 94°C, 1.5 min at 51°C, 1 min at 72°C and a final extension step of 5 min at 72°C. The reaction performed in the absence of DNA was used as negative control.

The resulted DNA fragments (710 bp) were analysed by electrophoresis on 1% agarose gels. The amplified COI gene fragments were purified using QIAquick PCR Purification Kit (Qiagen), and sequenced (Macrogen) on both strands, using the cloning primers. Sequence similarity was determined by BLAST-NCBI screening tool (<http://www.ncbi.nlm.nih.gov>).

RESULTS

Spatial and temporal characteristics of T. nigricornis occurrence in Bucharest – Romania

The insects were observed in the second half of April, 2013, when the average temperature raised to $20.05 \pm 2.1^{\circ}\text{C}$. The precipitation and relative humidity during this interval corresponded to 0.53 ± 0.09 mm and $57.06 \pm 8.0\%$, respectively. The insects were located on the surface of the pig carcass, in the vicinity of the posterior section. A total of ten specimens, counting seven males and three females, were collected during midday period over the two week interval. Noteworthy, the presence of *T. nigricornis* on the carcass was simultaneous with other necrophagous species belonging to Diptera and Coleoptera Orders, including members of Calliphoridae, Muscidae, Cleridae and Silphidae families.

Taxonomic identification of T. nigricornis

Taxonomic identification of this species was carried out based on the taxonomic keys provided by Pont & Meier (2002). The analysis of male adult specimen (Fig. 2) indicates a series of characteristics of *T. nigricornis* species, as follow: black thorax and abdomen, and habitus presenting orange-yellow genal area (Fig. 2A); the front femure (Fig. 2B) exhibiting several posterodorsal setae

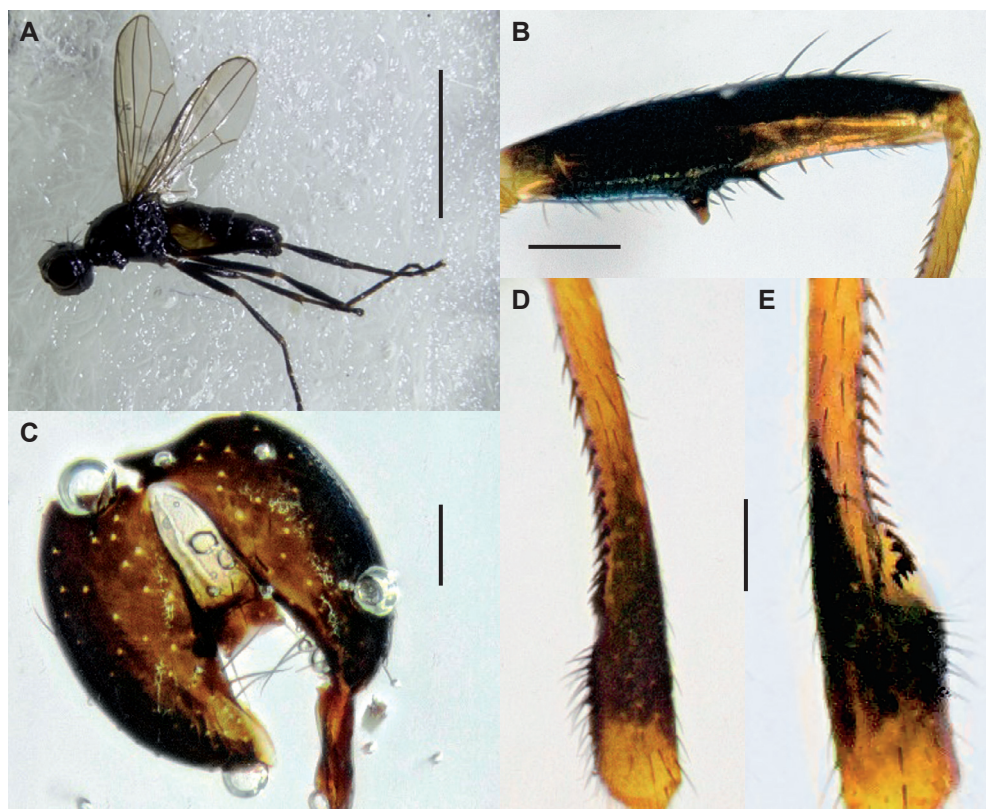


Fig. 2 - Stereomicroscopic images of *T. nigricornis*. A, habitus; B, fore femure anterior view; C, hypopygium; D, fore tibia, anterior view; E, fore tibia, view posterior. Scales (in mm): A – 2; B-E – 0.5.

in the apical half, and hypopygium as part of the copulatory apparatus (Fig. 2 C); yellow coloured fore tibia except of the apical half region, as shown by the anterior (Fig. 2 D) and posterior (Fig. 2 E) views.

These corroborated elements correspond to key morphological characteristics of *T. nigricornis*, indicating that the isolated organism corresponds to this species.

DNA barcoding identification of T. nigricornis

PCR amplification of mitochondrial cytochrome C oxidase I gene (COI) using specific primers for invertebrates was obtained for 2 distinct adult individuals. DNA sequencing of both TN1 and TN2 amplicons indicate 100% sequence identity over a 622-bp gene fragment.

The TN1 sequence was assigned GenBank accession number KJ007735.

Sequence similarity search using BLAST screening indicated the closest match of TN1 sequence (99% identity) with the *T. nigricornis* COI gene fragment (Laamanen et al., 2005; accession number AJ832117).

DISCUSSION

This report represents the first mentioning of *T. nigricornis* presence in Romania.

The location of the insect on a pig carcass in advanced decomposition stage confirmed the preference of this species for such environments.

The adult abundance in the forensic experimental setting was relatively low, only 10 individuals (males and females) being observed on the site over 2 weeks period. Such low density is in accordance with previous statements (Pont & Meier, 2002) mentioning that *T. nigricornis* was only occasionally abundant. Moreover, the appearance season of *T. nigricornis* on Romanian territory in early spring, when temperatures raised to about 20°C, is in accordance with prior reports on the main occurrence period of this species within end of March - August interval, corresponding to the warm season (Pont & Meier, op. cit.). The identity of this species was confirmed both taxonomically and by DNA barcoding based on mitochondrial cytochrome C oxidase I gene (COI) amplification and sequencing.

To date, the worldwide spread range of this species covered the nearctic USA region (Alaska, Connecticut, Illinois, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania), and Palaearctic regions of Asia including Kazakhstan, Korea, Kyrgyzstan, Pakistan, Turkmenistan, South Korea and Japan (Pont & Meier, op. cit.; Ozerov, 2005).

In Europe, the distribution of *T. nigricornis* species covered 19 countries (Pont & Meier, op. cit.), with a species widespread incidence in the central and northern European zones and eastwards to Russia (Far East province), but with only specific locations in certain European countries such as Denmark (East Jutland and North East Zealand), Norway (northwards to Nord Trøndelag), Sweden (Skane to Torne Lappmark), and Finland (northwards to Kuusamo).

In this respect, the current report on the presence of *T. negricornis* on the southern Romanian territory contributed to update the distribution map of this species on the European range (Fig. 3), indicating the southernmost location of this Sepsidae species within Eastern Europe.

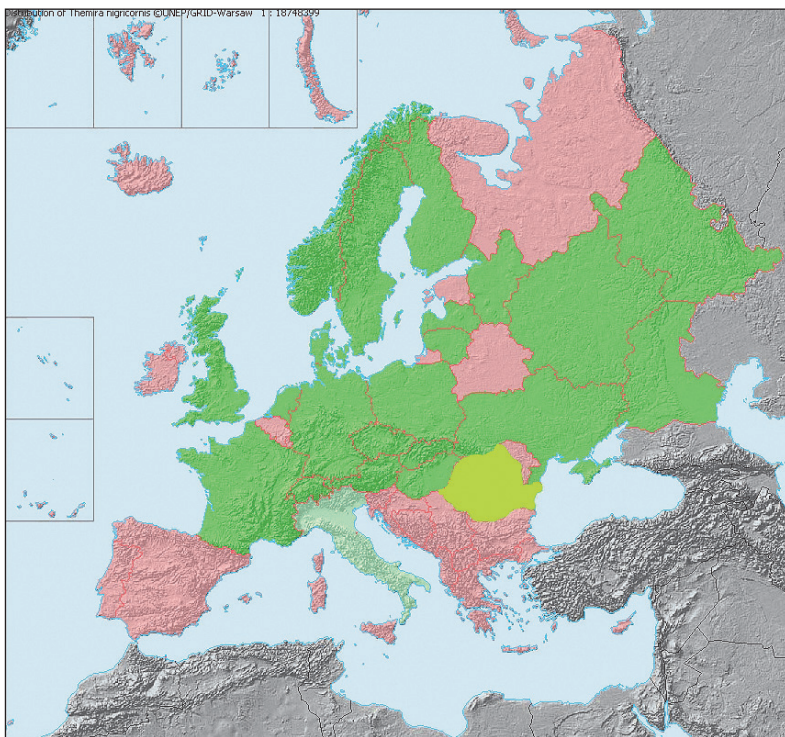


Fig. 3 - Updated map of *T. nigricornis* distribution in Europe (modified from <http://www.faunaeur.org>). Legend: Presence - dark green, doubtful presence - light green, absence - pink, new record - bright green.

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PRIMA SEMNALARE A SPECIEI *THEMIRA NIGRICORNIS* (MEIGEN, 1826) (SEPSIDAE: DIPTERA) ÎN ROMÂNIA

REZUMAT

Acest raport privind semnalarea speciei *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) pe teritoriul românesc reprezintă prima înregistrare a acestei specii în sud-estul Europei. Adulții speciei *T. nigricornis* au fost colectați în anotimpul primăvara, în a doua jumătate a lunii aprilie, în cadrul unui experiment amplasat în spațiu urban (București), în partea de sud a României. Au fost utilizate carcase de porc domestic (*Sus scrofa domesticus*) aflate într-un stadiu de descompunere avansată, amplasate direct pe sol și înconjurată de vegetație. Exemplarele de *T. nigricornis* au fost localizate în segmentul posterior al carcaselor. Abundența a fost relativ scăzută, constând în 10 exemplare colectate într-un interval de două săptămâni. Specia a fost caracterizată și identificată taxonomic. Acest studiu, ce documentează prezența speciei *T. nigricornis* în sudul României, extinde arealul de distribuție semnalat de Fauna Europaea, desemnând localizarea în partea de sud a Europei.

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NESTING PREFERENCES FOR TWO WOODPECKER SPECIES (*DENDROCOPOS MAJOR* AND *DENDROCOPOS MEDIUS*) IN COMANA FOREST, SOUTHERN ROMANIA

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Abstract. The main goal of this study is to get a better insight of the habitat requirements for the Great- and Middle Spotted Woodpeckers. Woodpeckers are forest specialists, threatened all over Europe mainly by the loss of forest habitats and also by the loss in quality of the habitat by reducing the food sources and nesting sites. Both species showed a strong preference for oaks, lime, large trees and dead wood for nesting, but Middle Spotted Woodpecker proved to be more selective in terms of tree species. Nest-height was influenced by tree diameter. Both species have the same nesting preferences for Turkey oak, lime and Pedunculate oak, in a *Quercetum farnetto-cerris* type of forest. The orientation of the nest hole on the tree was mainly NE-E-SE for Middle Spotted Woodpecker and N-NE-E for Great Spotted Woodpecker.

Résumé. L'objectif principal de cette étude est de mieux connaître les besoins en matière d'habitat pour le pic épeiche et le pic mar. Les pics sont des spécialistes de la forêt, menacés dans toute l'Europe principalement par la perte d'habitats forestiers et aussi par la perte de la qualité de l'habitat en réduisant les sources de nourriture et les sites de nidification. Les deux espèces ont montré une forte préférence pour les chênes, de chaux, de grands arbres et du bois mort pour la nidification, mais le pic mar s'est avéré être plus sélectif en termes d'espèces d'arbres. Nid-hauteur a été influencé par le diamètre de l'arbre. Les deux espèces ont les mêmes préférences de nidification pour le chêne Turquie, les tilleuls et le chêne pédonculé, dans un *Quercetum farnetto-cerris* type de forêt. L'orientation du trou de nid sur l'arbre était principalement NE-E-SE pour le pic mar et N-NE-E pour le pic épeiche.

Key words: nest-site parameters, Middle Spotted Woodpecker, Great Spotted Woodpecker, Comana Forest.

INTRODUCTION

All over Europe, conservation of forest habitats is of great importance, this biotope being dominant in the continent before massive human intervention; now only one third of the post-glacial forest is still present (Thirgood, 1989; Mikusinski et al., 2001). Regarding the loss of biodiversity, this took place not only by reducing the forest area, but also by reducing the quality of this biotope.

Woodpeckers are a special group among forest birds, with very selective ecological requirements (Angelstam et al., 1994) being regarded as the group with the greatest affinity for forests, also as indicators of forest biodiversity. European woodpeckers are dependent on trees for nesting-sites and they forage for food in old, dying or dead trees. For this reason, woodpeckers are declining in population, especially in the countries with intensive forest management, or where the conversion for agriculture has been massively made (Pettersson, 1985).

Woodpeckers are threatened mainly by the loss of forest habitats and also by the loss in quality of the habitat by reducing the food sources and nesting sites. Cutting the old trees and removing the decaying wood from the forest is the main cause for the declining of those species (Mikusinski, et al., op. cit.; Angelstam et al., op. cit.; Munteanu, 2009).

In Romania, woodpeckers have been studied since the beginning of the 1930 period (Cătuneanu, 1933). Papers dedicated to this group dealt with the distribution, taxonomy, reproduction biology, diet, anatomy, habitat requirements and, within the last years, conservation (Paşcovschi, 1937; Papadopol, 1973, 1974; Papadopol & Mândru, 1977; Popovici, 1971; Korodi Gal, 1970, 1975; Glăvan, 2004; Dorresteijn et al., 2013; Domokos et al., 2014).

Middle spotted woodpecker, *Dendrocopos medius* (Linnaeus, 1758) (MSW), is considered an oak forest specialist (Pasinelli, 2000). Because it prefers mature woods, inhabiting old forests at optimal harvest age, the species decline severely in those regions. Oaks are requiring several decades to become suitable habitats (60-100 years) (Pasinelli, 2003). Losing suitable habitat increases fragmentation and reduces density which in extreme cases can cause extinction, as the southern population from Sweden (Pettersson, op. cit.). Middle spotted woodpecker is listed in Annex I of the Birds Directive of the European Union listing threatened species that require special conservation measures.

Great Spotted Woodpecker, *Dendrocopos major* (Linnaeus, 1758) (GSW), is regarded as the most numerous and widespread European woodpecker and is not listed as threatened. Being primary cavity excavators, woodpeckers are considered as 'key species', producing nest sites and roosting places for other animals (Kosiński & Winiecki, 2004; Kosiński et al., 2006; Wesolowski, 1989), especially Great Spotted Woodpecker which builds more than one cavity in search for the final nesting place, offering more opportunities for the secondary nesters (Cramp, 1985).

It has been reported that although Great- and Middle Spotted Woodpecker are taxonomically related species, coexisting in deciduous forests (del Hoyo et al., 2002; Kosiński et al., op. cit.), both species differ with respect to nest-tree selection, nest height and orientation of the hole entrance (Kosiński & Winiecki, op. cit.; Kosiński et al., op. cit.).

The main goal of this study is to get a better insight of the habitat requirements for the two species, by characterising the nest sites used by Great and Middle Spotted Woodpeckers and to compare the nest sites between species in a lowland forest, a remaining fragment of the secular forest that dominated in the past the southern part of Romania.

MATERIALS AND METHODS

Study area. The study was conducted in Comana Forest, Southern Romania (44°09'N, 26°07'E), 30 km south of the capital of Bucharest. This woodland is a remnant of an ancient vast forest which dominated this part of the country, being in time fragmented and cleared for agriculture and human settlements. Now, the forest (8000 ha) is included together with a mosaic of habitats: wetlands, agriculture fields and atrophic areas in Comana Natural Park and is part of the Special Protection Area Comana (ROSPA0022) and the Community Importance Site Comana (ROSCI0043). Since 2012 the area is a RAMSAR site. The deciduous forest is situated on the right bank of the Neajlov River and Lake Comana and it belongs to several plant associations: *Quercetum cerris* Georgescu, 1941, *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949, *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992, *Ornithogalo-Tilio-Quercetum* A. Dihoru, 1976, *Fraxino pallisae-angustifoliae-Quercetum roboris* Popescu et al., 1979 (Paucă-Comănescu et al., 2000; Paucă-Comănescu et al., 2001). The area is

known as an important *hot spot* for the biodiversity of this part of the country, here being mentioned over 240 bird species (Petrescu et al., 2009).

Data collection and analysis. Data were collected during the pre-breeding and breeding season of 2013. From March to the end of April, the number and distribution of territorial birds was established by responses to the play-back of taped calls (Kosiński et al., 2004). After the bird's response, the territories were checked for occupied nest-holes. Searches continued especially in May and June, identifying the nest by the calls of the nestlings. The position of the nests was recorded with a GPS and revisited after fledging for recording nest-site parameters. The following parameters were recorded to describe the nest site: tree species, diameter of the tree at breast height (Dbh), health of the tree on a scale from 1 to 5 describing the decaying state (1-dead, 5-alive), exact position of the tree, nest and tree height, orientation of the nest, vegetation on a 10 m radius around the nest tree.

Statistical analyses were performed at a confidence level $\alpha = 0.05$, using PAST software (Hammer et al., 2001). Where data did not fit a normal distribution, normalization was carried out by means of Box-Cox transformation and tested again for normality. If normalization was not successful, non-parametric tests were used to test data for statistical significance.

Statistical procedures included Kruskal-Wallis non-parametric ANOVA with Tukey post-hoc analysis to test woodpecker-tree species association, one-way ANOVA for species-tree circumference relationship and χ^2 test for independence to test any existing relationship between tree circumference and height at which the nest was built.

RESULTS AND DISCUSSIONS

In 2013, we found 20 nests for Middle Spotted Woodpecker and 29 nests for Great Spotted Woodpecker (Figs 1, 2). Both species prefers oaks as nesting tree

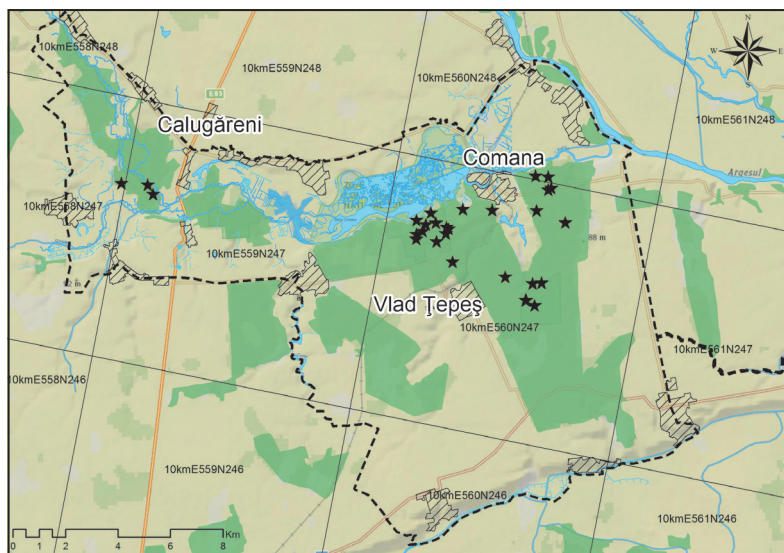


Fig. 1 - Distribution of the nest sites for Great Spotted Woodpecker in Comana Forest (★) - GSW nests, (- -) - limit of Comana Natural Park.

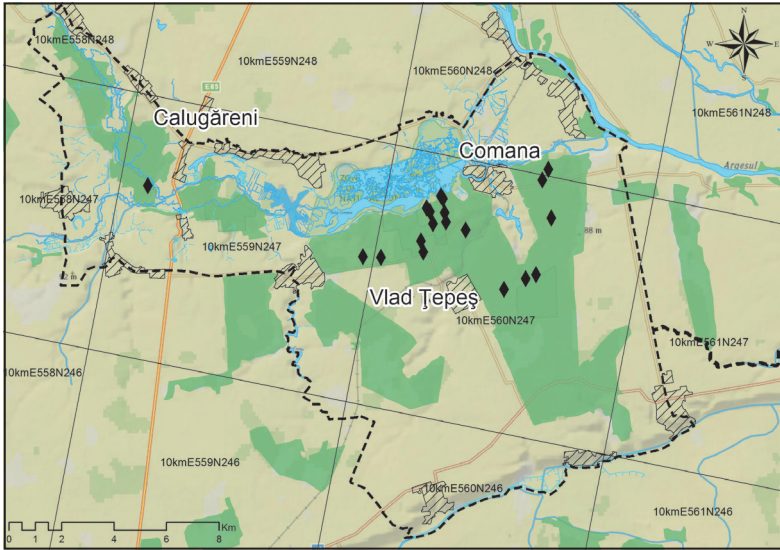


Fig. 2 - Distribution of the nest sites for Middle Spotted Woodpecker in Comana Forest (◆) - nests, (- -) - limit of Comana Natural Park.

(Tab. 1, fig. 3), Turkey oak *Quercus cerris* was the most commonly used tree by *Dendrocopos major* and *D. medius*, followed by Pedunculate oak *Q. robur* and Silver lime *Tilia tomentosa*. For *D. medius*, the differences between selected trees are not significant, although there can be observed a preference for Turkey oak and Silver lime (binomial exact test, $p=0.07$, $\alpha=0.05$). Same for *D. major* (binomial exact test, $p=0.012$, $\alpha=0.05$), it can be observed a preference for Turkey oak and Pedunculate oak. There was also a highly positive selection for dead trees (Fig. 4).

The average breast height diameter (Dbh) of the nesting tree was 33 ± 13.7 cm ($n=20$) in Middle Spotted Woodpecker and 36 ± 12.8 cm ($n=29$) in Great Spotted Woodpecker. Median nest tree Dbh differed significantly between the two species

Table 1

Trees used by Great- and Middle Spotted Woodpecker (N-sample size, dbh-diameter at breast height, *-mean \pm standard deviation).

Species	<i>Dendrocopos medius</i>				<i>Dendrocopos major</i>			
	N	%	dbh*	nest height*	N	%	dbh*	nest height*
<i>Quercus robur</i>	4	20	51 \pm 18.2	9 \pm 1.41	8	28	49 \pm 13.5	11 \pm 3.1
<i>Quercus cerris</i>	7	35	27 \pm 6.2	7.2 \pm 5.11	10	34	27 \pm 3	5.4 \pm 1.8
<i>Tilia tomentosa</i>	6	30	34 \pm 5.2	8.66 \pm 4.71	5	17	30 \pm 2.2	6.7 \pm 3.2
<i>Carpinus betulus</i>	1	5	25	9	1	3	29	4.5
<i>Fraxinus excelsior</i>	0	0	0	0	3	10	37 \pm 3	5.2 \pm 2.4
<i>Quercus frainetto</i>	0	0	0	0	1	3	27	5
<i>Salix alba</i>	0	0	0	0	1	3	65	5
<i>Robinia pseudoacacia</i>	2	10	15	3	0	0	0	0
Total	20	100			29	100		

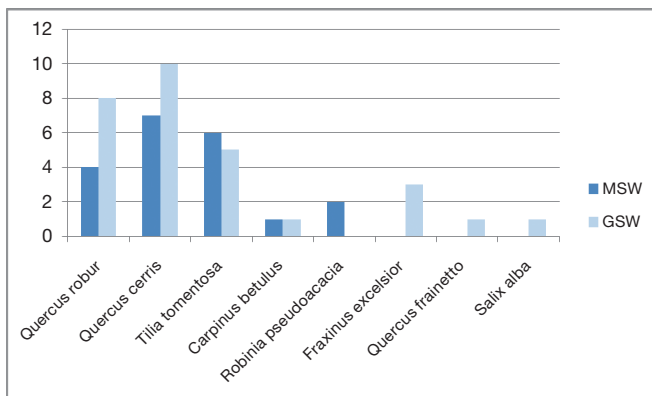


Fig. 3 - Trees used by Great- (GSW) and Middle Spotted Woodpecker (MSW).

($t = 67.464$, $p = 4.3282 \cdot 10^{-24}$) (Fig. 5). The average height of the nest hole from the ground was 7.7 ± 3.6 cm ($n=20$) for Middle Spotted Woodpecker and 7.1 ± 3.4 cm ($n=29$) for Great Spotted Woodpecker. For *Dendrocopos medius* it was found that there is a positive association between tree circumference and nest height $\chi^2=386.84$; $df=19$; $p=2.378 \cdot 10^{-70}$) (Fig. 6). Also, the association was positive for Great Spotted Woodpecker ($\chi^2=779.33$; $df=28$; $p=4.684 \cdot 10^{-146}$) (Fig. 7).

Comparing preferences of woodpeckers for specific trees species as nesting places (seven tree species for *Dendrocopos major* and five for *D. medius*), applying Kruskal-Wallis non-parametric ANOVA, it showed a significant difference between species ($p=1.01 \cdot 10^{-8}$). Applying Tukey post-hoc test we found that there is a significant difference about the selection preferences for nesting regarding tree species. Hereby, for Great Spotted Woodpecker, there are significant differences between the preference for hornbeam *Carpinus betulus* and Turkey oak *Quercus cerris* (Tukey post-hoc, $p=0.00014$), the woodpecker strongly preferring the Turkey oak. The same, regarding Turkey oak and other tree species, ash *Fraxinus excelsior* ($p=0.00049$), Hungarian oak *Q. frainetto* ($p=3.36 \cdot 10^{-05}$) and White willow *Salix alba* ($p=3.36 \cdot 10^{-05}$). Also, between selection of Turkey oak, Pedunculate oak and

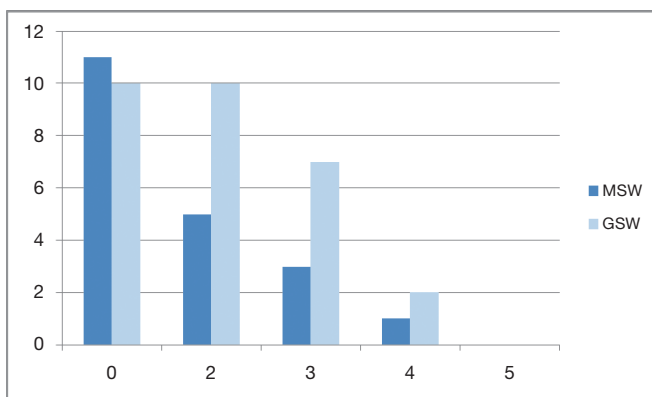


Fig. 4 - Decaying state of trees used by Great- (GSW) and Middle Spotted Woodpecker (MSW), on a 1 to 5 scale: 1- dead, 5-alive.

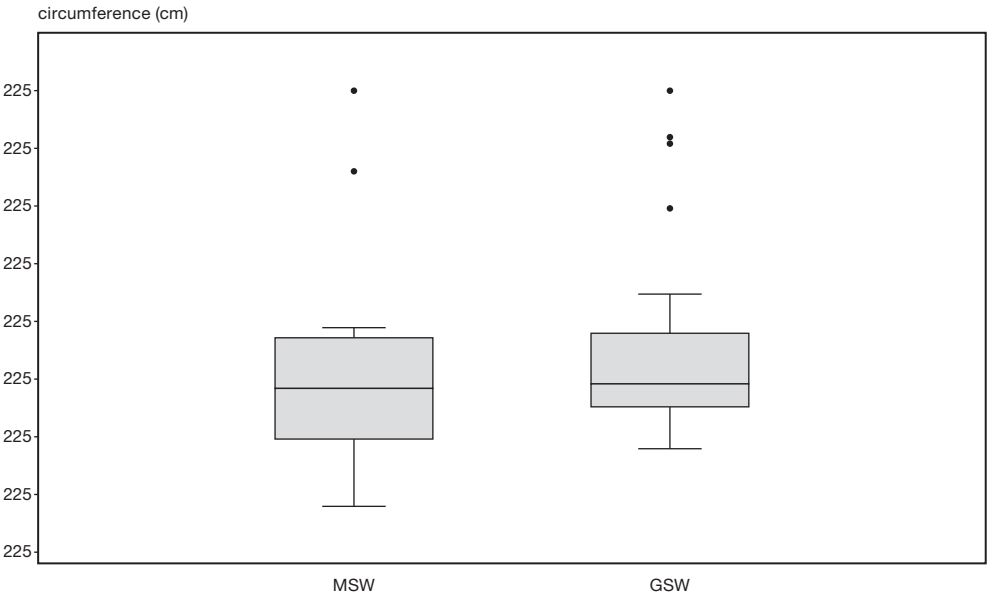


Fig. 5 - Differences of nest-trees circumference between *Dendrocopos medius* (MSW) and *D. major* (GSW).

lime, there are no differences regarding the nesting preferences, Great Spotted Woodpecker nesting often in those trees.

Middle Spotted Woodpecker has the same nesting preferences for Turkey oak, lime and Pedunculate oak, but it can choose also hornbeam *C. betulus* and

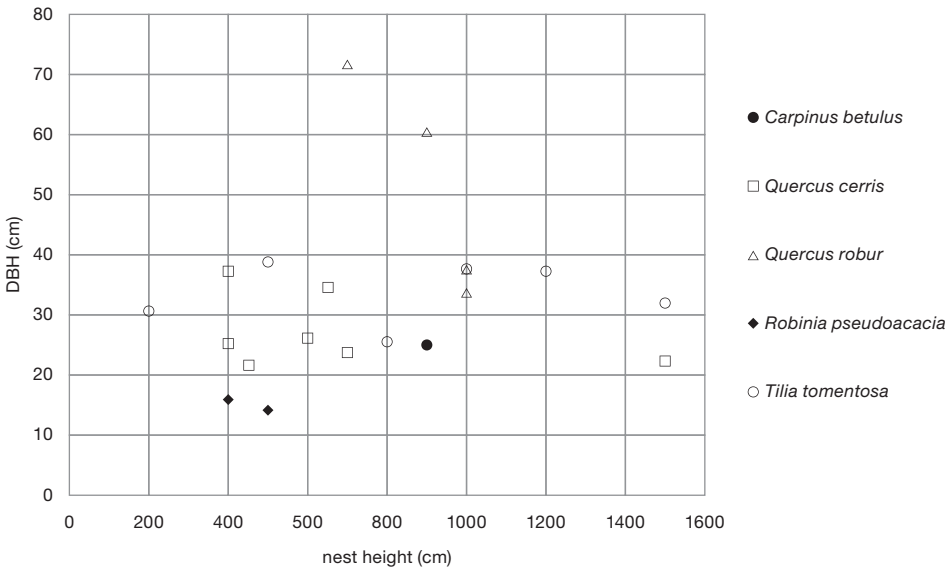


Fig. 6 - Relation between tree diameter (DBH) and nest height in Middle Spotted Woodpecker.

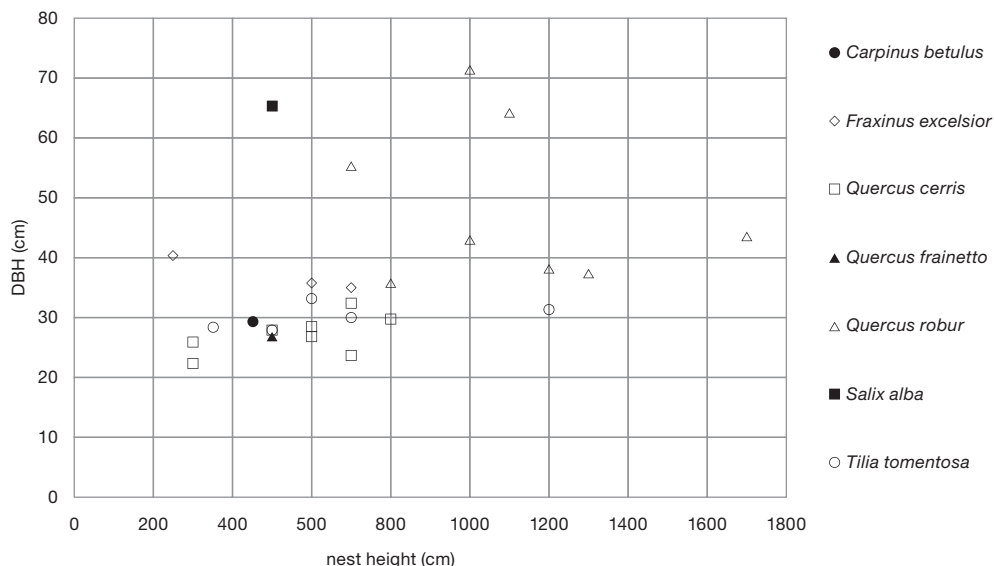


Fig. 7 - Relation between tree diameter (DBH) and nest height in Great Spotted Woodpecker.

even black locust *Robinia pseudoacacia*. Choosing between Turkey oak and hornbeam there are statistic significant differences ($p = 0.00014$), *Dendrocopos medius* preferring the Turkey oak for nesting, but between Turkey oak and lime ($p = 0.1834$) or Pedunculate oak ($p = 0.2729$), data do not differ significantly. Hereby, Middle Spotted Woodpecker is more selective in terms of tree species than the Great Spotted Woodpecker, choosing only five species of trees for nesting.

The orientation of the nest hole on the tree was mainly NE-E-SE for Middle Spotted Woodpecker (Fig. 8) and N-NE-E for Great Spotted Woodpecker (Fig. 9). In other studies, the orientation of the nest hole was SE and NE for *D. medius* and S, NE and NW for *D. major*, but the orientation is believed to be related with the slope (Glăvan, 2004). In our case, the slope was not a criteria factor.

Vegetation around the nest tree was recorded on 10 m radius from the tree and identified according to Habitats of Romania (Doniță et al., 2005). We recorded 5 plant association for nesting habitat of Middle Spotted Woodpecker, 50% of the nest being placed in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski type of association, followed by *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu 1971), corr Popescu et Sanda, 1992 and *Lychnio coronariae-Quercetum cerris* Sanda et Popescu, 2003 (Tab. 2). Also, 45% of Great Spotted Woodpecker nests were identified in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949 type of forest, followed by *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992 (Tab. 3).

In conclusion, Great Spotted Woodpecker and Middle Spotted Woodpecker in Comana forest do not differ very much in terms of nesting preferences, with the difference that *D. medius* is more selective about tree species. The woodpeckers nesting preferences depends on the forest composition. In a mosaic of forest plant associations, the two woodpecker species choose to nest more frequently in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949 and *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992. In

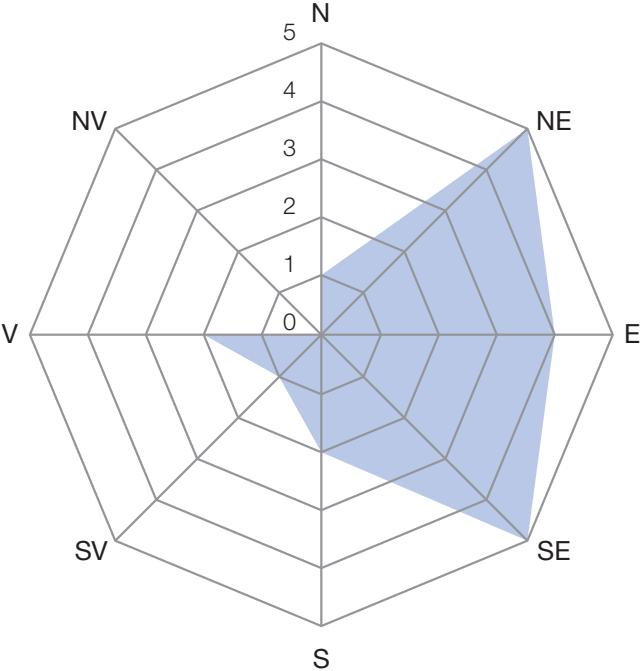


Fig. 8 - Nest hole orientation for *Dendrocopos medius*.

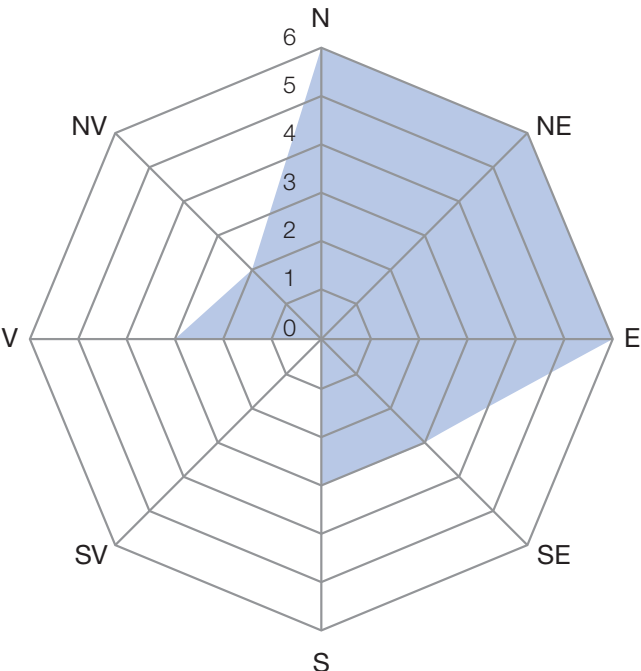


Fig. 9 - Nest hole orientation for *Dendrocopos major*.

Table 2

Plant associations selected by *Dendrocopos medius* as nesting habitat (N - sample size, * - mean±standard deviation).

%	N	Plant association	Cover (%)*
5	1	<i>Bromo sterilis-Robinetum pseodacaciae</i> (Pócs, 1954) Soó, 1964	75
20	4	<i>Lychnio coronariae-Quercetum cerris</i> Sanda et Popescu, 2003	80±9.1
20	4	<i>Melico uniflorae-Tilietum tomentosae</i> (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992	80±7.1
5	1	<i>Ornithogalo-Tilio-Quercetum</i> A. Dihoru, 1976	90
50	10	<i>Quercetum farnetto-cerris</i> (Georgescu, 1945) Rudski, 1949	75.5±10.9
100	20	Total	

Table 3

Plant associations selected by *Dendrocopos major* as nesting habitat (N - sample size, * - mean±standard deviation).

%	N	Plant association	Cover (%)*
3	1	<i>Fraxino pallisae-angustifoliae-Quercetum roboris</i> Popescu et al., 1979	80
14	4	<i>Lychnio coronariae-Quercetum cerris</i> Sanda et Popescu, 2003	76.3±7.5
28	8	<i>Melico uniflorae-Tilietum tomentosae</i> (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992	83.7±5.2
7	2	<i>Ornithogalo-Tilio-Quercetum</i> A. Dihoru, 1976	82.5
3	1	<i>Polygonato latifolio - Quercetum roboris</i> (Hargitai, 1940) Borhidi, 1966 in Borhidi et Kevey, 1996	70
45	13	<i>Quercetum farnetto -cerris</i> (Georgescu, 1945) Rudski, 1949	80±9.1
100	29	Total	

related literature, it was found that *D. major* prefers living trees from species like *Populus tremula*, *Fagus sylvatica*, *Quercus petrea*, *Quercus robur*, *Tilia cordata* and *D. medius* nests mostly in dead wood, preferring *Fagus sylvatica*, *Tilia cordata*, *Fraxinus excelsior* as nesting trees (Glăvan, 2004).

We found that *D. medius* can choose as nesting site Black locust *Robinia pseudoacacia*, a tree with extremely hard wood, resistant to rot and toxic when is alive, woodpeckers avoiding it as nesting place, except for Great Spotted Woodpecker. The nests were found in decaying snags, probably old nests of Great Spotted Woodpecker, which proofs again the importance of old and decaying trees for woodpeckers, especially when other tree species are not available. In literature, we found only one case of nesting in Black locust for *D. medius* (Mazgajski, 1997 in Pasinelli, 2003). This aspect, together with the results related to the preference for large oaks and lime and decaying wood bring the base information for a specific management action plan for the conservation of the species and the forest in this protected area.

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PREFERINȚELE DE CUIBĂRIT LA DOUĂ SPECII DE CIOCĂNITORI
(*DENDROCOPOS MAJOR* ȘI *DENDROCOPOS MEDIUS*), ÎN PĂDUREA COMANA,
SUDUL ROMÂNIEI

REZUMAT

Scopul principal al acestui studiu este de a obține o mai bună înțelegere a nevoilor pe care ciocănitoarea pestriță mare și ciocănitoarea de stejar le au pentru habitatul în care trăiesc. Ciocănitorele sunt specialiști pădurii, fiind amenințate cu dispariția în întreaga Europă, mai ales prin distrugerea habitatelor forestiere precum și prin pierderea calității habitatului, prin reducerea surselor de hrană și a locurilor de cuibărit. Ambele specii au aratat o preferință puternică pentru stejari, tei, arbori mari și lemn mort pentru cuiburi, dar Ciocănitoarea de stejar s-a dovedit a fi mai selectivă în ceea ce privește speciile de arbori. Înălțimea cuibului a fost influențată de diametrul copacului. Ambele specii au aceleași preferințe de cuibărit pentru cer, tei și stejarul pedunculat, într-o pădure de tipul *Quercetum farnetto-cerris*. Orientarea intrării în cuibul din arbore a fost în principal NE-E-SE pentru ciocănitoarea de stejar și N-NE-E pentru ciocănitoarea pestriță mare.

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THE BIRD FAUNA FROM LOTRIOARA RIVER BASIN (LOTRU MOUNTAINS, ROMANIA)

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Abstract. The results of a one year study of bird communities from the Lotrioara River Basin (Lotru Mountains, Romania), using the transect method along the main valley, are presented. The study aimed to reveal the characteristics of the community's dynamics, both from spatial and temporal point of view. During the research period 70 species belonging to 9 orders were identified in the investigated area. The number of species decreases with the altitude, but it is also related to the heterogeneity of habitats. During the year the species' number varies from a minimum in winter to a maximum in spring. Insectivores are the prevailing feeding guild in the bird communities from Lotrioara basin, but during the cold season the dominance is taken over by omnivorous and granivorous species.

Résumé. On présente les résultats d'une étude des communautés des oiseaux du bassin de la rivière Lotrioara (Lotru Montagnes, Roumanie), en utilisant la méthode des transects au long de la vallée principale. L'étude visait à révéler les caractéristiques de la dynamique de l'ornithofaune, du point de vue spatial et temporel. Au cours de la période de recherche 70 espèces appartenant à 9 ordres ont été identifiées dans la zone étudiée. Le nombre d'espèces diminue avec l'altitude, mais il dépend aussi de l'hétérogénéité des habitats. Au cours de l'année, le nombre des espèces varie d'un minimum en hiver à un maximum en printemps. La structure trophique des communautés d'oiseaux dans le bassin Lotrioara est dominée par les insectivores, mais pendant la saison froide, la domination est prise par les omnivores et granivores.

Key words: elevational gradient, species richness, feeding guilds, bird phenology.

INTRODUCTION

Birds are a well studied group in Romania, with many papers concerning the ornithofauna of different areas. Although most of them deal with wetlands and lowlands, some researches were carried out also in the Carpathians. The first data concerning birds from mountain areas in Romania date back to the 19th century. Stetter made the first avifaunal list of Transylvania, published in 1845. Several other naturalists working in the Carpathians made notes also on birds, among them A. Berger, J. Csato, W. Hausmann, O. Hermann, M. von Kimakovicz. Their data, along with his own observations, were synthesized by Bielz (1888) in the volume concerning the vertebrates of Transylvania. He cites among others, species that are currently extinct from Romania, like the three species of vultures: *Aegypius monachus*, *Gyps fulvus* and *Gypaetus barbatus*.

During the 20th century several ornithologists published papers concerning the bird fauna from different mountain areas. In the last two decades some studies were carried out in some of the South Carpathian massifs, namely Piatra Craiului (Petrescu, 1995), Făgăraș (Petrescu, 2005) and the neighbouring Cindrel Mountains (Murariu et al., 2009 a), where 92 species were found over a period of more than 135 years of observations. Other articles deal with a series of ecological aspects of bird communities. An ornithological zonation along vertical (elevation) and horizontal gradients, based on data from literature and personal observations, is presented by several authors: Papadopol (1992), Radu (1973), Papadopol and Petrescu (1992) and

others. Recently, Mestecăneanu (2008) published a paper on the monthly dynamics of bird communities from a dam lake in Iezer-Păpușa massif.

In this paper we present the results of the first study on the bird fauna done in Lotru Mountains. Up to the present there are only scarce data available on birds from this area, most of them dating back to the 19th century when Kimakowicz made several observations at Prejba, mentioning *Tetrao urogallus*, *Apus melba*, *Regulus regulus*, *Eremophila alpestris* and *Loxia curvirostra* (Bielz, 1888). The only recently published data concern a female capercaillie (*T. urogallus*) and her 10 chicks (Roberts, 2000).

The present study highlights the variation of the ornithofauna, both in space (along the elevational gradient) and time (seasonally). It also reveals the changes occurred in its trophic structure.

STUDY AREA AND METHODS

Lotrioara River Basin is part of Lotru Mountains (Southern Carpathians), being placed in the middle of Romania (Fig. 1). Lotrioara is a right side tributary of the Olt River. Its river basin has 117 km² and the largest part is covered by natural or planted forests, from deciduous in the lower part, to coniferous in the upper areas. The valleys are mostly narrow, with steep slopes. However, in the lower sector Lotrioara valley is open and wide, and a traditional village was established here, resulting in a large forest clearing, now occupied by orchards and hayfields. Originally stretching on 1.5 km, during the last years the village has expanded by new buildings down- and upstream. In the river basin, small areas are occupied by secondary mountain meadows, resulted from deforestation. Subalpine shrubs are found only on the highest peaks, on the southern slope. On Sterpu Peak (2143 m), above the subalpine shrubs, an alpine meadow can also be distinguished.

The investigations were carried out monthly during one year, using the transect method. Five transects, coded from I to V, were established along the main



Fig. 1 - Position of the research area and the five transects.

valley and in the upper sector on the left side slope, from upstream the confluence with Olt River (420 m), up to Prejba Chalet (1660 m) (Fig. 1). Transect I is a sector in the beech forest near the confluence, including Lotrioara village, II and III are transects in the mixed forest along Lotrioara Valley and one of its tributaries - Pârâul Cailor, IV crosses a slope covered by a young spruce plantation, and V is a transect in an ecotone area, at the limit between an old spruce forest and secondary meadows near Prejba Chalet. Besides these transects other observations were made along the way to Sterpu Peak. The data were included in tab. 1 in a separate column, noted as transect VI, and were included only in some of the analysis (the seasonal dynamics and the trophic structure).

A cluster analysis based on the Jaccard index was performed in order to assess the similarity of bird fauna structure in the four seasons and at different elevations.

The bird species were ascribed to the feeding guilds according to their prevailing food (Bezzel, 1996), while their phenological status was established based on the observations during the present research. The dependence of the trophic structure of bird fauna on season and the altitude were tested by Pearson chi-square test of independence.

RESULTS

During the one year study, 70 species of birds belonging to 9 orders, were identified in Lotrioara River Basin. Among them, the best represented are the orders Passeriformes (49 species), Falconiformes (9 species) and Piciformes (5 species), the systematics being according to Bruun et al. (1999).

The list of the observed species is given in table 1, with the mention of the seasonal and altitudinal occurrence, as well as their inclusion in the annexes II (strictly protected fauna species) and III (protected fauna species) of the Convention on the Conservation of European Wildlife and Natural Habitats (known as the Bern Convention) (<http://conventions.coe.int/Treaty/en/Treaties/Html/104.html>) (column BC in tab. 1), Annex I (species subject of special conservation measures concerning their habitat) of the Directive 2009/147/EC (known as the Birds Directive) (<http://ec.europa.eu/environment/nature/legislation/birdsdirective>) (column BD) and their conservation status (VU-vulnerable, EN-endangered, CR-critically endangered) according to the Red Book of Romanian Vertebrates (Munteanu, 2005) (column RB). The codes used for seasons are: W - winter (observations from December to February), SP - spring (March to May), SM - summer (June to August), A - autumn (September to November).

The species richness remains relatively constant during the warm period of the year, with a slight decrease from spring, when the maximum number of species (41) was recorded, till autumn, but is lower during winter, when the species' number (23) drops to a little more than half.

The number of bird species decreases constantly (a difference of 5 species between consecutive sectors) on altitude. The only exception is represented by the sector V (spruce forest and montane meadow), where a higher number of species than in the previous one was observed. A high number of species (42) was recorded apart from these transects, on the way to Sterpu Peak. This is the sole part of the river basin where subalpine *Pinus mugo* shrubs and rocky meadows can be found, as well as an alpine meadow covering a small area around the peak. The alpine and subalpine meadows are the typical habitats for *Anthus spinoletta* and *Prunella*

Table 1

The bird species observed in Lotrioara River Basin and their seasonal and altitudinal distribution (the codes are explained in the text).

No.	Species	Season				Sector						BC	BD	RB
		W	SP	SM	A	I	II	III	IV	V	VI			
1.	<i>Aquila pomarina</i>			+							+	II	I	VU
2.	<i>Hieraaetus pennatus</i>			+	+				+		+	II	I	CR
3.	<i>Circetus gallicus</i>			+							+	II	I	VU
4.	<i>Buteo buteo</i>	+	+	+	+	+	+	+	+		+	II		
5.	<i>Pernis apivorus</i>			+							+	II	I	VU
6.	<i>Accipiter gentilis</i>		+	+	+	+	+	+	+		+	II		
7.	<i>Accipiter nisus</i>	+		+	+	+	+	+			+	II		
8.	<i>Falco subbuteo</i>			+	+					+	+	II		
9.	<i>Falco tinnunculus</i>			+							+	II		
10.	<i>Tetrao urogallus</i>	+		+	+		+		+	+	+	III	I	
11.	<i>Bonasa bonasia</i>	+		+	+			+	+	+		III	I	
12.	<i>Columba palumbus</i>		+	+						+	+			
13.	<i>Cuculus canorus</i>		+	+		+	+		+			III		
14.	<i>Strix uralensis</i>		+	+			+				+	II	I	
15.	<i>Upupa epops</i>			+			+					II		VU
16.	<i>Picus canus</i>				+			+				II	I	
17.	<i>Dendrocopos major</i>	+	+	+	+	+	+				+	II		
18.	<i>Dendrocopos minor</i>				+		+					II		
19.	<i>Dryocopus martius</i>				+					+		II	I	
20.	<i>Jynx torquilla</i>			+						+		II		EN
21.	<i>Alauda arvensis</i>		+							+		III		
22.	<i>Hirundo rustica</i>		+	+		+						II		
23.	<i>Delichon urbica</i>			+	+	+					+	II		
24.	<i>Anthus spinoletta</i>			+							+	II		
25.	<i>Anthus trivialis</i>			+	+				+	+		II		
26.	<i>Motacilla cinerea</i>		+	+	+	+	+	+			+	II		
27.	<i>Motacilla alba</i>		+	+	+	+	+	+		+	+	II		
28.	<i>Lanius collurio</i>		+	+		+	+		+		+	II		
29.	<i>Sturnus vulgaris</i>		+	+		+								
30.	<i>Garrulus glandarius</i>	+	+	+	+	+	+	+	+	+	+			
31.	<i>Nucifraga caryocatactes</i>	+	+	+	+	+	+	+	+	+	+	II		
32.	<i>Corvus corax</i>	+	+	+	+	+	+	+	+	+	+	III		EN
33.	<i>Cinclus cinclus</i>	+	+	+	+	+	+	+			+	II		
34.	<i>Troglodytes troglodytes</i>	+	+	+	+	+	+	+	+	+	+	II		
35.	<i>Prunella collaris</i>			+							+	II		
36.	<i>Prunella modularis</i>		+	+		+	+	+	+		+	II		
37.	<i>Sylvia atricapilla</i>		+	+	+	+	+	+	+	+	+	II		
38.	<i>Sylvia curruca</i>		+	+		+			+		+	II		
39.	<i>Phylloscopus trochilus</i>		+	+			+	+	+			II		
40.	<i>Phylloscopus collybita</i>		+	+	+	+	+	+	+		+	II		
41.	<i>Phylloscopus sibilatrix</i>			+							+	II		
42.	<i>Regulus regulus</i>	+	+	+	+		+	+	+	+	+	II		
43.	<i>Regulus ignicapillus</i>		+		+	+	+	+				II		
44.	<i>Ficedula parva</i>			+					+			II	I	
45.	<i>Muscicapa striata</i>			+							+	II		
46.	<i>Phoenicurus phoenicurus</i>		+	+		+					+	II		
47.	<i>Phoenichurus ochruros</i>		+	+	+	+				+	+	II		
48.	<i>Erithacus rubecula</i>		+	+	+	+	+	+	+	+	+	II		
49.	<i>Turdus torquatus</i>			+						+		II		
50.	<i>Turdus merula</i>		+	+	+	+	+	+	+	+	+	III		
51.	<i>Turdus philomelos</i>		+	+	+	+	+	+				III		
52.	<i>Turdus viscivorus</i>		+	+	+			+		+		III		
53.	<i>Turdus pilaris</i>		+			+						III		
54.	<i>Parus montanus</i>	+	+	+	+	+	+	+	+	+	+	II		
55.	<i>Parus cristatus</i>	+	+	+	+		+	+		+	+	II		
56.	<i>Parus caeruleus</i>	+	+	+	+	+	+	+	+	+		II		
57.	<i>Parus ater</i>	+	+	+	+	+	+	+	+	+	+	II		
58.	<i>Parus major</i>	+	+	+	+	+	+	+	+			II		
59.	<i>Aegithalos caudatus</i>	+	+		+	+	+	+	+	+		II		
60.	<i>Sitta europaea</i>	+	+	+	+	+	+	+				II		
61.	<i>Certhia familiaris</i>	+	+		+	+	+	+		+		II		
62.	<i>Fringilla coelebs</i>	+	+	+	+	+	+	+	+	+	+	III		
63.	<i>Pyrrhula pyrrhula</i>	+		+	+	+		+	+	+	+	III		
64.	<i>Coccothraustes coccothraustes</i>			+		+						II		
65.	<i>Carduelis spinus</i>	+			+	+	+	+		+		II		
66.	<i>Carduelis carduelis</i>		+		+	+	+			+		II		
67.	<i>Carduelis cannabina</i>				+	+						II		
68.	<i>Loxia curvirostra</i>	+		+	+					+	+	II		
69.	<i>Emberiza cia</i>		+			+						II		
70.	<i>Emberiza citrinella</i>		+	+		+					+	II		
Total		23	41	40	38	42	37	32	28	29	42	67	10	7

collaris, which were observed only here. Other 6 species were also found only along this transect: *Phylloscopus sibilatrix*, *Muscicapa striata*, *Pernis apivorus*, *Aquila pomarina*, *Falco tinnunculus* and *Delichon urbica*. The last two species were observed near Sterpu Peak as well.

Both the species number and the specific structure of bird communities remain relatively constant during the warm period of the year. Thus, the cluster analysis of the four seasons based on Jaccard similarity index (Fig. 2) shows a high homogeneity of the warm seasons, while during winter, the most distinctive bird fauna is found. The same analysis, performed along the altitudinal gradient, also reveals a gradual change in the ornithofauna, different transects joining by the increase in elevation (Fig. 3). However, the highest similarity (0.73 in terms of Jaccard index) was calculated not for the first two transects, but for transects II and III, both situated in the mixed forest vegetation level, joined at a greater distance (0.57) by transect I, which crosses the village. The most distinctive fauna (0.35) was found in transect V, situated at the highest elevation, but also along an ecotone.

Based on the birds' observed presence in the research area, we established three phenological categories: sedentary species - encountered during the entire study period, warm season species - observed during spring, summer and autumn but not found in winter, and wintering species. As several less abundant species were only seldom observed (some in a single transect), we do not have the evidence of breeding for all the species recorded during the warm period of the year. The

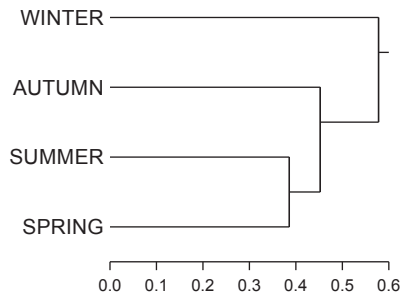


Fig. 2 - Similarity (1-Jaccard index values) between the four seasons based on the bird fauna.

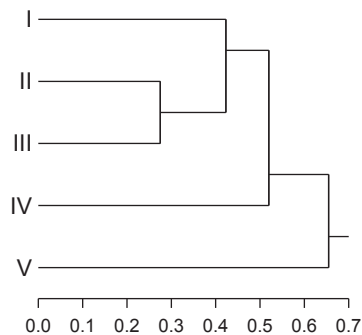


Fig. 3 - Cluster analysis of the five transects, based on the similarity (1-Jaccard index values) between their bird fauna.

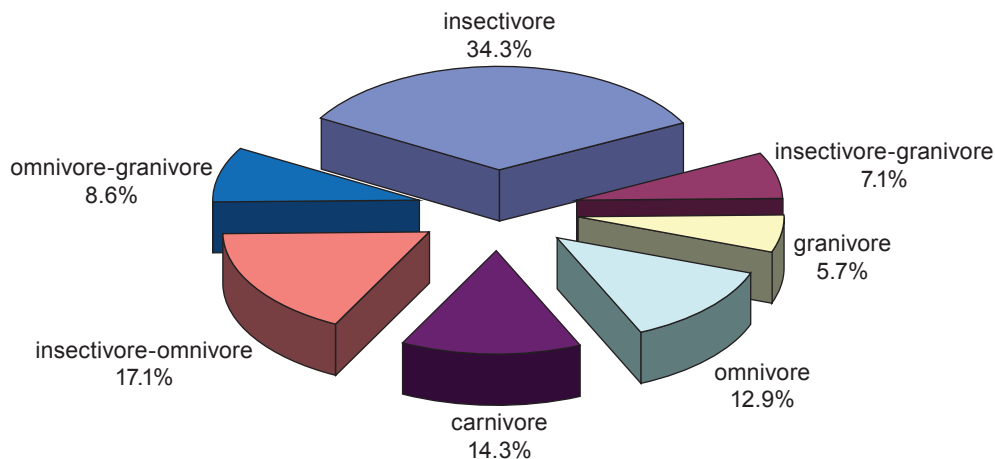


Fig. 4 - Trophic structure of bird community (% of species) from the Lotrioara River Basin during the study period.

warm season birds are the most numerous species, representing 67.1%, while the sedentary birds make up only 31.4% of the species.

Among the feeding guilds the insectivores are prevailing, representing 34.3% (Fig. 4) and, as the antropic impact on the valley is low, the carnivorous species are also well represented in the area (14.3%). However, many bird species, especially insectivores, change their diet during the year, according to the availability of different food sources. Some species feed during the breeding season exclusively (or mainly) on insects, but switch during winter to an exclusively vegetal (e.g. *Emberizidae*) or omnivorous diet (e.g. *Turdidae*), dominated by fruits (berries) and seeds. These species are included in two separate groups with a variable trophic regime, insectivores-granivores (7.1%) and the insectivores-omnivores (17.1%). The omnivores (12.9%) (belonging to *Corvidae* and *Paridae* families) have a mixed trophic regime all year round, although a shift in the prevailing food resource exploited by these birds also occurs with the change of seasons (Bezzel, 1996).

The Pearson chi-square test for independence revealed significant differences ($\chi^2 = 18.56$, d.f.= 3, $p < 0.01$) between the ratios of feeding guilds in the breeding season (from late spring to late summer) and in the rest of the year (from beginning of autumn to early spring), showing a seasonal dynamics of the bird fauna trophic structure.

An important change is recorded by granivores, which increase in ratio from 5.8% during the breeding season to 30.4% in winter (Fig. 5). Omnivores also become more numerous, prevailing during the cold season (43.4%). In contrast, insectivores decrease from 59.4% in the breeding season to 17.7% in winter. Carnivores present a low amplitude of variation along the year.

Concerning the altitudinal distribution of the feeding guilds, the most evident characteristic is the variation of granivores, which reach the highest ratio (10.3%) in the uppermost sector (V), where numerous species which turn in winter to vegetarian diet (*Fringillidae*) also occur. However, the Pearson chi-square test for independence indicates no significant dependence of the trophic structure on the elevation.

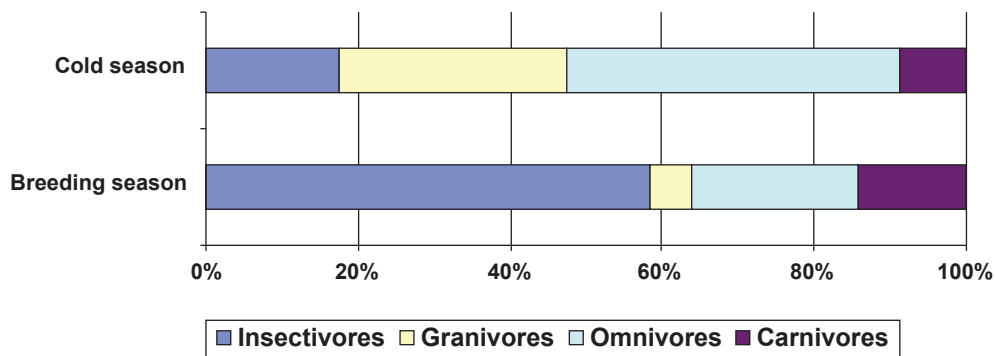


Fig. 5 - Seasonal dynamics of feeding guilds (% of species) in the ornithofauna from Lotrioara River Basin.

DISCUSSIONS

The 70 identified bird species make Lotrioara River Basin comparable to other researched mountain areas. Based on observations during the breeding season Petrescu notes 64 bird species from Făgăraș Mountains (2005) and 76 from Piatra Craiului (1995), Murariu et al. (2009 b) 74 species (among them 10 mentioned only in the literature) from Zarand Mountains. During the 22 months study in the Râșor dam lake area (Iezer-Păpușa Mountains) Mestecăneanu (2008) recorded 69 bird species. However, these results cannot be compared directly, due to the differences in the research methodology and habitat structure from the study areas.

Lotrioara River Basin is a mountain area typical for the Southern Carpathians, characterised by a relatively low human impact, especially in its upper part. The high proportion of species included in the annexes of Bern Convention (95.7%, 80% being strictly protected - annex II), Bird Directive (14.2%) and in the Red Book of Romanian Vertebrates (10%, four species being considered vulnerable, two endangered and one critically endangered) confirms the conservative interest of this area, included in the ROSPA0043 Frumoasa, being one of the Important Bird Areas in Romania - AIA RO051 (Papp & Fântână, 2008).

Considering the elevational distribution some of the bird species from Lotrioara River Basin can be accounted as eurybiotic, being found in a large variety of habitats, at different altitudes (*Nucifraga caryocatactes*, *Corvus corax*, *Erithacus rubecula*, *Turdus merula*, *Fringilla coelebs*, *Phylloscopus collybita*, *Parus montanus*, etc.). Other species were observed only in the lower sector, or exclusively in the village (*Phoenicurus phoenicurus*, *Hirundo rustica*, *Turdus pilaris*, *Sturnus vulgaris*). The number of birds restricted to higher elevations is small, some of them being linked to the subalpine vegetation level (*Anthus spinoletta*, *Prunella collaris*), others to the spruce forest (*Turdus torquatus*, *Loxia curvirostra*). Thus, the species richness decreases constantly with the increase in altitude. The only exception is represented by the last sector, transect V, which shelters a higher number of species than the previous one, because it crosses a variety of habitats and the ecotone effect is strong. Here we observed birds typical both for mature spruce forests, feeding on the abundant seeds (*Loxia curvirostra*) or insects from the tree trunks (*Dendrocopos martius*, *Jynx torquilla*), and for open habitats (*Alauda arvensis*, *Anthus trivialis*).

The monotonic decrease of species' number with increasing altitude was mentioned by several other authors, in different mountains, both in tropical (Terborgh,

1977; MacKinnon & Phillips, 1993) and temperate (Sackl & Samwald, 1997; Sergio & Perdini, 2007) regions. In many cases the continuous decrease observed along the elevational gradient is the effect of area. If the necessary correction is made, the relationship between species richness and elevation gives in several cases a humpshaped curve (Rahbek, 1995).

Compared to the Romanian bird fauna, the ornithofauna from Lotrioara Basin has a very different phenologic structure. Considering the whole Romanian territory, most of the encountered bird species are sedentary, while in mountains, including the research area, most birds only nest here. The breeding species include the migratory birds (*Phylloscopus collybita*, *Sylvia atricapilla*, *Hirundo rustica*, *Cuculus canorus*) but also non-migratory species that during winter are found at lower elevations (*Turdus merula*, *T. viscivorus*, *Coccothraustes coccothraustes*, *Carduelis carduelis*). The relatively small proportion of sedentary species is due to the insufficient resources offered by the area in the cold season. Most of the resident species (*Garrulus glandarius*, *Nucifraga caryocatactes*, *Corvus corax*, *Parus montanus*, *P. ater*) are found during the whole year up to Prejba Chalet, while a smaller number (*P. major*, *Fringilla coelebs*, *Troglodytes troglodytes*) are present during winter only in the lower parts of the valley. The species which descend to lower altitudes during the cold season, whether they leave the basin or not, in spring return gradually up to the maximum elevation. Thus, *Turdus merula* was found in March in sectors I and II, in April in sectors I, II, III and in June up to Prejba Chalet. Contrary, the migratory species advance generally much faster on altitude. Thus, *Phylloscopus collybita* was first observed in April, being noted in the same day up to the maximum altitude where it was recorded, and *Motacilla alba* was observed in March next to Prejba Chalet.

The species not observed in winter are not necessarily completely absent from the research area in this season, but their densities are decreased, most of the individuals having left the valley for some more suitable areas.

Among the feeding guilds, the prevailing insectivores include birds feeding on insects mainly in the canopy (*Phylloscopus* spp., *Regulus* spp., *Aegithalos caudatus*), on the tree stems (*Dendrocopos minor*, *Dryocopus martius*), in the air (*Delichon urbica*, *Hirundo rustica*), on the ground (*Motacilla alba*, *Anthus spinoletta*), and also two species living exclusively along the river courses (*Cinclus cinclus* and *Motacilla cinerea*), which feed on aquatic invertebrates. The latter are included by some authors (Stănescu, 1971) in a separate feeding guild, the potamotrophs. Most species belonging to this group are breeding species, as insects are a resource available mainly in the warm season, being the most important food for the growing chicks. Thus, the strong decrease of the insectivores' ratio during winter is due to the migration of some species (*Phylloscopus* spp., *Delichon urbica*, *Hirundo rustica*, *Lanius collurio*) and to the fact that other species (*Turdus* spp., *Fringilla coelebs*) switch to vegetal food. The shift in the birds' diet occurs at the end of the breeding season, at the end of summer and beginning of autumn, when fruits and seeds become an accessible food resource, and becomes stronger in winter, when insects and other invertebrates are scarce and difficult to reach.

In turn the ratio of granivores increases significantly during the cold season. Their food includes seeds and fruits of trees, both deciduous (*Carduelis spinus*, *Pyrrhula pyrrhula*) and coniferous (*Loxia curvirostra*), but also herbaceous plants (*Carduelis cannabina*, *C. carduelis*). The slight increase of granivores' ratio at higher elevations was observed also in other studies (Klosius, 2008). However, like in our case, the differences were not significant.

Conclusions

During this study in Lotrioara River Basin 70 bird species belonging to 9 orders were recorded. The spatial dynamics of the community is characterised by the decrease of species' number with the increase in altitude. However, this relation is not always linear, being influenced also by the habitat heterogeneity. Transects are clustered depending on altitude and habitat type. The bird community from Lotrioara River Basin is dominated by the breeding species, a few species being adapted to the harsh environmental conditions in the mountain valleys during winter. Insectivores prevail in the community, but significant seasonal variations are recorded, during winter omnivores and granivores becoming dominant.

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AVIFAUNA DIN BAZINUL RÂULUI LOTRIOARA (MUNȚII LOTRULUI, ROMÂNIA)

REZUMAT

Sunt prezentate rezultatele unui studiu asupra comunităților de păsări din bazinul râului Lotrioara (Munții Lotrului, România), desfășurat pe parcursul unui an, utilizând metoda transectelor de-a lungul văii principale. Cercetările au urmărit caracteristicile dinamicii ornitofaunei, atât din punct de vedere spațial cât și temporal. Pe perioada studiului au fost identificate, în zona cercetată, 70 de specii aparținând la 9 ordine. Numărul de specii scade cu creșterea altitudinii, însă această descreștere nu este liniară, ci depinde și de heterogenitatea habitatelor. Pe parcursul anului, numărul speciilor variază de la un minim iarna la un maxim în timpul verii. Structura trofică a comunităților de păsări din bazinul râului Lotrioara este dominată de insectivore, dar în perioada rece a anului dominanța este preluată de omnivore și granivore.

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TERRESTRIAL SMALL MAMMAL COMMUNITIES FROM HÂRTIBACIU PLATEAU (ROMANIA)

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ADRIAN RĂULEA, ADRIANA VORNICU

Abstract. Small mammal communities were studied by live trapping during August-September 2010 and June-September 2011 in three localities from Hârtibaciu Plateau, in southern Transylvania. The area is situated between 420 and 550 m a.s.l., and represents a mosaic of small patches of different land use. 200 traps were set in lines for three consecutive nights, in 80 different habitats representing 12 habitat types, both cultivated and semi-natural. 1235 small mammals belonging to 15 species (four soricomorphs and 11 rodents) were captured. Abundance of small mammals was expressed by means of capture index (number of individuals caught per 100 active trap-nights). The community structure was strongly shaped by habitat type, even in case of small land patches. *Microtus arvalis* prevailed in the investigated area, being the dominant species in open fields with high grassy vegetation. The density of this species increased strongly from the beginning of summer to autumn, when the traps were occasionally saturated with field voles.

Résumé. Les communautés de petits mammifères ont été étudiées en utilisant des pièges pour la capture des animaux vivants, pendant Août-Septembre 2010 et Juin-Septembre 2011 dans trois localités du Plateau Hârtibaciu, dans le sud de la Transylvanie. La zone est située entre 420 et 550 m altitude et représente une mosaïque de petites parcelles de différentes utilisations. 200 pièges ont été installés dans les transects linéaires pour trois nuits consécutives, dans 80 habitats différents représentant 12 types d'habitats, cultivés et semi-naturels. 1235 petits mammifères, appartenant à 15 espèces (quatre musaraignes et 11 rongeurs) ont été capturés. L'abondance des petits mammifères a été exprimée par l'index de capture (nombre d'individus capturés par 100 pièges-nuits actifs). La structure de la communauté de petits mammifères a été fortement influencée par le type d'habitat, même en cas de petites parcelles. *Microtus arvalis* a prévalu dans la zone étudiée, étant l'espèce dominante dans les champs ouverts avec végétation herbeuse haute. La densité de cette espèce a augmenté à partir du début de l'été jusqu'à l'automne, lorsque les pièges ont été occasionnellement saturés avec campagnols agrestes.

Key words: rodents, shrews, live trapping, community structure, habitat preferences.

INTRODUCTION

Hârtibaciu Plateau is an area of great conservation importance in Romania, being part of the Site of Community Importance ROSCI0132 Oltul Mijociu-Cibin-Hârtibaciu. It is a mosaic of habitats in an almost natural state, which shelters a high biodiversity. Several studies were made on different groups, mainly plants and birds, but information on the mammal fauna is scarce. The only published research (Benedek, 2007) presents the data obtained by live-trapping in September 2003 from four study sites (Retiș, Brădeni, Stejărișu and Dealu Frumos localities) in the upper part of Hârtibaciu River Basin.

The aim of the present study is to widen the knowledge on small mammal communities from different localities in relation to the habitat types and to highlight the seasonal changes in these communities.

STUDY AREA AND METHODS

Between 2010 and 2011, a survey of small mammal communities from different habitat types was carried out in the Hârtibaciu Plateau. In autumn 2010 a field campaign took place in two localities from Hârtibaciu Plateau, namely Benești (named Benești I) and Iacobenii. In 2011 the survey was accomplished during two campaigns, one in summer and the other in autumn (beginning with late August), in Alțâna and Benești, in another area than during the previous year (named Benești II). The survey was carried out by means of CMR (capture-mark-release) method, using plastic handmade box traps (18x8x6 cm) set in lines in different habitats. Each transect included 33 or 34 traps, placed at intervals of 10 m. Six (in 2010) or five (in 2011) trap lines were set at the same time, and traps were checked for three consecutive nights, at dawn and in the evening. In all, 80 transects were established in 12 habitat types: pastures, hayfields, unused lands with low vegetation - margins of roads and railroads - and high vegetation - river and canal banks, corn, wheat and alfalfa fields, abandoned cultures, pastures with sparse shrubs, shrubby pastures with extensive woody vegetation cover, forest edges and hornbeam (*Carpinus betulus*) forests. The position of sampling localities is indicated in fig. 1. The number of transects in each habitat type was proportional to its ratio in the area, so that the results give a sound image of the structure and abundance of small mammal communities from the investigated zones.

The traps were baited with sunflower seeds and apple slices. No prebaiting was done. No bedding material was provided, but the traps were set in shady places or when not possible, hay cover was provided in order to avoid overheating of captured animals. The captured specimens were identified to species based on morphological characters (Murariu, 2000; Popescu & Murariu, 2001), marked by fur clipping on

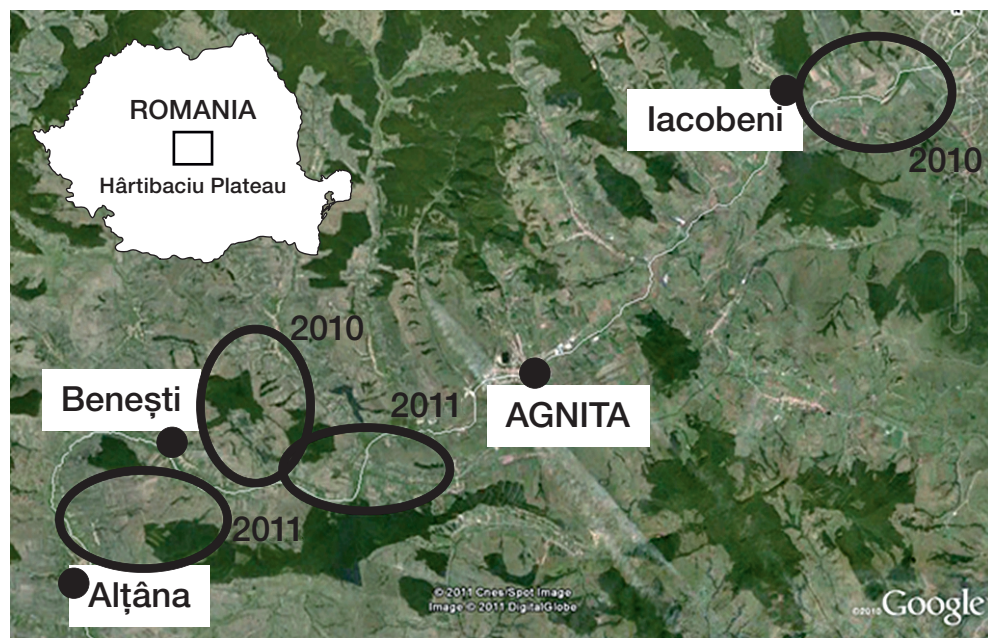


Fig. 1 - Study area in Hârtibaciu Plateau with sampling localities and the year of sampling.

the rear part of the back, and released. In case of mice belonging to *Apodemus* genus (*A. flavicollis*, *A. sylvaticus*, *A. uralensis*) we considered the presence and shape of the collar, the colour of the back and belly, the length of hind foot and the ratio between the lengths of tail and body.

Relative abundance was expressed as the ratio of the species (in percentages) within a sample. Frequency was calculated as the ratio (in percentages) between the trap lines where the species was captured and the total number of trap lines. Abundance, as a measure of population density, was expressed as capture index, meaning the number of captured individuals per 100 active trap-nights (TN). Many traps were disturbed by animals (especially shepherd dogs), rain or wind, destroyed by tractors or cattle, or even stolen, thus of the intended 8010 TN (80 lines with 33-34 traps for 3 consecutive nights) only 5571 TN (69.6%) were effective.

Mystat 12 software was used for data analysis. The significance of correlation between the abundance and frequency of the captured species and between the number of captured species and capture index in different habitat types was tested and its strength expressed by Pearson correlation coefficient. The Pearson χ^2 test of independence was used to test the influence of the locality on the species' ratio (McDonald, 2009). The association between the prevailing species was tested using t test, and its strength was expressed both in qualitative - by means of Fager index (Southwood, 1966) and quantitative terms - proportion of individuals occurring together - we used the modified Whittaker and Fairbanks equation (Southwood & Henderson, 2000), with the range of 0 to 1.

RESULTS

A total number of 1235 individuals were captured, belonging to 15 species, four shrews and 11 rodents. Further three species were identified based on direct or indirect visual observations. The number of specimens captured during the research period, the species' frequency (F%), the trapping effort and the capture index for each site are presented in tab. 1.

The terrestrial small mammal species known to inhabit Hârtibaciu Plateau, based on the data collected during the field campaigns and the previous study carried out in September 2003 (Benedek, 2007), are presented below. Systematics is given according to Wilson & Reeder (2005).

Order Erinaceomorpha

Family Erinaceidae

1. *Erinaceus roumanicus* Barret-Hamilton, 1900 (Eastern hedgehog) – a specimen was found crossing a dirt road in Alțâna in August 2011.

Order Soricomorpha

Family Soricidae

2. *Sorex araneus* Linnaeus, 1758 (Common shrew) – the most abundant and frequent shrew species during this study, but also in September 2003, captured in a great variety of habitat types.

3. *Sorex minutus* Linnaeus, 1766 (Pygmy shrew) – two specimens were captured in one of the research areas (Benești) in August and September 2011. In the 2003 study, this shrew species was captured at the forest edge from Brădeni and Retiș.

Table 1

Terrestrial small mammals captured in the localities from Hârtibaciu Plateau, in 2010 and 2011 (F% stands for frequency).

Species	2010		2011		Total	F%
	Benești	Iacobeni	Alțâna	Benești		
<i>S. araneus</i>	0	4	11	1	16	12.50
<i>S. minutus</i>	0	0	0	2	2	1.25
<i>C. suaveolens</i>	0	1	0	1	2	2.50
<i>C. leucodon</i>	0	1	0	0	1	1.25
<i>M. glareolus</i>	2	0	0	2	4	2.50
<i>A. sherman</i>	1	0	0	5	6	7.50
<i>M. arvalis</i>	55	277	178	108	618	73.75
<i>M. subterraneus</i>	0	0	27	4	31	7.50
<i>M. minutus</i>	0	0	4	0	4	2.50
<i>A. agrarius</i>	29	169	87	55	340	47.50
<i>A. flavicollis</i>	50	12	14	4	80	31.25
<i>A. sylvaticus</i>	0	24	37	6	67	25.00
<i>A. uralensis</i>	0	0	28	2	30	16.25
<i>M. musculus</i>	1	4	28	0	33	10.00
<i>R. norvegicus</i>	0	0	0	1	1	1.25
Total	138	492	414	191	1235	
Trapping effort	763	1010	2121	1677	5571	
Capture index	18.08	48.71	19.51	11.38	22.16	

4. *Neomys fodiens* (Pennant, 1771) (Water shrew) – one specimen captured in the riverside willow thicket at Stejărișu in September 2003.

5. *Crocidura leucodon* (Hermann, 1780) (Bicoloured white-toothed shrew) – was found during both studies, in 2003 in the shrubs from Stejărișu, and in 2010 in the pasture with sparse shrubs from Iacobeni.

6. *Crocidura suaveolens* (Pallas, 1811) (Lesser white-toothed shrew) – two specimens were captured, one in the pasture with sparse shrubs from Iacobeni in September 2010 and the other under a bush in a hayfield from Benești, in September 2011.

Family Talpidae

7. *Talpa europaea* Linnaeus, 1758 (European mole) – was widely spread in the area, its presence being indicated by the numerous mole hills from different habitats. One specimen was found dead in a hayfield in Alțâna in July 2011.

Order Rodentia

Family Castoridae

8. *Castor fiber* Linnaeus, 1758 (Beaver) – probably went extinct in Romania during the first decades of the 19th century, although in 1850 Bielz mentioned the possibility of its presence in Transylvania. In 1998 ICAS (The Institute for Forest Research and Management) Brașov initiated a program of reintroduction on three

rivers from Romania, namely Olt, Mureş and Ialomiţa, which lasted until 2003. 182 specimens brought from Bavaria were released and they established stable populations, which are now in process of expansion (www.beaver.icaswildlife.ro). From the upper sector of the Olt River, the reintroduced beavers colonised its middle course and some of tributaries, including Hârtibaciu (via Cibin River). Local people claim that the beaver is found along the most part of the river. During our study several burrow entrances and footprints were observed downstream Alţâna and more recently fallen and gnawed willow trunks and branches were found downstream Caşolţ, near the confluence with Cibin River and in the upper sector, upstream Netuş.

Family Gliridae

9. *Glis glis* (Linnaeus, 1866) (Fat dormouse) – was captured in the mixed broadleaf forest from Retiş and at the forest edge from Brădeni in 2003.

10. *Muscardinus avellanarius* (Linnaeus, 1758) (Hazel dormouse) – three specimens were captured in September 2003 at Dealu Frumos, in the hornbeam and oak forest, the forest clearing and in the ditch along a dirt road.

Family Cricetidae

11. *Arvicola sherman* (Shaw, 1801) (Montane water vole) – was captured only at Beneşti, both in 2010 and 2011, in hayfields, unused lands with high vegetation and pastures with sparse shrubs.

12. *Myodes* (syn. *Clethrionomys*) *glareolus* (Schreber, 1780) (Bank vole) – was found in 2003 in the forests and at the forest edges from Dealu Frumos, Brădeni and Retiş, in 2010 at the forest edge from Beneşti and in 2011 in the unused land with high vegetation bordering the willow riparian forest on the banks of Hârtibaciu River at Beneşti.

13. *Microtus arvalis* (Pallas, 1778) (Common vole) – captured in 2003 only at Dealu Frumos and Brădeni, in several open habitats, was the most abundant and frequent species during the present study, found in most types of habitat, in all the research areas, both in 2010 and 2011.

14. *Microtus subterraneus* (de Selys-Longchamps, 1836) (Common pine vole) – was found only in 2011, both in Alţâna and Beneşti, in different moist habitats with high and rich vegetation.

Family Muridae

15. *Micromys minutus* (Pallas, 1771) (Harvest mouse) – was captured only at Alţâna, in a hayfield and an unused field with high vegetation, in August 2011.

16. *Apodemus agrarius* (Pallas, 1771) (Striped field mouse) – although not the prevailing species, it was very abundant and frequent both in 2003 and 2010-2011, being present in all the habitat types except for the forest.

17. *Apodemus flavicollis* (Melchior, 1834) (Yellow-necked mouse) – the prevailing species in 2003, was captured during the present study in all the research areas, mainly in forests and at forest edges, but also in other habitats with wooded vegetation or near the forest.

18. *Apodemus sylvaticus* (Linnaeus, 1758) (Wood mouse) – in 2003, was captured at Dealu Frumos (dominant in the clearing), Brădeni (dominant in the reed bed) and at Retiş and during the present study in all the three localities (at Beneşti only in 2011), in cultivated fields and semi-natural habitats with moderate cover of woody vegetation (it was absent both in the hayfields and forests).

19. *Apodemus uralensis* (Pallas, 1811) (Pygmy field mouse) – in 2003, was found only at Dealu Frumos in the cornfield and the adjacent shrubby ditch, during the present study it was found only in 2011, in both areas, in the same habitat types as *A. sylvaticus*.

20. *Mus musculus* Linnaeus, 1758 (House mouse) – was found in all three localities (at Benești only in 2010), mainly in cultivated (corn and wheat) fields, being most numerous in the maize culture near the abandoned farm from Alțâna.

21. *Rattus norvegicus* (Berkenhout, 1769) (Brown rat) – one juvenile was captured in July 2011 in an abandoned cornfield from Benești.

Among the captured small mammals rodents were dominant, and among them the vole *M. arvalis* (50%) and the mice species belonging to *Apodemus* genus (Fig. 2). *M. arvalis* also recorded the highest frequency, being captured in 73.75% of the trap lines. It was followed by *A. agrarius*, both in what relative abundance (27.5%) and frequency (47.5%) are concerned. A significant association was found between these two species ($p < 0.001$; $t = 3.979$; $df = 95$), both preferring open habitats with high vegetation, and being widely distributed in the research area. The affinity between these species was slightly stronger when abundance was considered (the proportion of the individuals occurring together was 0.75, while the Fager affinity index was 0.68).

A. flavicollis and *A. sylvaticus* had similar ratios, the first being slightly more abundant and more frequent, found mainly in forests and at forest edges, as well as in habitats with woody vegetation. All the other small mammals presented low ratios and frequencies. Among the shrews *S. araneus* prevailed, with 16 captured specimens (1.3%).

There was a very significant ($p < 0.001$), positive and strong ($r = 0.950$) correlation between the relative abundance and frequency calculated for the captured small mammals.

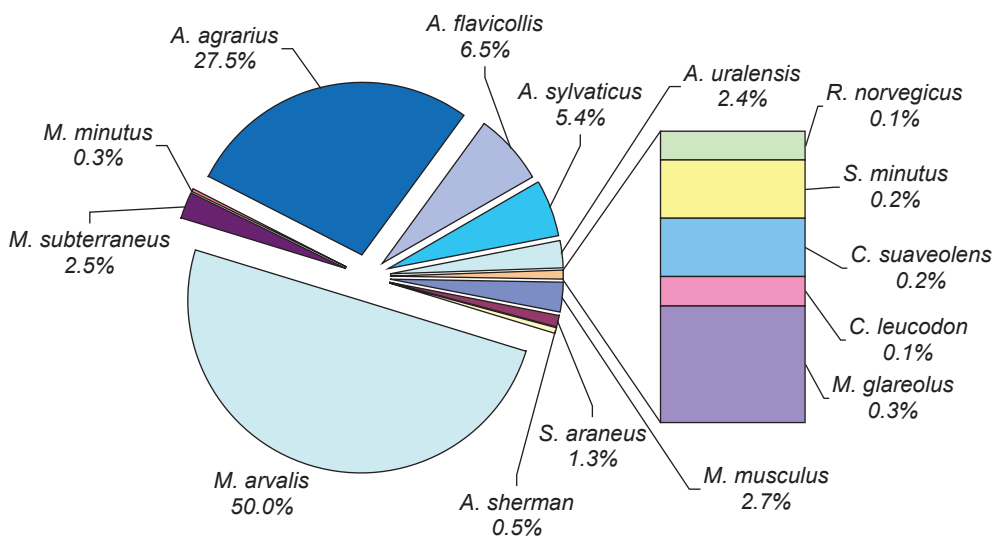


Fig. 2 - Relative abundance of terrestrial small mammal species captured in Hârtibaciu Plateau during the research.

Considering separately the four investigation areas, the Pearson chi-square test for independence showed a very significant ($p < 0.001$, $\chi^2 = 233.737$, $df = 9$) dependence of the relative abundance of the most abundant species (*M. arvalis*, *A. agrarius*, *A. flavicollis* and *A. sylvaticus*) on the locality, the most distinctive being Benești I. Here *A. flavicollis* had a high ratio, outnumbering *A. agrarius*, being second only to *M. arvalis*. However, if we consider only the two prevailing species in the four areas, *M. arvalis* and *A. agrarius*, their abundance did not differ significantly ($p > 0.05$, $\chi^2 = 2.195$, $df = 3$), indicating a homogeneity of the small mammal communities in this type of patchy landscape from southern Transylvania.

In 2011, each transect was set twice, first time in mid-summer and then in late summer and early autumn, enabling us to observe the changes occurred in the small mammal populations as a consequence of the breeding season. There were some similarities but also differences between the patterns of seasonal changes in the two localities. In both cases there was a significant increase of the total capture index. The increase was stronger in Benești, where the capture index rose from 3.3 ind./100 TN in summer to 19.3 in autumn (Fig. 3). At Alțâna the increase was given mainly by *A. agrarius* and at a lesser extent by *A. sylvaticus* and *M. subterraneus*, while *M. arvalis* presented a similar abundance (8.1 ind./100 TN in summer and 8.6 in autumn). *A. flavicollis* was the only species with a lower capture index in autumn (0.4 compared with 0.9 ind./100 TN in summer), indicating that it was present along the trap lines only temporarily, coming from the neighbouring forest. At Benești the strong growth of the community density was given by *A. agrarius* and especially *M. arvalis*, the latter with an increase in the capture index more than tenfold (from 0.9 to 12 ind./100 TN).

In autumn, although the total capture index for *M. arvalis* was around 10 ind./100 TN in both localities, in suitable habitats (e.g. some unmown hayfields) the traps were saturated with field voles, the capture index being occasionally higher than 100 ind./100 TN (due to day-time captures and multiple catches).

The density and diversity of small mammal communities varied greatly among the researched habitat types (Fig. 4). Although the correlation between the species number and capture index is not really significant ($p = 0.06$), if we leave out the forests and consider only the more or less open habitats, the correlation becomes highly significant and strong ($p = 0.003$, $r = 0.805$). The highest capture index (51.1 ind./100 TN) and also species richness (11 species) were recorded for the unused

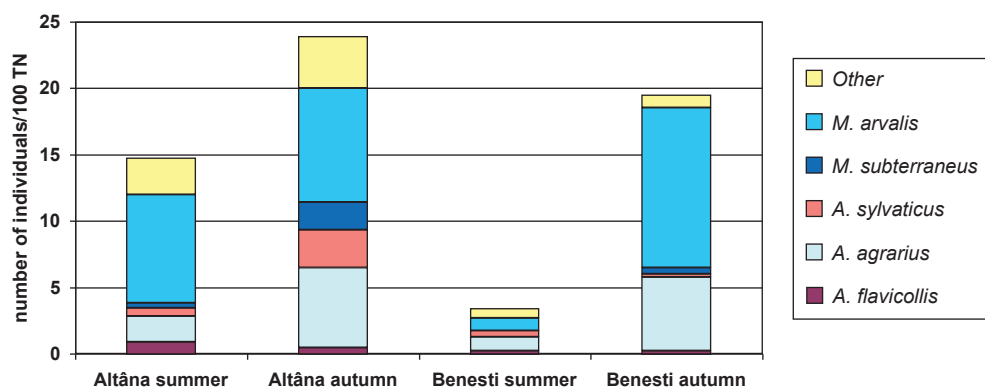


Fig. 3 - The abundance of small mammals from the two localities sampled in summer and autumn 2011.



Fig. 4 - Abundance and species richness of small mammal communities in the investigated habitat types (captures from all trap lines in the same habitat type are pooled together).

lands with high vegetation, most of them situated along the willow riparian forest on the bank of Hârtibaciu River and along the canals separating the cultivated fields. Abundant and diverse assemblages were sheltered also by abandoned fields, where 8 species were found, with a total of 44.2 ind./100 TN. Both had a good ground cover by high and diverse vegetation and presented a low human disturbance.

In forests the relatively high density was given by the yellow-necked mouse, the sole species captured in this habitat. The other typical forest species (e.g. dormice, bank vole), well represented in the previous survey, are more exacting in what the habitat conditions are concerned. Thus, they were absent from the two forests due to the lack or poor development of undergrowth (Benești I) or to the disturbance from grazing sheep (Altâna).

Among the cultivated terrains the richest small mammal assemblages were sheltered by cornfields, due to the high vegetation and food availability, their structure being influenced by the presence and density of weeds. In plots where intensive agricultural works were carried out, leaving behind an extremely neat and tidy maize culture, with no other plants among the corn stems, small mammals were poorly represented, with the house mouse among the prevailing species. In contrast, in plots with a rich cover of weeds, where no herbicides were sprayed and no hoeing was done, communities were more abundant and diverse. Several other species of rodents were also abundant in these habitats: the striped field mouse, the wood mouse, the pygmy field mouse and the common vole, the latter being the prevailing species in the wheat and alfalfa fields. However, the presence of rodents in different cultures is usually temporary, depending on the food and shelter resources and the disturbing effect of agricultural works (Hamar & Șutova, 1965, 1968; Theiss, 1962).

The species number and capture index values decreased with the reduction of land cover, vegetation height and human pressure. The poorest habitats in what density is concerned, were the pastures. The same conclusion was drawn also in the Făgăraș Piedmont (Lazăr et al., 2012). In pastures only 3.8 ind./100 TN were

captured, although in all 4 species were identified. The reasons for the scarcity of small mammals in pastures are the frequent disturbance by grazing sheep (or cattle) and the shepherd dogs, the compacted soil, and especially the short vegetation and the lack of cover.

DISCUSSION

The large extent of open habitats in Hârtibaciu Plateau shapes the structure of the small mammal community, favouring the common vole and the striped field mouse. The two species prevail in all the research sites, finding favourable conditions in several habitat types, where they build up populations increasing in density from summer to autumn.

The results of this study show several similarities with those from another plateau area, the Făgăraș Piedmont (Lazăr et al., 2012). However, the shares of the dominant species are reversed in the two research areas. Compared to Hârtibaciu Plateau, the Făgăraș Piedmont is moister, due to the numerous streams and rivers crossing it, the proximity of the mountains and the montane forest belt. The higher humidity favours the striped field mouse, while the numerical development of the common vole populations is limited. The proximity of the mountain forest belt determines also a relatively high capture index for the yellow-necked mouse. The reduced abundance of this species in autumn compared to summer was observed in both areas, indicating a retreat from the open habitats (including cultivated fields), inhabited or more frequently visited during summer, to the forest.

Although the soricomorphs had a low relative abundance, the common shrew had a relatively high frequency, being captured in a large variety of habitat types. This result confirmed that it is an euryoecious species, inhabiting both open and forested habitats in lowlands and mountain areas (Istrate, 1998; Murariu, 2003; Benedek & Sîrbu, 2009). The scarcity of shrews among the captured small mammals was due mainly to the high density of rodents and the large proportion of open lands among the researched habitats, but might be also the result of sampling bias. The relative abundance of soricomorphs was significantly lower than in 2003 (Benedek, 2007) or in some mountain areas, especially when rodent population densities are low (Benedek, 2006; Benedek & Drugă, 2005), but close to their ratio in the Făgăraș Piedmont (Lazăr et al., 2012), where similar habitat types were surveyed.

Conclusions

During the research period a total number of 1235 individuals were captured, belonging to 15 species (four species of shrews and 11 of rodents). *Microtus arvalis* was the prevailing species, followed by the mice from *Apodemus* genus (*A. agrarius*, *A. flavicollis*, and *A. sylvaticus*). They recorded also the highest frequencies. The population densities increased from summer to autumn, as a result of the breeding season, later in the common vole and earlier in other open habitat species. The number of species and the capture index values decreased with the reduction of land cover, vegetation height and increase in the human pressure. The most abundant and diverse assemblages were sheltered by unused lands with high vegetation and abandoned fields, while the poorest communities were found in pastures. Among the cultivated fields the richest small mammal assemblages were sheltered by maize cultures, their structure being influenced by the presence and density of weeds.

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COMUNITĂȚI DE MAMIFERE MICI TERESTRE DIN PODIȘUL HÂRTIBACIU (ROMÂNIA)

REZUMAT

Comunitățile de mamifere mici au fost studiate prin utilizarea capcanelor tip cutie în perioada august-septembrie 2010 și iunie-septembrie 2011, în trei localități din Podișul Hârtibaciu, în sudul Transilvaniei. Zona este situată între 420 și 550 m alt. și reprezintă un mozaic de mici parcele cu diferite folosințe ale terenurilor. 200 de capcane au fost amplasate în transecte liniare timp de trei nopți consecutive, în 80 de habitate diferite reprezentând 12 tipuri de habitate, atât cultivate cât și semi-naturale. 1235 exemplare aparținând la 15 specii (4 soricomorfe și 11 rozătoare) au fost capturate. Structura comunităților de mamifere mici a fost puternic influențată de tipul de habitat, chiar și în cazul parcelelor mici de teren. *Microtus arvalis* a predominat în zona cercetată, fiind specia dominantă în terenuri deschise cu vegetație ierboasă înaltă, densitatea ei crescând puternic de la începutul verii până toamna.

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MOLECULAR CONFIRMATION ON THE PRESENCE OF *ANADARA KAGOSHIMENSIS* (TOKUNAGA, 1906) (MOLLUSCA: BIVALVIA: ARCIDAE) IN THE BLACK SEA

ANA-MARIA KRAPAL, OANA PAULA POPA,
ALEXANDRA FLORINA LEVARDA, ELENA IULIA IORGU,
MARIETA COSTACHE, FABIO CROCETTA, LUIS OVIDIU POPA

Abstract. The use of DNA barcoding in alien invasions has recently proved to be a powerful tool in delineating dispersal pathways and clarifying doubtful identifications. Morphological similarities between *Anadara kagoshimensis* (Tokunaga, 1906) and *Anadara inaequalis* (Bruguière, 1789) require the use of genetic markers in identifying the ark shell species that has recently invaded the Black Sea. The high genetic similarity (99.8-100%) hereby found between COI sequences obtained from the Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to this taxon.

Résumé. L'utilisation des codes-barres ADN dans les invasions étrangères s'est récemment révélé être un outil puissant dans la délimitation des voies de dispersion et de clarifier des identifications douteuses. Les similitudes morphologiques entre *Anadara kagoshimensis* (Tokunaga, 1906) et *Anadara inaequalis* (Bruguière, 1789) exigent l'utilisation des marqueurs génétiques pour identifier l'espèce d'arcidé qui a récemment envahi la Mer Noire. La similarité génétique élevée (de 99,8 à 100%) trouvée entre les séquences COI obtenus à partir des échantillons de la Mer Noire et les japonais *A. kagoshimensis* confirme au niveau moléculaire que l'espèce bivalve de la Mer Noire roumaine fait partie de ce taxon.

Key words: *Scapharca*, alien species, Black Sea, Romanian coast, COI, DNA barcoding.

INTRODUCTION

Anadara kagoshimensis (Tokunaga, 1906) is a bivalve species, belonging to Arcidae Lamarck, 1809, family frequently consumed in Japan, where it was introduced in several coastal areas in order to increase local food production soon after the end of the World War II (Tanaka & Aranishi, 2014). In Europe, this ark clam species was recorded since the early '60s in Ravenna area (Adriatic Sea), where it was thought to be introduced from the Indo-Pacific region with ballast water (Crocetta, 2012). It was initially identified as *Scapharca* (cf.) *cornea* (Reeve, 1844) (Ghisotti, 1973), although, only few years later, it was re-identified as belonging to *Scapharca inaequalis* (Bruguière, 1789) (Ghisotti & Rinaldi, 1976). This taxon was also recorded two decades later from the Black Sea (Gomoiu, 1984). Lutaenko (2006) first noticed morphological differences between *A. inaequalis* specimens from India and Philippines and those from the Black and Adriatic Seas, concluding that European specimens were, most likely, not *A. inaequalis*. Finally, Huber (2010) suggested that the “*S. inaequalis*” invading Europe was in reality *A. kagoshimensis* from Japan.

As a matter of fact, diagnostic characters differentiating *Anadara* nominal species are weak, and indeed *A. kagoshimensis* exhibits high similarities with *A. inaequalis*. Moreover, the native distributions of the two species partially overlap, with the former widespread in the South China Sea, Yellow Sea and Sea of Japan, whilst the latter living in the Indo-Pacific Ocean (India and Philippines), with the

exception of the Red Sea (Huber, 2010). Due to these similarities, a molecular confirmation of the correct identity of the anadardid species found in Europe should be mandatory.

MATERIAL AND METHODS

Twelve specimens from two different Black Sea sampling sites (Romania: Năvodari - 43°48'33.5" N, 28°35'13.8" E; Grindul Chituc - 44°10'43.1" N, 28°39'35" E) were sequenced for the COI (cytochrome oxidase subunit I) marker. Samples were collected by hand in shallow sandy bottoms and kept in 96% ethanol. Total genomic DNA was isolated from mantle muscle tissue, using Macherey-Nagel NucleoSpin® Tissue kit, according to producer's specifications. Partial COI sequence was amplified in a PCR reaction using the COI-4 primer pair (Tanaka and Aranishi, 2013). The PCR reaction was carried out in 30 µl final reaction volume containing 100 ng DNA template, 10 mM Tris-HCl (pH 8.8 at 25°C), 50 mM KCl, 0.08% (v/v) Nonidet P40, 2 mM MgCl₂, 0.2 mM of each dNTP, 0.1 µM of each primer, 1 U of Taq DNA polymerase 5U/µL (Fermentas UAB, Vilnius, Lithuania) and water up to final volume. The temperature profile of the polymerase chain reaction for the COI marker consisted of initial denaturation at 95°C for 2min, followed by 35 cycles at 94°C for 30s, 50°C for 1min, 72°C for 1min, with a final extension step of 5 min at 72°C. The amplified fragments were visualized on a 1.5% agarose gel stained with ethidium bromide, and then purified using innuPREP DOUBLEpure Kit (Analytik Jena AG, Jena, Germany). Single strand sequencing was performed on a Li-Cor 4300L platform using IRD700-labeled M13 primer HCO2198 and DNA Cycle Sequencing Kit (Jena Bioscience GmbH, Jena, Germany). The obtained sequences were aligned using CodonCode Aligner 3.7.1 (CodonCode Corporation, Dedham, MA, USA), manually edited and then used as a query to the CoreNucleotide collection of GenBank database (<http://www.ncbi.nlm.nih.gov/nucleotide/>).

RESULTS AND DISCUSSIONS

To date, with the sole exception of *Anadara transversa* (Say, 1822) (Albano et al., 2009), no genetic analysis have ever been performed on European *Anadara* species, and only morphology has been used to address the *A. cornealinaequivalvis/kagoshimensis* taxonomic question. Huber (2010) most recent suggestion, despite widely accepted, was exclusively based on shell characters (shape, ligament, inequivalvity, number of ribs, rib sculpture) and color. Ten COI sequences (4 from Năvodari and 6 from Grindul Chituc) were finally obtained from our samples, all exhibiting the same haplotype (GenBank Accession Numbers: KM267562 and KM267563). This was used for querying the CoreNucleotide collection of GenBank database, returning a species match with *Anadara kagoshimensis* at similarity levels between 100% and 99.84% (9 matches).

The COI molecular marker is a highly conserved region of the mitochondrial genome, frequently used in discriminating closely related species and uniformly chosen as the best DNA barcode (Hebert et al., 2003 a; Hebert et al., 2003 b). The high genetic similarity hereby found between COI sequences obtained from Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to *Anadara kagoshimensis* (Tokunaga, 1906).

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CONFIRMAREA MOLECULARĂ A PREZENȚEI SPECIEI *ANADARA KAGOSHIMENSIS* (TOKUNAGA, 1906) (MOLLUSCA: BIVALVIA: ARCIDAE) ÎN MAREA NEAGRĂ

REZUMAT

Utilizarea tehnicii ADN barcoding în studiul speciilor invazive s-a dovedit a fi un instrument puternic în delimitarea diferitelor căi de introducere și clarificare a unor determinări incerte. Similaritățile morfologice dintre *Anadara kagoshimensis* (Tokunaga, 1906) și *Anadara inaequalis* (Bruguière, 1789) impun utilizarea markerilor genetici în identificarea taxonomică a speciei care a invadat recent Marea Neagră. Similaritatea foarte înaltă identificată între secvențele de COI obținute de la probele din Marea Neagră și cele existente pentru *A. kagoshimensis* din Japonia, confirmă, la nivel molecular, că specia care a invadat sectorul românesc al Mării Negre aparține acestui taxon.

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**TWO NEW SPECIES OF THE GENUS *CALOZODION* GARDINER
(CRUSTACEA: TANAIDACEA: APSEUDOMORPHA)
FROM THE ADRIATIC SEA AND THE INDIAN OCEAN,
AND THE RECLASSIFICATION OF *C. DOLLFUSI* GUȚU, 1989
IN THE GENUS *JULMARICHARDIA* GUȚU**

MODEST GUȚU

Abstract. Two new species, *Calozodion bogoescui* (from the southeast coast of Italy) and *C. tanzaniense* (from Tanzania waters), are described and illustrated. *C. bogoescui* n. sp. represents the first record of the genus *Calozodion* Gardiner, 1973 in the Mediterranean Basin. The main morphological features by which *C. bogoescui* differs from all others of the genus consist in the small number of uropodal endopod articles (only seven, compared to 13–16) combined with the short chelipedal merus (in contrast with the carpus length). *C. tanzaniense* n. sp. is characterized by the following combination of morphological features: (1) antennule first peduncular article with three spiniform apophyses on outer side, (2) antenna with nine articles, (3) pereopod II basis with long plumose setae only on dorsal margin, (4) pereopods III and IV basis with a midventral spiniform apophysis, and (5) pereopod VII merus with five long plumose setae on dorsal side. Also, some comments are made on morphological features belonging to the males of *C. dominiki* Bochert, 2012 and to the status of species *C. dollfusi* Guțu, 1989 (= *Julmarichardia dollfusi*, comb. nov.). An identification key of the currently recognized species of the genus *Calozodion* is presented.

Résumé. On décrit et illustre deux nouvelles espèces, *Calozodion bogoescui* (de la côte sud-est de l'Italie) et *C. tanzaniense* (dans les eaux de la Tanzanie). *C. bogoescui* n. sp. représente le premier mention du genre *Calozodion* Gardiner, 1973 dans le bassin méditerranéen. Les principales caractéristiques morphologiques avec lesquelles *C. bogoescui* diffère de tous les autres espèces du genre consistent dans le petit nombre d'articles de d'endopode uropodale (seulement sept, comparativement à 13–16) combiné avec le merus chelipedal court (en contraste avec la longueur de la carpe). *C. tanzaniense* n. sp. est caractérisé par la combinaison suivante de caractéristiques morphologiques: 1) premier article pédonculaire de l'antennule avec trois apophyses spiniformes sur le côté externe, (2) antenne avec neuf articles, (3) base du péréiopode II avec longues soies plumées seulement sur la marge dorsale, (4) base des péréiopodes III et IV avec une apophyse spiniforme médio ventrale, et (5) merus du péréiopode VII avec cinq longues soies plumées sur la face dorsale. En outre, certains commentaires sont faits sur les caractéristiques morphologiques appartenant aux mâles de *C. dominiki* Bochert 2012 et le statut d'espèces *C. dollfusi* Guțu, 1989 (= *Julmarichardia dollfusi*, comb. nov.). On présente une clé d'identification des espèces actuellement reconnues du genre *Calozodion*.

Key words: Tanaidacea, Apseudomorpha, *Calozodion*, *Julmarichardia*, Adriatic Sea, Indian Ocean.

In the tanaidacean material which remained unstudied by the late Prof. Mihai Băcescu, I have discovered two females of the genus *Calozodion* Gardiner, 1973, each representing an unknown species. One of these which came from the Adriatic Sea (south-east Italy), was collected by the research vessel “Calypso”, during the campaign of the French oceanographer Jaques-Yves Cousteau in his research on pollution of the Mediterranean Basin in 1977. The second species was collected from West Indian Ocean by the members of the expedition initiated and led by Mihai Băcescu, along the coasts of Tanzania, during in 1973.

If for the Mediterranean Basin it is the first report of the genus *Calozodion*, the species from the eastern coast of Africa was reported for the first time (Guțu, 2006: 209) as *Calozodion* cf. *wadei* Gardiner, 1973.

The descriptions of these two new species and discussion of the status of *Calozodion dollfusi* Guțu, 1989 (which was re-classified in the genus *Julmarichardia* Guțu, 1989) and on several morphological particularities of the males of *Calozodion dominiki* Bochert, 2012 are presented herein. With this contribution, the number of the species classified in the genus *Calozodion*, increases to eleven, as can be seen in the identification key.

Family Metapseudidae Lang, 1972
Subfamily Chondropodinae Guțu, 2008
Genus *Calozodion* Gardiner, 1973

***Calozodion bogoescai* n. sp.**
(Figs 1-3)

Material: one female with oostegites, Adriatic Sea, Southeast of Italy, adjacent to the town of Bari, collected in shallow waters by the “Calypso” Expedition, 1977 (without other data).

Holotype, female with oostegites (dissected), preserved in the Collections of the „Grigore Antipa” National Museum of Natural History, Bucharest, No 250015.

Etymology. The specie was named in memory of Prof. Dr. Constantin Bogoescu, from the Biological Faculty of Bucharest.

Description of the female

Body (Fig. 1 A) dorsoventrally flattened, six times as long as wide; standard length, 2.85 mm.

Carapace 1.2 times as long as broad. Rostrum short, rounded, with a small median denticular prominence and some tubercles on its sides. Ocular lobes well defined; eyes pigmented.

Pereon 2.8 times as long as carapace. First pereonite shortest, rounded laterally, 2.6 times as wide as long. Second pereonite a little shorter than each of following three pereonites, but as long as the last pereonite. Third pereonite slightly shorter than the fourth pereonite. Fifth pereonite shorter than the fourth pereonite. Pereonites 3-6 narrower anteriorly, with a small tubercle on half anterior sides and two-three short setulated setae.

Pleon 1.5 times as long as carapace, decreasing in width from the first pleon to pleotelson. Each pleonite short. Pleotelson, as long as last two pleonites together, pointed terminally and with one rounded conspicuous prominence on lateral margins. Pleonites and pleotelson with some setulated short setae on lateral margins.

Antennule (Fig. 1 B) about as long as carapace and first two pereonites combined. First peduncular article four times as long as wide, with some setae and two spiniform apophyses on each side. Second article, narrower than the first article, twice as long as wide, with several unequal broom and simple setae. Third article narrower and shorter than the second. Common article of flagella slightly longer than the first article of outer flagellum. Inner flagellum, as long as first three articles of outer flagellum, with two thin but long articles; terminally with three long simple setae. Outer flagellum with seven short articles, some of them having one to four unequal setae; fourth and sixth articles with an aesthetasc.

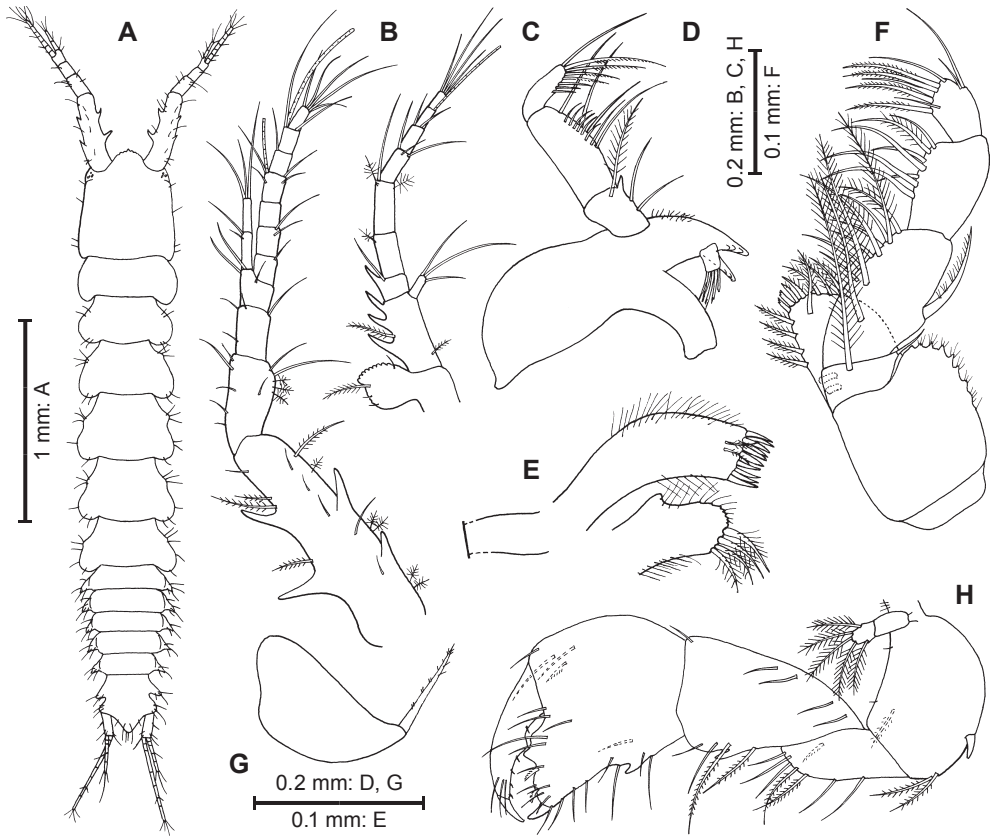


Fig. 1 - *Calozodion bogoeskui* n. sp., female, holotype: A, body, dorsal; B, antennule, right; C, antenna, right; D, mandible, left; E, maxillule, palp unshown; F, maxilliped, right; G, epignath; H, cheliped, left.

Antenna (Fig. 1 C) of nine articles; first article with a large rounded inner expansion having a long setulated seta; second article twice as long as wide, with three (or four?) long denticles and a setulated seta on the outer side; squama small, with three simple setae; third article shorter than squama, with a spiniform apophysis and a simple seta, distoinnerly; fourth article twice as long as third article, about twice as long as wide; fifth article slightly longer than preceding article, with two broom and one long simple setae, distally. Last four articles as long as previous three articles together; sixth, seventh and ninth articles with two-three simple setae; penultimate article with one simple seta and a long aesthetasc.

Epistome well developed, acute.

Mandibles (Fig. 1 D) with well developed pars molaris. Pars incisiva and lacinia mobilis of the left mandible with four and three teeth, respectively. Setiferous lobe with five long furcate setae. Palp three-articled; first article short, with one distoinner denticle and three setae; second article approximately 1.8 times as long as first article, with four long simple and about seven short ciliate setae; third article as long as first article but narrower, with eight unequal setae on distal half of inner margin and terminally. Right mandible with four-denticled pars incisiva.

Labium as in other species of genus. Terminal lobe triangular, with numerous long setulae on sides and one long setiform spine in top.

Maxillule (Fig. 1 E) with two-articled palp; number of terminal setae unknown (broken at time of dissection). Inner endite with four distal setulated setae and long setulae on both sides. Outer endite with numerous setulae on sides, two subterminal setulated setae and ten distal stout spines.

Maxilla unstudied.

Maxilliped (Fig. 1 F) as in other species of genus. Coxa short. Basis a little longer than wide, with some conspicuous denticles and numerous setulae on distoexternal corner. Palp four-articled; first article short, with one very long circumplumose seta on distoinner corner and other one distoexternal, simple and short; second article 1.8 times as long as wide, with five circumplumose setae (three very long) and five simple, short, on the inner margin, and one very long midouter ciliate spine; third article about 0.65 times as long as previous article and 1.4 times as long as wide with one long circumplumose and six simple setae (three relatively short) on inner margin; fourth article of palp with nine long simple and ciliate setae. Endite well developed, with about nine different setae on rostral side, four plumose setae on inner margin, and two blunt couplers; distoinner seta well developed, plumose.

Epignath (Fig. 1 G) cup-shaped, with a long spinulate spine, as illustrated.

Cheliped (Fig. 1 H) well developed. Exopod present, with five long plumose setae. Basis stout, 1.5 times as long as wide, with a median robust spine and two distal circumplumose setae on ventral margin; distally, on inner face, also with a circumplumose seta. Merus rounded distoventrally, much smaller than carpus, having seven long setae on ventral margin. Carpus enlarged distally, 1.6 times as long as maximum width; ventrally with one denticle and four setae, and dorsally with five setae. Propodus large, as long as wide (excluding fixed finger); proximoventrally with one denticle and some simple setae, and three setae near dactylus joint; fixed finger short and thick with a large dentiform expansion on midinner margin and some short setae; claw stout. Dactylus, much thinner than fixed finger, curved, with a small median apophysis and five spinules on inner margin; distolaterally with three simple setae; claw well developed, slightly longer than that of fixed finger.

Pereopod II (Fig. 2 A) thick and strong. Exopodite present, with five long plumose setae. Coxa small, with several short circumplumose setae. Basis thick, two times as long as broad, with one long and one short proximodorsal spiniform apophyses, and a row of seven long plumose setae, dorsally; distoventrally with a seta and one spine. Ischium very short, with two ventral setae. Merus, wider distally, much longer than carpus; distodorsally with one long spine and one long seta; ventrally with around of nine unequal setae and one distal robust spine. Carpus short and thick; dorsally with nine setae and one distal robust spine but ventrally with four setae and one distal stout spine, as figured. Propodus narrower but longer than carpus, 1.8 times as long as wide, with two short and three long simple setae, and one stout spine on dorsal side and four simple setae and three spines on ventral margin; distally with a ciliate seta, near dactylus joint. Dactylus stout, slightly shorter than carpus, curved, with one dorsal seta and one ventral spine; unguis shorter than last ventral spine of propodus.

Pereopod III (Fig. 2 B) slender. Coxa short, with several circumplumose short setae. Basis three times as long as wide, with five ventral and four dorsal small setae; proximodorsally with a curved spiniform apophysis. Ischium with two ventral setae. Merus, about twice as long as ischium, with two distoventral spines,

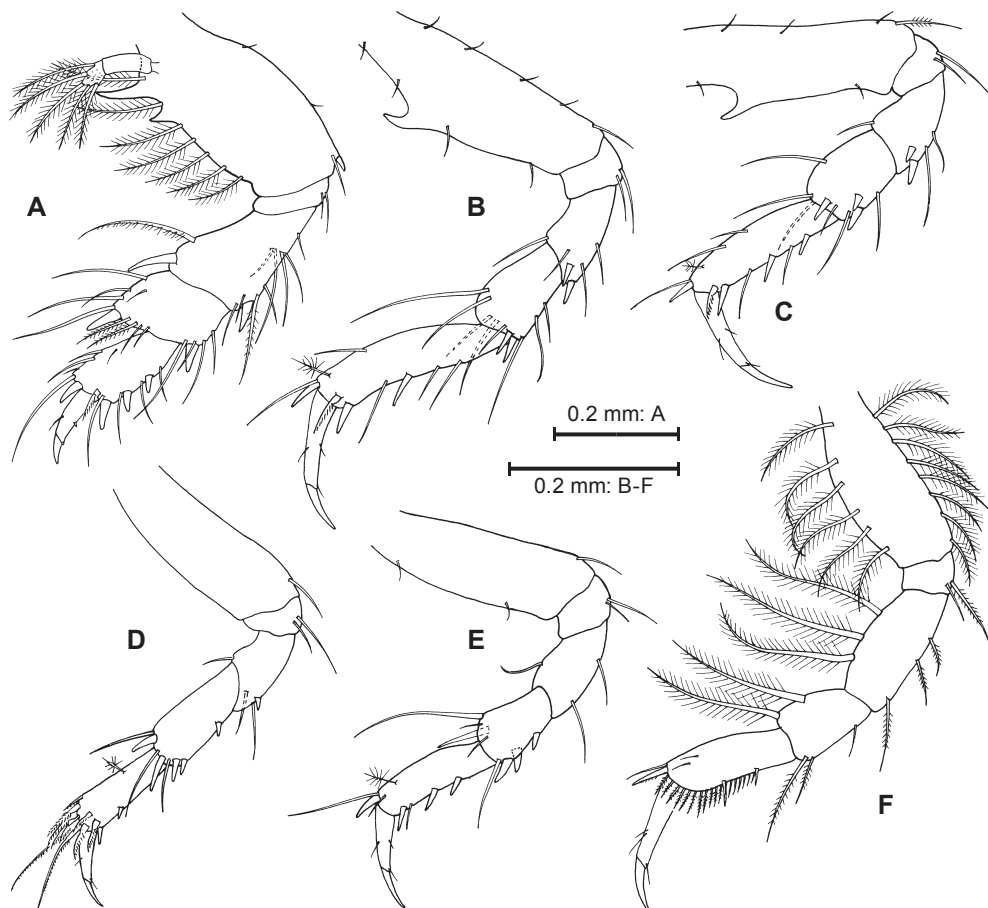


Fig. 2 - *Calozodion bogoeskui* n. sp., female, holotype: A-F, pereopods II-VII, respectively.

one distodorsal, two ventral and one distal setae. Carpus, slightly longer than merus, with eight setae and two spines, as illustrated. Propodus slender, curved ventrally, about as long as merus and carpus together, with two stout spines and three setae on ventral margin and one distal spine and three setae on dorsal side; distally, near dactylus joint with a ciliate seta. Dactylus long and thin, curved, with two ventral and one dorsal short setae; unguis well developed, acute.

Pereopod IV (Fig. 2 C) similar to pereopod III, excepting some features of carpus and propodus; carpus with six setae and three spines and propodus with two setae and three spines on ventral, tergal and distal margins, as figured.

Pereopod V (Fig. 2 D, 3A) as long as pereopod IV. Basis three times as long as wide, with a distoventral seta. Ischium with two setae. Merus one third as basis length, with one spine and two setae, distoventrally, and a distotergal seta. Carpus, 1.8 times as long as merus; midventrally with a small spine and distally with four unequal spines and three setae. Propodus as long as carpus, with two ventral spines; distally with ten setae, eight of them short and ciliate and other two very long, as illustrated. Dactylus similar to that of pereopod III or IV, but smaller.

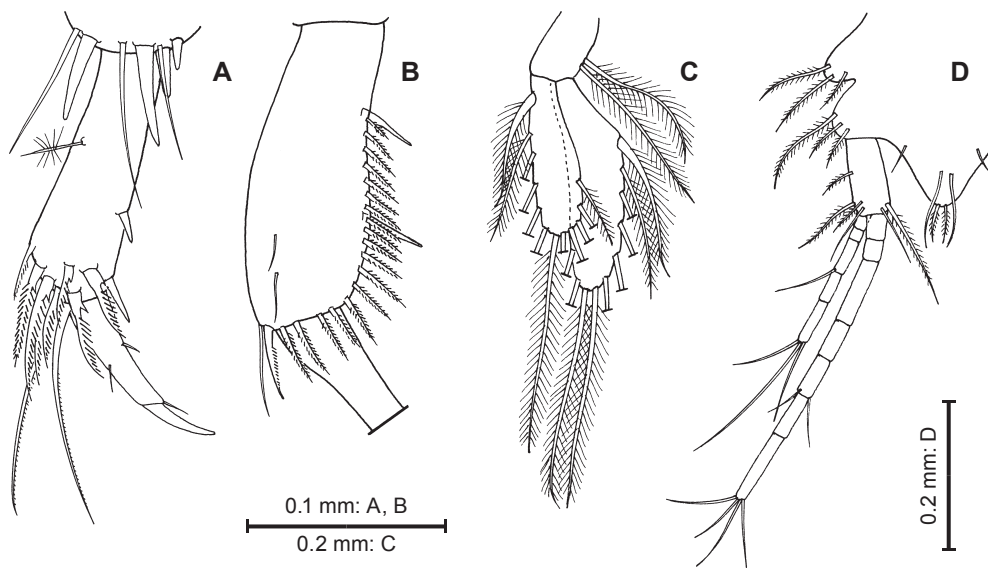


Fig. 3 - *Calozodion bogoescui* n. sp., female, holotype: A, pereopod V propodus and dactylus; B, pereopod VII propodus; C, pleopod; D, pleotelson, left half, and corresponding uropod.

Pereopod VI (Figs 2 E) relatively similar to pereopod III or IV. Basis without ventral spiniform process. Merus with three setae. Carpus, as long as merus, with three spine and one seta, ventrally, and two short and one very long seta and one spine, distodorsally. Propodus, 1.3 times as long as carpus; ventrally with three spines and one small seta and distodorsally with one broom and two simple setae (one of them very long) and one spine. Dactylus as in previous pereopods.

Pereopod VII (Figs 2 F, 3 B) slightly stonger than pereopods III-VI. Basis 2.5 times as long as wide, with six and eight long plumose setae, dorsally and ventrally, respectively. Ischium with two setae. Merus, 2.1 times as long as wide, with three very long and three short plumose setae, dorsally and ventrally, respectively. Carpus much shorter than merus, with two long plumose setae on dorsal margin and three short but unequal, on ventral side. Propodus, as long as merus, with a row of 18 short ciliate setae, three spines and one short seta, as figured. Dactylus as in pereopods III-VI.

Pleopods (Fig. 3 C) well developed, biramous, in five pairs. Basal article 1.5 times as long as wide, with two long plumose setae on the outer side. Endopod twice as long as basal article, but shorter than exopod, with twelve plumose setae of various lengths. Exopod with ten plumose setae.

Uropod (Fig. 3 D) biramous. Basal article stout, with six setae. Exopod as long as pleotelson length, four-articled, with one and three setae on second and last articles, respectively. Endopod 2.2 times as long as exopod, with seven articles; fifth and seventh articles with two and four simple setae, respectively.

Remarks. *Calozodion bogoescui* n. sp. is distinguished from other species of the genus by the combination of two features: chelipedal merus much smaller than the carpus (Fig. 1 H) and the uropodal endopod with only seven articles (Fig. 3 D). *C. bogoescui* resembles *C. suluk* by its distinctively short uropod (Bamber &

Shedder, 2005, fig. 5 f) and with the two species belonging to genus *Vestigiramus* Guțu, 2009 (Guțu, 1996, 2009), a genus related to *Calozodion*.

***Calozodion tanzaniense* n. sp.**

(Figs 4, 5)

Calozodion cf. *wadei* Guțu, 2006: 209

Material: one female with oostegites, Western Indian Ocean, Mbudya Island (coast of Tanzania), collected in shallow waters; December 1973; Leg. Romanian Expedition leading by Prof. Mihai Băcescu.

Holotype, female with oostegites (dissected), preserved in the Collections of the „Grigore Antipa” National Museum of Natural History, Bucharest, No 250016.

Etymology. After the collected place.

Description of the female

Body (Fig. 4 A) dorsoventrally flattened, five times as long as maximum width; length, 2.75 mm.

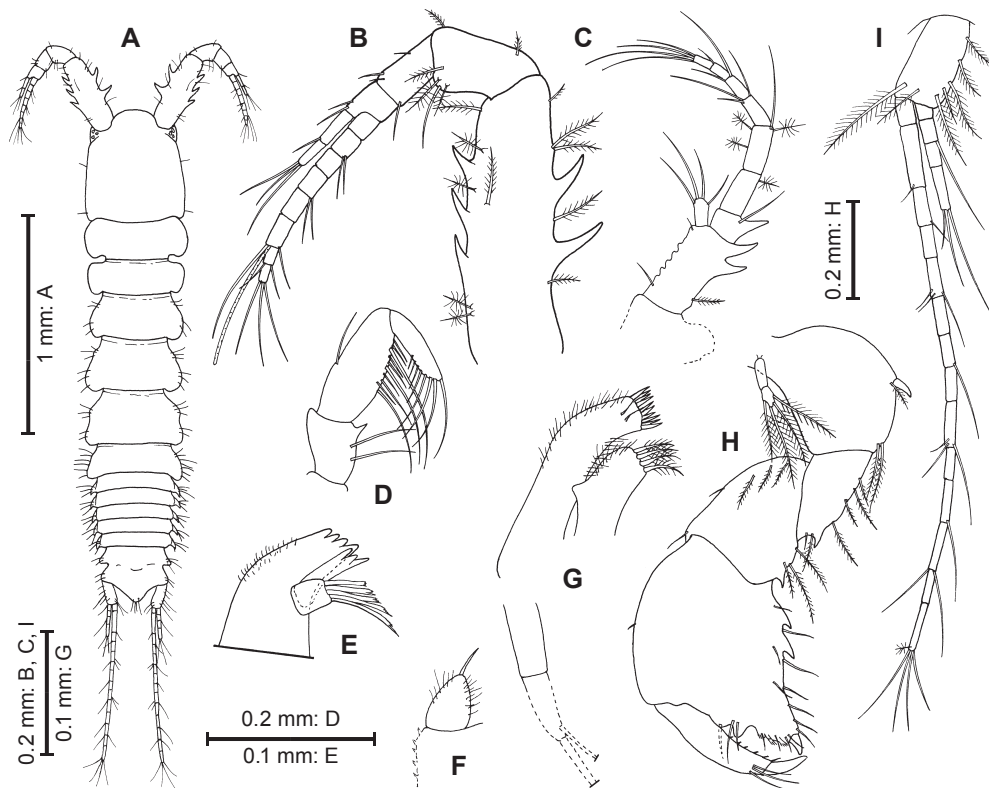


Fig. 4 - *Calozodion tanzaniense* n. sp., female, holotype: A, body, dorsal; B, antennule; C, antenna; D, mandible palp; E, pars incisiva, lacinia mobilis and setiferous lobe of left mandible; F, labium terminal lobe (schematic); G, maxillule; H, cheliped, left; I, uropod, right.

Carapace, 1.1 times as long as broad, with two short setae on each side. Rostrum short, rounded and smooth anteriorly. Ocular lobes well defined; visual elements pigmented.

Pereon about 2.4 times as long as wide and 2.1 times as long as carapace length. First pereonite rounded laterally, 2.7 times as wide as long. Second pereonite slightly shorter than the first pereonite. Third, fourth and fifth pereonites narrower anteriorly, approximately equal, each being a little longer than first pereonite. Sixth pereonite shortest. Each pereonite with a few short setae on lateral margins.

Pleon, about 1.2 times as long as carapace, decreasing in width from the first pleon to pleotelson; laterally with short circumplumose setae. Each pleonite very short, all together as long as last two pereonites. Pleotelson, approximately as long as last three pleonites together, pointed terminally and with one rounded conspicuous prominence on lateral margins.

Antennule (Fig. 4 B) as long as carapace and first two pereonites together. First peduncular article stout, 3.3 times as long as median width, with three spiniform apophyses and some broom and two circumplumose setae on outer side; inner margin with two spiniform apophyses (larger than the same of outer margin) and four circumplumose setae. Second peduncular article, about one third as long as first article and 1.5 times as long as wide, with two and several broom and circumplumose setae on inner margin and distoexternal corner, respectively. Third article shorter and narrower than second article, with one distoextern simple seta and other three on inner margin. Fourth article short. Outer flagellum, one half as long as first three peduncular articles combined, with eight short articles; second, fourth, sixth and seventh articles with two and eight one with three simple setae; sixth article with one very long aesthetasc. Inner flagellum, a little longer than first three articles of outer flagellum with one and three simple setae on first and second articles, respectively.

Antenna (Fig. 4 C) nine-articled, as long as first two peduncular articles of antennule. First article short, with a large inner rounded expansion. Second article twice as long as wide with two proximal setae, several tubercles on outer side and two spiniform apophyses on distoinner margin; squama small, with four setae. Third article very short with one seta and one spiniform apophysis on inner corner. Fourth article 1.5 times as long as third article but narrower, with one distoinner broom seta. Fifth article as long as fourth article, with one distoinner long simple and several broom setae. Each of following four articles thin and short, with one to four simple setae, as illustrated.

Epistome well developed, acute.

Mandibles (Fig. 4 D, E) with pars incisiva four-denticulated. Lacinia mobilis of left mandible with three denticles. Setiferous lobe with five furcate setae. Pars molaris without special features. Palp three-articled; first article one half as long as second article, with two simple setae and one dentiform process on distoinner side; second article 2.5 times as long as wide, with one simple seta on outer side, and four long and seven short setae on inner margin; third article 1.3 times as long as first article but narrower, with eight unequal setae.

Labium (Fig. 4 F) as in other species of the genus. Terminal lobe triangular, with a long setiform spine in top and numerous long setulae on inner margin.

Maxillule (Fig. 4 G) with two-articled palp, second article having two simple setae, one of them very long. Outer endite with many long setulae on sides and ten distal stout denticles. Inner endite with long setae on outer margin and four terminal setulated setae.

Maxilla without special features.

Maxilliped and *epignath* similar to those of the previously described species.

Cheliped (Fig. 4 H) with exopod having four long plumose setae on last article. Basis large, 1.3 times as long as broad; ventrally with one robust spine and a short seta, and distroventrally with three unequal circumplumose setae. Merus, relatively triangular, with ventral free margin longer than that of carpus, having a distoventral spiniform apophysis and five circumplumose setae. Carpus broad, as wide as median length; ventrally with a spiniform apophysis and three circumplumose setae, and dorsally with three circumplumose and two simple setae. Propodus palm as long as wide; proximoventrally with two spiniform apophyses and several simple setae; fixed finger short, much wider proximally, with several setae on outer and inner sides; also, the inner side with a rounded proximal apophysis; claw stout. Dactylus

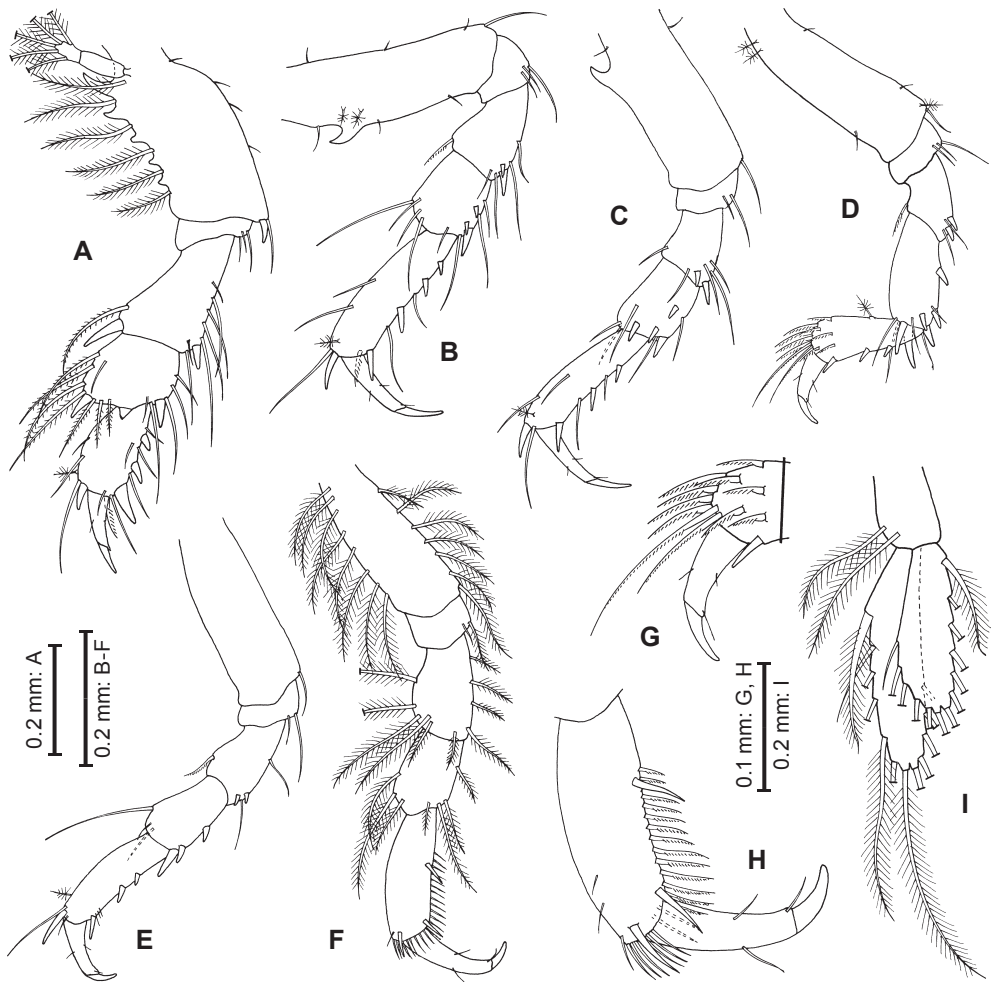


Fig. 5 - *Calozodion tanzaniense* n. sp., female, holotype: A-F, pereopods II-VII, respectively; G, distal part of pereopod V propodus and dactylus; H, pereopod VII propodus and dactylus; I, pleopod.

curved, thin, approximately four times as long as median width, with six spinules on inner margin and three distal setae; claw curved, longer than that of fixed finger.

Pereopod II (Fig. 5 A) larger than following pereopods. Exopodite present, with five plumose setae on last article. Coxa small, rounded distally, bearing several short circumplumose setae. Basis thick, 2.2 times as long as wide; dorsally with six long plumose setae and five spiniform apophyses; ventrally with four short simple setae and distoventrally with one spine and one simple seta. Ischium very short with three setae. Merus wider distally, twice as long as median width, with seven setae and one stout spine on ventral margin and one spine and one circumplumose seta on distodorsal corner. Carpus much shorter than merus and slightly wider than long, with three spines and 13 setae, as illustrated. Propodus 1.3 times as long as carpus but narrower, with three stout spines, one ciliate and six simple setae on ventral margin; dorsally with one broom and three simple setae, and one robust spine. Dactylus curved, about twice shorter than propodus, with one dorsal seta and two ventral spinules; unguis as long as distodorsal spine of propodus.

Pereopod III (Fig. 5 B) much thinner than pereopod II, with a small coxa, bearing several short circumplumose setae. Basis three times as long as wide, with a curved proximodorsal spiniform apophysis and several short setae on both margins. Ischium with three setae. Merus 2.5 times shorter than basis, with five setae and two spines. Carpus about as long as merus with four distodorsal setae; ventrally with three spines and four setae. Propodus slender, curved ventrally, about as long as merus and carpus combined, with four stout spines, two simple and one ciliate setae on ventral margin; distodorsally with one broom and three simple setae, and a robust spine. Dactylus long, slightly curved, with two ventral and one dorsal setulae; unguis curved, acute.

Pereopod IV (Fig. 5 C) relatively similar to previous pereopod. Carpus with five setae and four spines. Propodus with three spines and two setae, ventrally, and one spine and four setae on dorsal margin.

Pereopod V (Fig. 5 D, G) basis 3.5 times as long as wide, with several broom and simple setae. Ischium with three setae. Merus short, one third as long as basis; distoventrally with two spines and two setae, and distotergally with a ciliate seta. Carpus, 1.8 times as long as median length of merus, with four spines and five setae. Propodus as long as carpus, with three ventral spines; dorsally with a broom seta and distodorsally with two long and nine short ciliate setae. Dactylus similar to that of pereopods III or IV.

Pereopod VI (Fig. 5 E) relatively similar to pereopods III or IV, as illustrated.

Pereopod VII (Fig. 5 F, H) not stronger than pereopod VI. Basis with eight and seven long plumose setae on dorsal and ventral margins, respectively. Ischium with two setae. Merus, 1.5 times as long as wide, with five dorsal and five ventral long plumose setae. Carpus about as long as merus, with three and four plumose setae, dorsally and ventrally, respectively. Propodus 1.5 times as long as carpus, with a row of about 24 short ciliate setae and three spines, as figured. Dactylus as in other pereopods.

Pleopods (Fig. 5 I) biramous, in five pairs. Basal article with two long plumose setae on the outer side. Endopod ovate, three times as long as broad, with 13 plumose setae of various lengths, around. Exopod, about 1.3 times as long as endopod and 4.4 times as long as wide, with 12 plumose setae.

Uropod (Fig. 4 I) biramous. Basal article stout, with eight circumplumose setae, as illustrated. Exopod four-articled, about as long as first three articles of endopod, with one and three setae on second and last articles, respectively. Endopod

slightly longer than last pereonite and pleon combined, with 14 articles; several articles with one to three setae; last article with one broom and four simple setae.

Remarks. *Calozodion tanzaniense* n. sp. belongs to a group of species (i. e., *C. bogoescui* n. sp., *C. dominiki* Bochert, 2012, *C. moyas* Menioui, 2013, *C. simile* Guțu, 2006 and *C. wadei* Gardiner, 1973) characterized by a mediodorsal spiniform apophysis on the basis of the pereopods III and IV. The differences between *C. tanzaniense* and these other five species are: (1) antennule first peduncular article with three spiniform apophyses on outer margin (other species have at most two apophyses; only *C. simile* in rare cases has three), (2) antenna with nine articles (ten in *C. simile*), (3) squama with four setae (three in *C. bogoescui* n. sp., *C. dominiki* and *C. wadei*), (4) pereopod VII merus with five long plumose setae on dorsal side (at most four setae in other species), and (5) uropod endopod with 13-16 articles (only seven articles in *C. bogoescui* n. sp. but relatively similar in other species).

Some remarks on Calozodion dollfusi Guțu, 1989 and *C. dominiki* Bochert, 2012

After a detailed analysis of the characteristic morphological features of the type species, *C. wadei* Gardiner, 1973, as well as other species within the genus *Calozodion* (based on the descriptions from literature: Bamber & Sheader, 2005; Bochert, 2012; Gardiner, 1973; Guțu, 1984, 1989a, 1996, 2002, 2006; Menioui, 2013), my attention was drawn by some specific particularities of the species *C. dollfusi* Guțu, 1989 and *C. dominiki* Bochert, 2012.

Thus, the main differences among the species of the genus *Calozodion* and that of *C. dollfusi*, which was described from a single manca (Guțu, 1989 a: 129), consist of (1) terminal lobe of labium with a single spiniform seta in top (three in *C. dollfusi*), (2) maxillule endite with four distal setae (five in *C. dollfusi*), (3) first article of maxillipedal palp with one very long distal inner plumose seta (absent in *C. dollfusi*), (4) second article of maxillipedal palp with one long spiniform seta on midouter side (two distally in *C. dollfusi*), (5) pereopod II carpus (or pereopod 1 as used by other specialists) with a single ventral spine (two in *C. dollfusi*) and (6) pereopod II propodus with a single distodorsal spine (two in *C. dollfusi*).

By the morphological features mentioned above (notably 1, 2, 5 and 6), the species *C. dollfusi* resembles those of the genus *Julmarichardia* Guțu, 1989 (Bamber & Sheader, 2005; Guțu, 1989 b; Ritger & Heard, 2007). Although these features might be considered unimportant for systematics by some specialists, their constant difference in the species of *Calozodion* and *Julmarichardia* is an undeniable fact. Moreover, in this situation it would have been enough to analyse only the terminal lobe of the labium, whose configuration is almost identical in the genera correctly defined (Guțu, 2006: 35). In conclusion *C. dollfusi* is here transferred to become *Julmarichardia dollfusi* (Guțu, 1989), comb. nov. In addition, the morphological features I referred should be considered amendments for the diagnoses of *Calozodion* and *Julmarichardia*.

The species *C. dominiki* Bochert, 2012 is in a special situation. If in the case of the female there is no doubt that it belongs to the genus *Calozodion*; however the situation is not the same for the male described by Bochert (2012). The male's obvious degree of sexual dimorphism in the carapace, rostrum, antennules, antenna and cheliped level is in contradiction with the characteristic features of *Calozodion*. By the great size of the rostrum, combined with the great length of the first article of the antennule peduncle and of the second article of antenna (Bochert, 2012: 47 and figs 8 A-F and 9 H, I), the male of *C. dominiki* resembles the species of

- 6 – Antennule main flagellum and antenna each with ten articles *C. simile* Guțu, 2006 (♀, ♂)
 – Antennule main flagellum and antenna with eight and nine articles, respectively *C. tanzaniense* n. sp. (♀; ♂ unknown)
- 7 – Pereopods III and IV basis with a median spiniform apophysis 8
 – Pereopods III and IV basis without a median spiniform apophysis 10
- 8 – Mandibles with an acute process on the first article of palp *C. moyas* Menioui, 2013 (♀, ♂)
 – Mandibles without an acute process on the first article of palp 9
- 9 – Cheliped propodus with acute processes on proximoventral margin *C. wadei* Gardiner, 1973 (♀, ♂)
 – Cheliped propodus without acute processes on proximoventral margin *C. dominiki* Bochart, 2012 (♀, ♂)
- 10 – Pereopod III with long plumose setae on twice margins, dorsally and ventrally *C. multispinosum* Guțu, 1984 (♀, ♂)
 – Pereopod III without long plumose setae on twice margins, dorsally and ventrally *C. singularis* Guțu, 2002 (♀; ♂ unknown)

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DOUĂ SPECII NOI DIN GENUL *CALOZODION* GARDINER
 (CRUSTACEA: TANAIDACEA: APSEUDOMORPHA)
 DIN MAREA ADRIATICĂ ȘI OCEANUL INDIAN ȘI RECLASIFICAREA
 SPECIEI *C. DOLLFUSI* GUȚU, 1989 ÎN GENUL *JULMARICHARDIA* GUȚU

REZUMAT

Sunt descrise două specii noi pentru știință, *Calozodion bogoescui* și *C. tanzaniense*, provenind din apele sud-estice italiene ale Mării Adriatice și, respectiv, cele tanzaniene ale Oceanului Indian. Prin descrierea speciei *C. bogoescui* n. sp. este menționată pentru prima dată prezența genului *Calozodion* Gardiner, 1973 în bazinul mediteranean. Principalele trăsături morfologice caracteristice speciei mediteraneene constau în numărul mic al articulelor endopodului uropodal (numai șapte, în comparație cu 13-16, cât au celelalte specii ale genului) și lungimea mică a merusului chelipedului (comparativ cu cea a carpului). Specia *C. tanzaniense* n. sp. se deosebește de celelalte cunoscute prin următoarea combinație de trăsături morfologice: (1) antenula cu trei apofize spiniforme pe marginea externă a primului articol peduncular, (2) antena formată din nouă aticule, (3) bazisul pereopodului II cu sete penate lungi numai pe marginea dorsală, (4) bazisul pereopodelor III și IV cu câte o apofiză spiniformă pe marginea dorsală și (5) merusul pereopodului VII cu cinci sete penate lungi pe marginea dorsală.

Totodată specia *C. dollfusi* Guțu, 1989 este transferată în alt gen, devenind *Julmarichardia dollfusi* (Guțu, 1989), comb. nov., iar în cazul masculilor speciei *C. dominiki* Bochart, 2012 sunt comentate unele particularități morfologice neîntâlnite la alte specii ale genului. În partea finală a lucrării este prezentată cheia de identificare a celor 11 specii ale genului *Calozodion*.

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FIRST RECORD OF *THEMIRA NIGRICORNIS* (MEIGEN, 1826) (SEPSIDAE: DIPTERA) IN ROMANIA

LAVINIA IANCU, CRISTINA PURCĂREA

Abstract. This report on the occurrence of *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) on Romanian territory represents the first record of this species within south-eastern Europe. Adults of *T. nigricornis* were collected in spring, in the second half of April, from an experimental setting placed in an urban location (Bucharest) in southern Romania. The bait consisted of domestic pig carcass in advanced decomposition stage, placed on soil ground and surrounded by vegetation. The visiting specimens were located around the posterior segment of the pig carcass. The registered abundance of adult individuals was relatively low, with 10 specimens distinguished during two weeks interval. The species was taxonomically characterized and identified. This study, documenting the presence of *T. nigricornis* in the southern part of Romania, expanded the Fauna Europaea distribution range record of this species, assigning the southernmost location of *T. nigricornis* in Europe.

Résumé. Ce rapport sur la présence de *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) sur le territoire roumain représente la première mention de cette espèce dans l'Europe du Sud-Est. Les adultes de *T. nigricornis* ont été recueillies pendant le printemps, dans la seconde moitié d'Avril, à partir d'un cadre expérimental placé dans un emplacement urbain (Bucarest) dans le sud de la Roumanie. L'appât consistait en une carcasse de porc en phase de décomposition avancée, placée sur le sol et entourée de végétation. Les spécimens en visite ont été trouvés dans le segment postérieur de la carcasse de porc. L'abondance enregistrée des individus adultes a été relativement faible, avec 10 spécimens démarqués au cours de deux semaines. Cette étude, en documentant la présence de *T. nigricornis* dans la partie du sud de la Roumanie, a élargi l'aire de répartition de cette espèce dans la Faune Europaea, par l'attribution de *T. nigricornis* au point le plus au sud d'Europe.

Key words: *Themira nigricornis*, first mention, pig carcass, Romania, distribution.

INTRODUCTION

The Sepsidae family, known as the black scavengers flies because of their coprophagous preference, comprises 37 genera and 318 species worldwide (Ozerov, 2005). The adults were found on dung (Snowball, 1944), animal and plant decaying material (Ozerov, 1989, 1999 a). These insects were predominantly located on human and animal excrements (Iwasa, 1980; Ozerov, 1991), playing an important role in faeces decomposition processes (Papp, 1971).

Species belonging to this family (Pont & Meier, 2002) are of relatively small size, reaching 6–12 mm in length. Morphologically, they resemble ants with narrow waist, the majority of individuals presenting pronounced sexual dimorphisms, of the legs and the male's 4th sternites. The forelegs of the male are used during courtship and mounting for holding onto the base of the female wing.

Themira species are characterized by the absence of supraalar seta (Pont & Meier, op. cit.). Adult males are easily recognized by the ornate fore-legs, and by the prominent form and colour that varies from black to yellow of the mid tarsomeres. The females are recognised by the absence of postpronotal setae, pruinose katepisternum, and partially yellow legs.

T. nigricornis, fully described and illustrated by Ozerov (1999 b), was first identified almost two centuries ago (1826) by Meigen, but no certain location and

holotype/syntype of female were indicated for this incidence (Ozerov, 2005). An earlier report of this species was recorded on American territory by Steyskal (1946). Since then, the presence of *T. nigricornis* was reported in western, central, eastern and northern European countries including Austria, Great Britain (Incl. Shetlands, Orkneys, Hebrides and Man Is.), Czech Republic, Danish mainland (Incl. Borhalm I.), Finland, French mainland, Germany, Hungary, Latvia, Lithuania, Norwegian mainland, Poland, Central, East, South and Northwest Russia, Slovakia, Sweden (Incl. Gotland I.), Switzerland, The Netherlands, Ukraine (Fauna Europaea, Version 2.6.2, de Jong, 2013) and Italy (Ozerov, 2005). So far, the south-eastern limit for the spread range of this species did not include Romania.

The current study reports the first occurrence of *T. nigricornis* on Romanian territory, in the southern part of the country, containing a brief description of the associated experimental settings, taxonomic identification of adult specimens collected from a pig decomposed carcass.

MATERIAL AND METHODS

Experimental setting

T. nigricornis specimens were identified during a forensic experimental model investigation in Bucharest, Romania. This urban site is located 100 m above sea level (44°27'10"N, 26°05'04"E) and belongs to a temperate climate region. The experimental setting consisted of a pig carcass weighing approximately 15 kg, placed on the ground, in a natural park area surrounded by spring vegetation (grass and trees), and protected by 50 cm x 100 cm metal cage against vertebrate scavengers (Fig. 1). The bait was exposed for approximately 5 months during cold period (December-February) and beginning of warm period (March-April). The spatial-temporal, environmental and experimental model features describing the occurrence of this species in Romania were summarized in table 1.

Sampling and taxonomical characterization

Insect sampling was performed using an entomological net, and the specimens were preserved in 75% ethanol at room temperature, until further investigations.

T. nigricornis taxonomic identification was performed according to the taxonomic keys for this species (Pont & Meier, 2002). The identification of main



Fig. 1 - Experimental setting for *T. nigricornis* appearance site. Pig carcass after 5 month exposure.

Table 1

Characteristics of experimental settings for *T. nigricornis* occurrence.

Characteristic	Experimental data
Location	Bucharest, Romania, 44°27'10"N L26°05'04"E
Period	15 – 30.IV.2013
Environmental temperature (°C)	20.05 ± 2.1°C
Relative humidity (%)	57.06 ± 8.0%
Precipitation (mm)	0.53 ± 0.09 mm
Experimental model	Pig carcass in advanced decomposition stage after 5 months of outdoor exposure in a park type setting
Environmental conditions	Arboreal vegetation (<i>Aesculus hyppocastanum</i> , <i>Tilia</i> sp., <i>Ulmus</i> sp.), rich cover of small plants and shrubs
Abundance	10 specimens (7 males and 3 females)

diagnosis characters was performed using a stereomicroscope Stemi2000 (Zeiss) at 3 x (1.9 to 225x) magnification scale.

DNA barcoding

T. nigricornis genomic DNA was extracted from two different adult individuals using DNeasy Blood & Tissue Kit (Qiagen), following an adapted protocol that included an additional initial cellular disruption step. The insect habitus suspended in 200 µl TE was disrupted at 20°C using a Cell Homogenizer SpeedMill PLUS (Analytik Jena), by applying continuous 50 Hz-power for 12 minutes at 20°C, in the presence of 5 Zirconia Beads II per tub (Invitex). After centrifugation of the cell extract at 10.000 x g for 1 min, the soluble fraction was further purified following the manufacturer procedure. The concentration and purity of the resulted DNA were measured with a NanoDrop1000 (Thermo Scientific).

DNA barcoding was performed based on PCR amplification of cytochrome oxidase subunit I (COI) mitochondrial gene fragment (Folmer et al., 1994). PCR amplification was carried out using a Mastercycler ProS System (Eppendorf). The reaction mixture contained 200 ng insect genomic DNA, 100 pmols of forward (LCO1490: 5'-GGTCAACAAATCATAAAGATATTGG-3') and reverse (HC02198: 5'-TAAACTTCAGGGTGACCAAAAAATCA-3') invertebrates' COI gene specific primers (Folmer et al., 1994), 1 unit of Taq DNA polymerase (Thermo Scientific), 1x Taq buffer, 2.5 mM MgCl₂, 0.1 mM dNTP (Thermo Scientific), in a total volume of 50 µl. The amplification reaction consisted of an initial incubation step of 1 min at 94°C, followed by 5 cycles of 30 sec at 94°C (denaturation), 1.5 min at 45°C (annealing) and 1 min at 72°C (extension), followed by 35 cycles of 30 sec at 94°C, 1.5 min at 51°C, 1 min at 72°C and a final extension step of 5 min at 72°C. The reaction performed in the absence of DNA was used as negative control.

The resulted DNA fragments (710 bp) were analysed by electrophoresis on 1% agarose gels. The amplified COI gene fragments were purified using QIAquick PCR Purification Kit (Qiagen), and sequenced (Macrogen) on both strands, using the cloning primers. Sequence similarity was determined by BLAST-NCBI screening tool (<http://www.ncbi.nlm.nih.gov>).

RESULTS

Spatial and temporal characteristics of T. nigricornis occurrence in Bucharest – Romania

The insects were observed in the second half of April, 2013, when the average temperature raised to $20.05 \pm 2.1^\circ\text{C}$. The precipitation and relative humidity during this interval corresponded to 0.53 ± 0.09 mm and $57.06 \pm 8.0\%$, respectively. The insects were located on the surface of the pig carcass, in the vicinity of the posterior section. A total of ten specimens, counting seven males and three females, were collected during midday period over the two week interval. Noteworthy, the presence of *T. nigricornis* on the carcass was simultaneous with other necrophagous species belonging to Diptera and Coleoptera Orders, including members of Calliphoridae, Muscidae, Cleridae and Silphidae families.

Taxonomic identification of T. nigricornis

Taxonomic identification of this species was carried out based on the taxonomic keys provided by Pont & Meier (2002). The analysis of male adult specimen (Fig. 2) indicates a series of characteristics of *T. nigricornis* species, as follow: black thorax and abdomen, and habitus presenting orange-yellow genal area (Fig. 2A); the front femure (Fig. 2B) exhibiting several posterodorsal setae

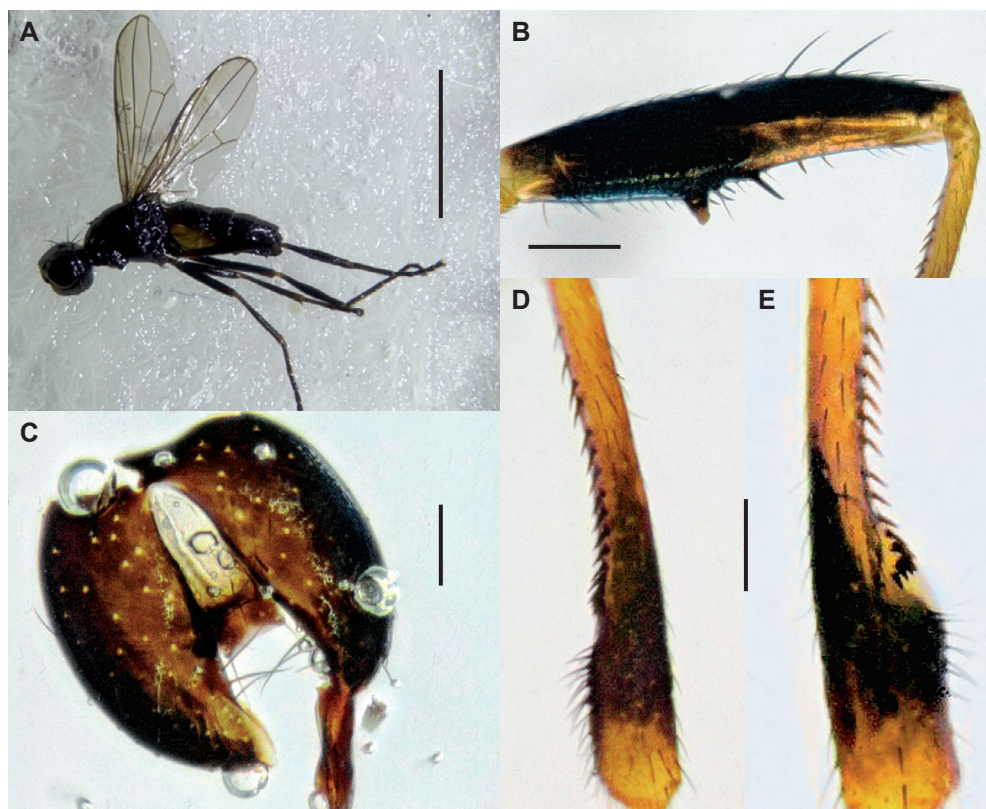


Fig. 2 - Stereomicroscopic images of *T. nigricornis*. A, habitus; B, fore femure anterior view; C, hypopygium; D, fore tibia, anterior view; E, fore tibia, view posterior. Scales (in mm): A – 2; B-E – 0.5.

in the apical half, and hypopygium as part of the copulatory apparatus (Fig. 2 C); yellow coloured fore tibia except of the apical half region, as shown by the anterior (Fig. 2 D) and posterior (Fig. 2 E) views.

These corroborated elements correspond to key morphological characteristics of *T. nigricornis*, indicating that the isolated organism corresponds to this species.

DNA barcoding identification of T. nigricornis

PCR amplification of mitochondrial cytochrome C oxidase I gene (COI) using specific primers for invertebrates was obtained for 2 distinct adult individuals. DNA sequencing of both TN1 and TN2 amplicons indicate 100% sequence identity over a 622-bp gene fragment.

The TN1 sequence was assigned GenBank accession number KJ007735.

Sequence similarity search using BLAST screening indicated the closest match of TN1 sequence (99% identity) with the *T. nigricornis* COI gene fragment (Laamanen et al., 2005; accession number AJ832117).

DISCUSSION

This report represents the first mentioning of *T. nigricornis* presence in Romania.

The location of the insect on a pig carcass in advanced decomposition stage confirmed the preference of this species for such environments.

The adult abundance in the forensic experimental setting was relatively low, only 10 individuals (males and females) being observed on the site over 2 weeks period. Such low density is in accordance with previous statements (Pont & Meier, 2002) mentioning that *T. nigricornis* was only occasionally abundant. Moreover, the appearance season of *T. nigricornis* on Romanian territory in early spring, when temperatures raised to about 20°C, is in accordance with prior reports on the main occurrence period of this species within end of March - August interval, corresponding to the warm season (Pont & Meier, op. cit.). The identity of this species was confirmed both taxonomically and by DNA barcoding based on mitochondrial cytochrome C oxidase I gene (COI) amplification and sequencing.

To date, the worldwide spread range of this species covered the nearctic USA region (Alaska, Connecticut, Illinois, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania), and Palaearctic regions of Asia including Kazakhstan, Korea, Kyrgyzstan, Pakistan, Turkmenistan, South Korea and Japan (Pont & Meier, op. cit.; Ozerov, 2005).

In Europe, the distribution of *T. nigricornis* species covered 19 countries (Pont & Meier, op. cit.), with a species widespread incidence in the central and northern European zones and eastwards to Russia (Far East province), but with only specific locations in certain European countries such as Denmark (East Jutland and North East Zealand), Norway (northwards to Nord Traendelag), Sweden (Skane to Torne Lappmark), and Finland (northwards to Kuusamo).

In this respect, the current report on the presence of *T. negricornis* on the southern Romanian territory contributed to update the distribution map of this species on the European range (Fig. 3), indicating the southernmost location of this Sepsidae species within Eastern Europe.

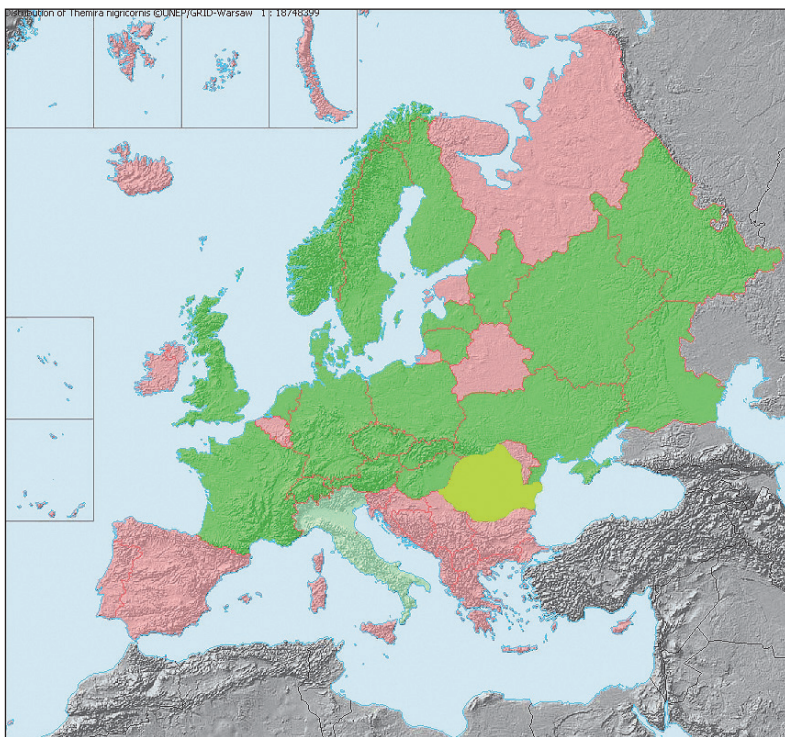


Fig. 3 - Updated map of *T. nigricornis* distribution in Europe (modified from <http://www.faunaeur.org>). Legend: Presence - dark green, doubtful presence - light green, absence - pink, new record - bright green.

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PRIMA SEMNALARE A SPECIEI *THEMIRA NIGRICORNIS* (MEIGEN, 1826) (SEPSIDAE: DIPTERA) ÎN ROMÂNIA

REZUMAT

Acest raport privind semnalarea speciei *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) pe teritoriul românesc reprezintă prima înregistrare a acestei specii în sud-estul Europei. Adulții speciei *T. nigricornis* au fost colectați în anotimpul primăvara, în a doua jumătate a lunii aprilie, în cadrul unui experiment amplasat în spațiu urban (București), în partea de sud a României. Au fost utilizate carcase de porc domestic (*Sus scrofa domesticus*) aflate într-un stadiu de descompunere avansată, amplasate direct pe sol și înconjurată de vegetație. Exemplarele de *T. nigricornis* au fost localizate în segmentul posterior al carcaselor. Abundența a fost relativ scăzută, constând în 10 exemplare colectate într-un interval de două săptămâni. Specia a fost caracterizată și identificată taxonomic. Acest studiu, ce documentează prezența speciei *T. nigricornis* în sudul României, extinde arealul de distribuție semnalat de Fauna Europaea, desemnând localizarea în partea de sud a Europei.

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NESTING PREFERENCES FOR TWO WOODPECKER SPECIES (*DENDROCOPOS MAJOR* AND *DENDROCOPOS MEDIUS*) IN COMANA FOREST, SOUTHERN ROMANIA

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MIHAELA ION, LOTUS ELENA MEȘTER

Abstract. The main goal of this study is to get a better insight of the habitat requirements for the Great- and Middle Spotted Woodpeckers. Woodpeckers are forest specialists, threatened all over Europe mainly by the loss of forest habitats and also by the loss in quality of the habitat by reducing the food sources and nesting sites. Both species showed a strong preference for oaks, lime, large trees and dead wood for nesting, but Middle Spotted Woodpecker proved to be more selective in terms of tree species. Nest-height was influenced by tree diameter. Both species have the same nesting preferences for Turkey oak, lime and Pedunculate oak, in a *Quercetum farnetto-cerris* type of forest. The orientation of the nest hole on the tree was mainly NE-E-SE for Middle Spotted Woodpecker and N-NE-E for Great Spotted Woodpecker.

Résumé. L'objectif principal de cette étude est de mieux connaître les besoins en matière d'habitat pour le pic épeiche et le pic mar. Les pics sont des spécialistes de la forêt, menacés dans toute l'Europe principalement par la perte d'habitats forestiers et aussi par la perte de la qualité de l'habitat en réduisant les sources de nourriture et les sites de nidification. Les deux espèces ont montré une forte préférence pour les chênes, de chaux, de grands arbres et du bois mort pour la nidification, mais le pic mar s'est avéré être plus sélectif en termes d'espèces d'arbres. Nid-hauteur a été influencé par le diamètre de l'arbre. Les deux espèces ont les mêmes préférences de nidification pour le chêne Turquie, les tilleuls et le chêne pédonculé, dans un *Quercetum farnetto-cerris* type de forêt. L'orientation du trou de nid sur l'arbre était principalement NE-E-SE pour le pic mar et N-NE-E pour le pic épeiche.

Key words: nest-site parameters, Middle Spotted Woodpecker, Great Spotted Woodpecker, Comana Forest.

INTRODUCTION

All over Europe, conservation of forest habitats is of great importance, this biotope being dominant in the continent before massive human intervention; now only one third of the post-glacial forest is still present (Thirgood, 1989; Mikusinski et al., 2001). Regarding the loss of biodiversity, this took place not only by reducing the forest area, but also by reducing the quality of this biotope.

Woodpeckers are a special group among forest birds, with very selective ecological requirements (Angelstam et al., 1994) being regarded as the group with the greatest affinity for forests, also as indicators of forest biodiversity. European woodpeckers are dependent on trees for nesting-sites and they forage for food in old, dying or dead trees. For this reason, woodpeckers are declining in population, especially in the countries with intensive forest management, or where the conversion for agriculture has been massively made (Pettersson, 1985).

Woodpeckers are threatened mainly by the loss of forest habitats and also by the loss in quality of the habitat by reducing the food sources and nesting sites. Cutting the old trees and removing the decaying wood from the forest is the main cause for the declining of those species (Mikusinski, et al., op. cit.; Angelstam et al., op. cit.; Munteanu, 2009).

In Romania, woodpeckers have been studied since the beginning of the 1930 period (Cătuneanu, 1933). Papers dedicated to this group dealt with the distribution, taxonomy, reproduction biology, diet, anatomy, habitat requirements and, within the last years, conservation (Paşcovschi, 1937; Papadopol, 1973, 1974; Papadopol & Mândru, 1977; Popovici, 1971; Korodi Gal, 1970, 1975; Glăvan, 2004; Dorresteijn et al., 2013; Domokos et al., 2014).

Middle spotted woodpecker, *Dendrocopos medius* (Linnaeus, 1758) (MSW), is considered an oak forest specialist (Pasinelli, 2000). Because it prefers mature woods, inhabiting old forests at optimal harvest age, the species decline severely in those regions. Oaks are requiring several decades to become suitable habitats (60-100 years) (Pasinelli, 2003). Losing suitable habitat increases fragmentation and reduces density which in extreme cases can cause extinction, as the southern population from Sweden (Pettersson, op. cit.). Middle spotted woodpecker is listed in Annex I of the Birds Directive of the European Union listing threatened species that require special conservation measures.

Great Spotted Woodpecker, *Dendrocopos major* (Linnaeus, 1758) (GSW), is regarded as the most numerous and widespread European woodpecker and is not listed as threatened. Being primary cavity excavators, woodpeckers are considered as 'key species', producing nest sites and roosting places for other animals (Kosiński & Winiecki, 2004; Kosiński et al., 2006; Wesolowski, 1989), especially Great Spotted Woodpecker which builds more than one cavity in search for the final nesting place, offering more opportunities for the secondary nesters (Cramp, 1985).

It has been reported that although Great- and Middle Spotted Woodpecker are taxonomically related species, coexisting in deciduous forests (del Hoyo et al., 2002; Kosiński et al., op. cit.), both species differ with respect to nest-tree selection, nest height and orientation of the hole entrance (Kosiński & Winiecki, op. cit.; Kosiński et al., op. cit.).

The main goal of this study is to get a better insight of the habitat requirements for the two species, by characterising the nest sites used by Great and Middle Spotted Woodpeckers and to compare the nest sites between species in a lowland forest, a remaining fragment of the secular forest that dominated in the past the southern part of Romania.

MATERIALS AND METHODS

Study area. The study was conducted in Comana Forest, Southern Romania (44°09'N, 26°07'E), 30 km south of the capital of Bucharest. This woodland is a remnant of an ancient vast forest which dominated this part of the country, being in time fragmented and cleared for agriculture and human settlements. Now, the forest (8000 ha) is included together with a mosaic of habitats: wetlands, agriculture fields and atrophic areas in Comana Natural Park and is part of the Special Protection Area Comana (ROSPA0022) and the Community Importance Site Comana (ROSCI0043). Since 2012 the area is a RAMSAR site. The deciduous forest is situated on the right bank of the Neajlov River and Lake Comana and it belongs to several plant associations: *Quercetum cerris* Georgescu, 1941, *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949, *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992, *Ornithogalo-Tilio-Quercetum* A. Dihoru, 1976, *Fraxino pallisae-angustifoliae-Quercetum roboris* Popescu et al., 1979 (Paucă-Comănescu et al., 2000; Paucă-Comănescu et al., 2001). The area is

known as an important *hot spot* for the biodiversity of this part of the country, here being mentioned over 240 bird species (Petrescu et al., 2009).

Data collection and analysis. Data were collected during the pre-breeding and breeding season of 2013. From March to the end of April, the number and distribution of territorial birds was established by responses to the play-back of taped calls (Kosiński et al., 2004). After the bird's response, the territories were checked for occupied nest-holes. Searches continued especially in May and June, identifying the nest by the calls of the nestlings. The position of the nests was recorded with a GPS and revisited after fledging for recording nest-site parameters. The following parameters were recorded to describe the nest site: tree species, diameter of the tree at breast height (Dbh), health of the tree on a scale from 1 to 5 describing the decaying state (1-dead, 5-alive), exact position of the tree, nest and tree height, orientation of the nest, vegetation on a 10 m radius around the nest tree.

Statistical analyses were performed at a confidence level $\alpha = 0.05$, using PAST software (Hammer et al., 2001). Where data did not fit a normal distribution, normalization was carried out by means of Box-Cox transformation and tested again for normality. If normalization was not successful, non-parametric tests were used to test data for statistical significance.

Statistical procedures included Kruskal-Wallis non-parametric ANOVA with Tukey post-hoc analysis to test woodpecker-tree species association, one-way ANOVA for species-tree circumference relationship and χ^2 test for independence to test any existing relationship between tree circumference and height at which the nest was built.

RESULTS AND DISCUSSIONS

In 2013, we found 20 nests for Middle Spotted Woodpecker and 29 nests for Great Spotted Woodpecker (Figs 1, 2). Both species prefers oaks as nesting tree

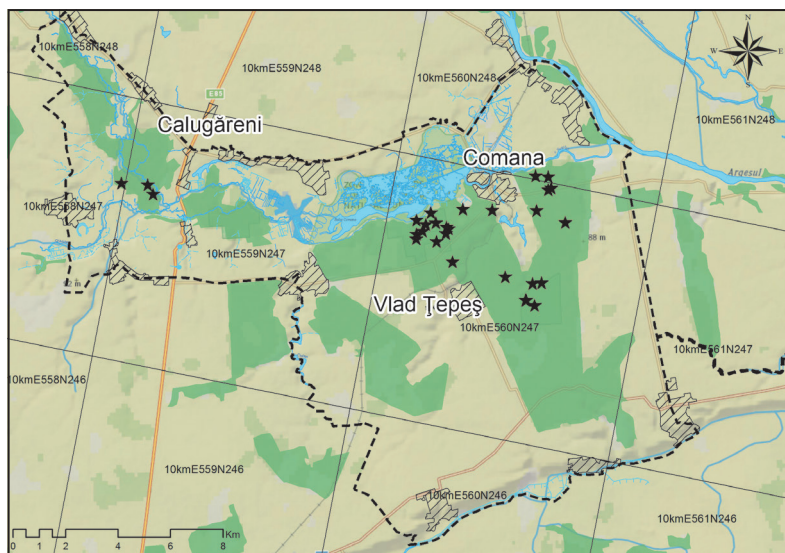


Fig. 1 - Distribution of the nest sites for Great Spotted Woodpecker in Comana Forest (★) - GSW nests, (- -) - limit of Comana Natural Park.

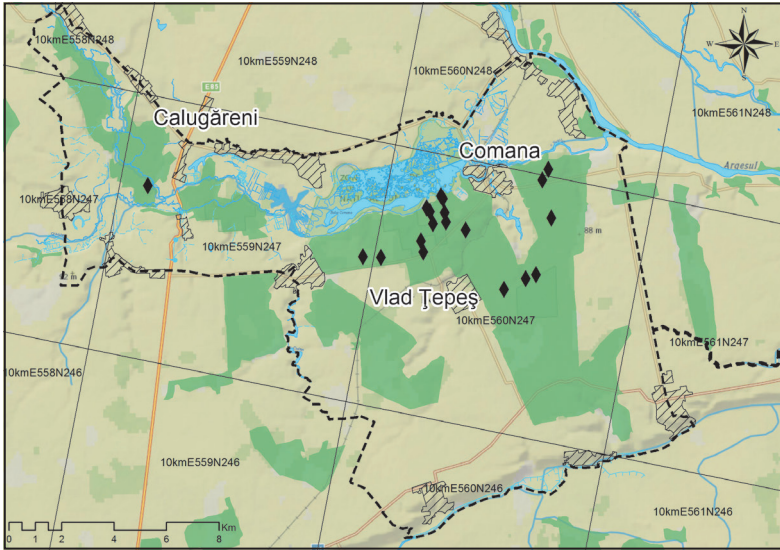


Fig. 2 - Distribution of the nest sites for Middle Spotted Woodpecker in Comana Forest (◆) - nests, (- -) - limit of Comana Natural Park.

(Tab. 1, fig. 3), Turkey oak *Quercus cerris* was the most commonly used tree by *Dendrocopos major* and *D. medius*, followed by Pedunculate oak *Q. robur* and Silver lime *Tilia tomentosa*. For *D. medius*, the differences between selected trees are not significant, although there can be observed a preference for Turkey oak and Silver lime (binomial exact test, $p=0.07$, $\alpha=0.05$). Same for *D. major* (binomial exact test, $p=0.012$, $\alpha=0.05$), it can be observed a preference for Turkey oak and Pedunculate oak. There was also a highly positive selection for dead trees (Fig. 4).

The average breast height diameter (Dbh) of the nesting tree was 33 ± 13.7 cm ($n=20$) in Middle Spotted Woodpecker and 36 ± 12.8 cm ($n=29$) in Great Spotted Woodpecker. Median nest tree Dbh differed significantly between the two species

Table 1

Trees used by Great- and Middle Spotted Woodpecker (N-sample size, dbh-diameter at breast height, *-mean \pm standard deviation).

Species	<i>Dendrocopos medius</i>				<i>Dendrocopos major</i>			
	N	%	dbh*	nest height*	N	%	dbh*	nest height*
<i>Quercus robur</i>	4	20	51 \pm 18.2	9 \pm 1.41	8	28	49 \pm 13.5	11 \pm 3.1
<i>Quercus cerris</i>	7	35	27 \pm 6.2	7.2 \pm 5.11	10	34	27 \pm 3	5.4 \pm 1.8
<i>Tilia tomentosa</i>	6	30	34 \pm 5.2	8.66 \pm 4.71	5	17	30 \pm 2.2	6.7 \pm 3.2
<i>Carpinus betulus</i>	1	5	25	9	1	3	29	4.5
<i>Fraxinus excelsior</i>	0	0	0	0	3	10	37 \pm 3	5.2 \pm 2.4
<i>Quercus frainetto</i>	0	0	0	0	1	3	27	5
<i>Salix alba</i>	0	0	0	0	1	3	65	5
<i>Robinia pseudoacacia</i>	2	10	15	3	0	0	0	0
Total	20	100			29	100		

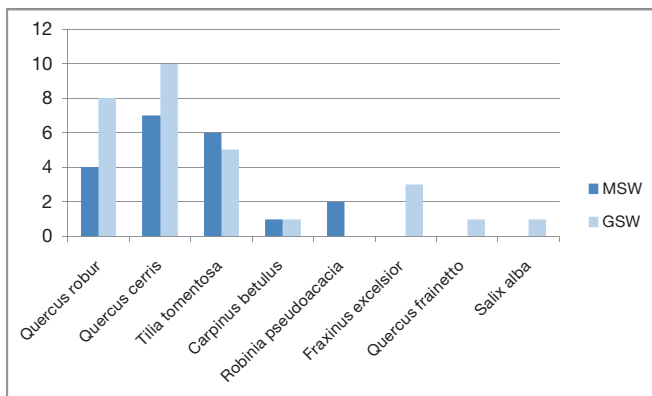


Fig. 3 - Trees used by Great- (GSW) and Middle Spotted Woodpecker (MSW).

($t = 67.464$, $p = 4.3282 \cdot 10^{-24}$) (Fig. 5). The average height of the nest hole from the ground was 7.7 ± 3.6 cm ($n=20$) for Middle Spotted Woodpecker and 7.1 ± 3.4 cm ($n=29$) for Great Spotted Woodpecker. For *Dendrocopos medius* it was found that there is a positive association between tree circumference and nest height $\chi^2=386.84$; $df=19$; $p=2.378 \cdot 10^{-70}$) (Fig. 6). Also, the association was positive for Great Spotted Woodpecker ($\chi^2=779.33$; $df=28$; $p=4.684 \cdot 10^{-146}$) (Fig. 7).

Comparing preferences of woodpeckers for specific trees species as nesting places (seven tree species for *Dendrocopos major* and five for *D. medius*), applying Kruskal-Wallis non-parametric ANOVA, it showed a significant difference between species ($p=1.01 \cdot 10^{-8}$). Applying Tukey post-hoc test we found that there is a significant difference about the selection preferences for nesting regarding tree species. Hereby, for Great Spotted Woodpecker, there are significant differences between the preference for hornbeam *Carpinus betulus* and Turkey oak *Quercus cerris* (Tukey post-hoc, $p=0.00014$), the woodpecker strongly preferring the Turkey oak. The same, regarding Turkey oak and other tree species, ash *Fraxinus excelsior* ($p=0.00049$), Hungarian oak *Q. frainetto* ($p=3.36 \cdot 10^{-05}$) and White willow *Salix alba* ($p=3.36 \cdot 10^{-05}$). Also, between selection of Turkey oak, Pedunculate oak and

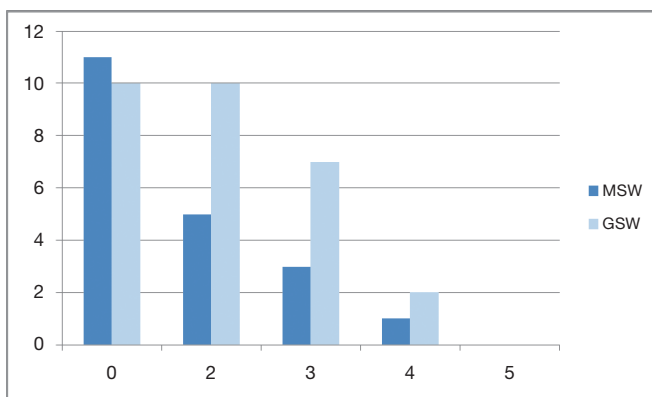


Fig. 4 - Decaying state of trees used by Great- (GSW) and Middle Spotted Woodpecker (MSW), on a 1 to 5 scale: 1- dead, 5-alive.

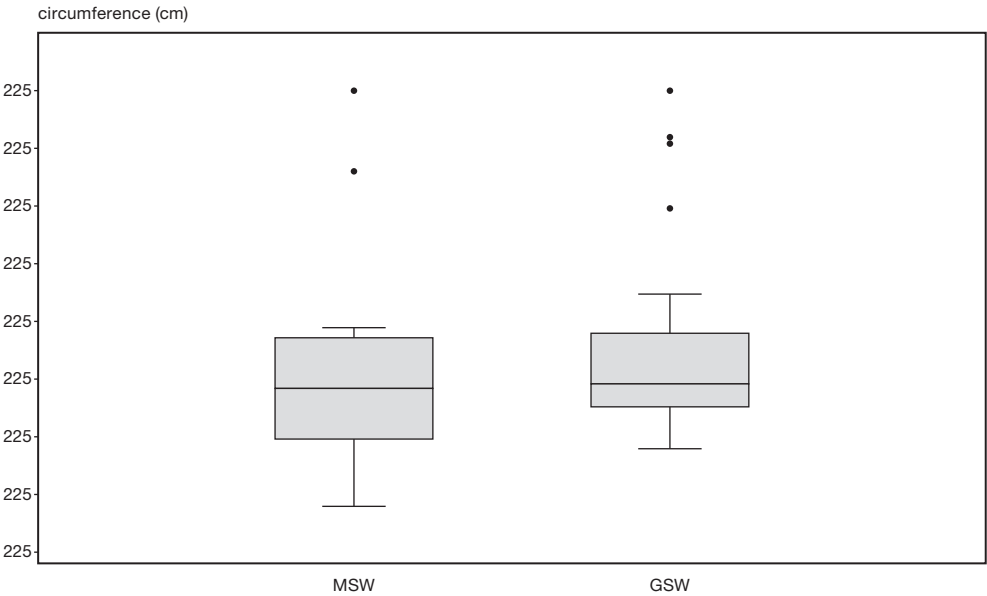


Fig. 5 - Differences of nest-trees circumference between *Dendrocopos medius* (MSW) and *D. major* (GSW).

lime, there are no differences regarding the nesting preferences, Great Spotted Woodpecker nesting often in those trees.

Middle Spotted Woodpecker has the same nesting preferences for Turkey oak, lime and Pedunculate oak, but it can choose also hornbeam *C. betulus* and

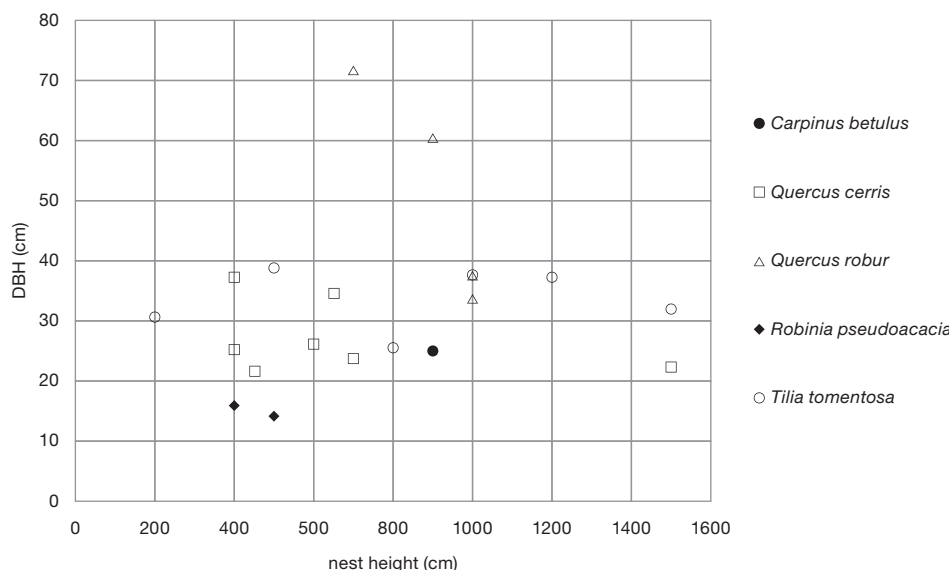


Fig. 6 - Relation between tree diameter (DBH) and nest height in Middle Spotted Woodpecker.

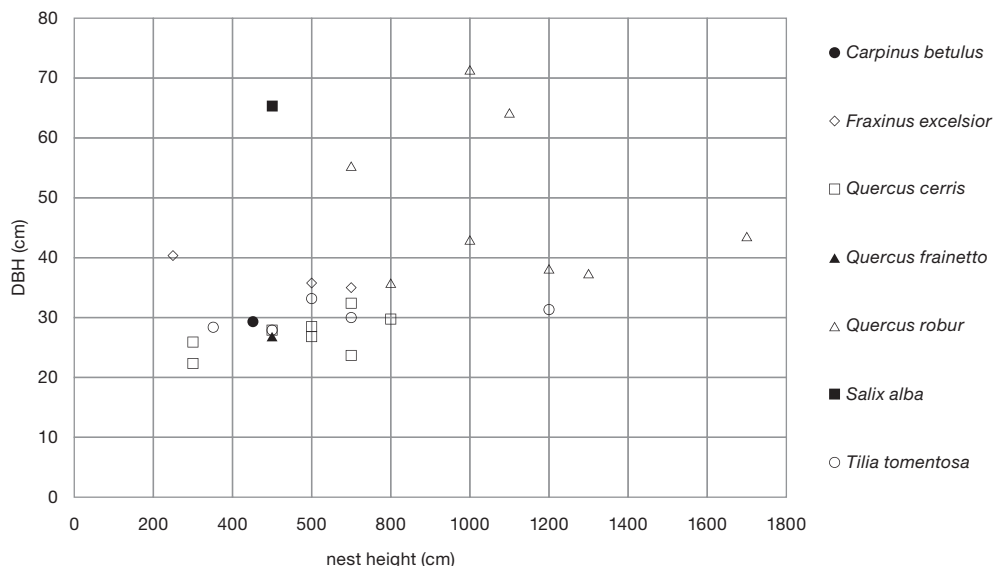


Fig. 7 - Relation between tree diameter (DBH) and nest height in Great Spotted Woodpecker.

even black locust *Robinia pseudoacacia*. Choosing between Turkey oak and hornbeam there are statistic significant differences ($p = 0.00014$), *Dendrocopos medius* preferring the Turkey oak for nesting, but between Turkey oak and lime ($p = 0.1834$) or Pedunculate oak ($p = 0.2729$), data do not differ significantly. Hereby, Middle Spotted Woodpecker is more selective in terms of tree species than the Great Spotted Woodpecker, choosing only five species of trees for nesting.

The orientation of the nest hole on the tree was mainly NE-E-SE for Middle Spotted Woodpecker (Fig. 8) and N-NE-E for Great Spotted Woodpecker (Fig. 9). In other studies, the orientation of the nest hole was SE and NE for *D. medius* and S, NE and NW for *D. major*, but the orientation is believed to be related with the slope (Glăvan, 2004). In our case, the slope was not a criteria factor.

Vegetation around the nest tree was recorded on 10 m radius from the tree and identified according to Habitats of Romania (Doniță et al., 2005). We recorded 5 plant association for nesting habitat of Middle Spotted Woodpecker, 50% of the nest being placed in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski type of association, followed by *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu 1971), corr Popescu et Sanda, 1992 and *Lychnio coronariae-Quercetum cerris* Sanda et Popescu, 2003 (Tab. 2). Also, 45% of Great Spotted Woodpecker nests were identified in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949 type of forest, followed by *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992 (Tab. 3).

In conclusion, Great Spotted Woodpecker and Middle Spotted Woodpecker in Comana forest do not differ very much in terms of nesting preferences, with the difference that *D. medius* is more selective about tree species. The woodpeckers nesting preferences depends on the forest composition. In a mosaic of forest plant associations, the two woodpecker species choose to nest more frequently in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949 and *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992. In

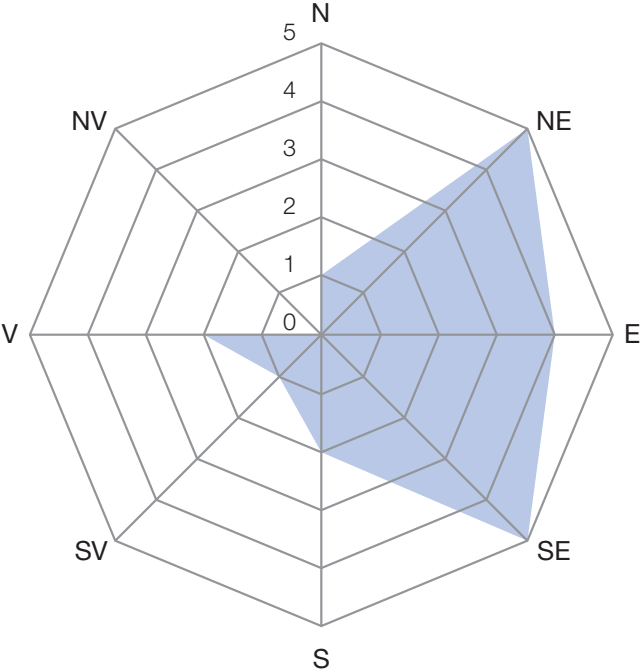


Fig. 8 - Nest hole orientation for *Dendrocopos medius*.

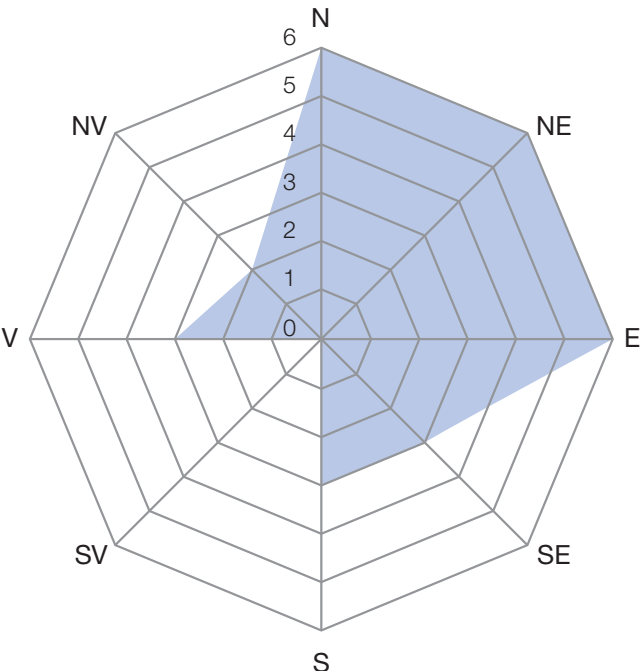


Fig. 9 - Nest hole orientation for *Dendrocopos major*.

Table 2

Plant associations selected by *Dendrocopos medius* as nesting habitat (N - sample size, * - mean±standard deviation).

%	N	Plant association	Cover (%)*
5	1	<i>Bromo sterilis-Robinetum pseodacaciae</i> (Pócs, 1954) Soó, 1964	75
20	4	<i>Lychnio coronariae-Quercetum cerris</i> Sanda et Popescu, 2003	80±9.1
20	4	<i>Melico uniflorae-Tilietum tomentosae</i> (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992	80±7.1
5	1	<i>Ornithogalo-Tilio-Quercetum</i> A. Dihoru, 1976	90
50	10	<i>Quercetum farnetto-cerris</i> (Georgescu, 1945) Rudski, 1949	75.5±10.9
100	20	Total	

Table 3

Plant associations selected by *Dendrocopos major* as nesting habitat (N - sample size, * - mean±standard deviation).

%	N	Plant association	Cover (%)*
3	1	<i>Fraxino pallisae-angustifoliae-Quercetum roboris</i> Popescu et al., 1979	80
14	4	<i>Lychnio coronariae-Quercetum cerris</i> Sanda et Popescu, 2003	76.3±7.5
28	8	<i>Melico uniflorae-Tilietum tomentosae</i> (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992	83.7±5.2
7	2	<i>Ornithogalo-Tilio-Quercetum</i> A. Dihoru, 1976	82.5
3	1	<i>Polygonato latifolio - Quercetum roboris</i> (Hargitai, 1940) Borhidi, 1966 in Borhidi et Kevey, 1996	70
45	13	<i>Quercetum farnetto -cerris</i> (Georgescu, 1945) Rudski, 1949	80±9.1
100	29	Total	

related literature, it was found that *D. major* prefers living trees from species like *Populus tremula*, *Fagus sylvatica*, *Quercus petrea*, *Quercus robur*, *Tilia cordata* and *D. medius* nests mostly in dead wood, preferring *Fagus sylvatica*, *Tilia cordata*, *Fraxinus excelsior* as nesting trees (Glăvan, 2004).

We found that *D. medius* can choose as nesting site Black locust *Robinia pseudoacacia*, a tree with extremely hard wood, resistant to rot and toxic when is alive, woodpeckers avoiding it as nesting place, except for Great Spotted Woodpecker. The nests were found in decaying snags, probably old nests of Great Spotted Woodpecker, which proofs again the importance of old and decaying trees for woodpeckers, especially when other tree species are not available. In literature, we found only one case of nesting in Black locust for *D. medius* (Mazgajski, 1997 in Pasinelli, 2003). This aspect, together with the results related to the preference for large oaks and lime and decaying wood bring the base information for a specific management action plan for the conservation of the species and the forest in this protected area.

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PREFERINȚELE DE CUIBĂRIT LA DOUĂ SPECII DE CIOCĂNITORI
(*DENDROCOPOS MAJOR* ȘI *DENDROCOPOS MEDIUS*), ÎN PĂDUREA COMANA,
SUDUL ROMÂNIEI

REZUMAT

Scopul principal al acestui studiu este de a obține o mai bună înțelegere a nevoilor pe care ciocănitoarea pestriță mare și ciocănitoarea de stejar le au pentru habitatul în care trăiesc. Ciocănitorele sunt specialiști pădurii, fiind amenințate cu dispariția în întreaga Europă, mai ales prin distrugerea habitatelor forestiere precum și prin pierderea calității habitatului, prin reducerea surselor de hrană și a locurilor de cuibărit. Ambele specii au aratat o preferință puternică pentru stejari, tei, arbori mari și lemn mort pentru cuiburi, dar Ciocănitoarea de stejar s-a dovedit a fi mai selectivă în ceea ce privește speciile de arbori. Înălțimea cuibului a fost influențată de diametrul copacului. Ambele specii au aceleași preferințe de cuibărit pentru cer, tei și stejarul pedunculat, într-o pădure de tipul *Quercetum farnetto-cerris*. Orientarea intrării în cuibul din arbore a fost în principal NE-E-SE pentru ciocănitoarea de stejar și N-NE-E pentru ciocănitoarea pestriță mare.

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THE BIRD FAUNA FROM LOTRIOARA RIVER BASIN (LOTRU MOUNTAINS, ROMANIA)

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Abstract. The results of a one year study of bird communities from the Lotrioara River Basin (Lotru Mountains, Romania), using the transect method along the main valley, are presented. The study aimed to reveal the characteristics of the community's dynamics, both from spatial and temporal point of view. During the research period 70 species belonging to 9 orders were identified in the investigated area. The number of species decreases with the altitude, but it is also related to the heterogeneity of habitats. During the year the species' number varies from a minimum in winter to a maximum in spring. Insectivores are the prevailing feeding guild in the bird communities from Lotrioara basin, but during the cold season the dominance is taken over by omnivorous and granivorous species.

Résumé. On présente les résultats d'une étude des communautés des oiseaux du bassin de la rivière Lotrioara (Lotru Montagnes, Roumanie), en utilisant la méthode des transects au long de la vallée principale. L'étude visait à révéler les caractéristiques de la dynamique de l'ornithofaune, du point de vue spatial et temporel. Au cours de la période de recherche 70 espèces appartenant à 9 ordres ont été identifiées dans la zone étudiée. Le nombre d'espèces diminue avec l'altitude, mais il dépend aussi de l'hétérogénéité des habitats. Au cours de l'année, le nombre des espèces varie d'un minimum en hiver à un maximum en printemps. La structure trophique des communautés d'oiseaux dans le bassin Lotrioara est dominée par les insectivores, mais pendant la saison froide, la domination est prise par les omnivores et granivores.

Key words: elevational gradient, species richness, feeding guilds, bird phenology.

INTRODUCTION

Birds are a well studied group in Romania, with many papers concerning the ornithofauna of different areas. Although most of them deal with wetlands and lowlands, some researches were carried out also in the Carpathians. The first data concerning birds from mountain areas in Romania date back to the 19th century. Stetter made the first avifaunal list of Transylvania, published in 1845. Several other naturalists working in the Carpathians made notes also on birds, among them A. Berger, J. Csato, W. Hausmann, O. Hermann, M. von Kimakovicz. Their data, along with his own observations, were synthesized by Bielz (1888) in the volume concerning the vertebrates of Transylvania. He cites among others, species that are currently extinct from Romania, like the three species of vultures: *Aegypius monachus*, *Gyps fulvus* and *Gypaetus barbatus*.

During the 20th century several ornithologists published papers concerning the bird fauna from different mountain areas. In the last two decades some studies were carried out in some of the South Carpathian massifs, namely Piatra Craiului (Petrescu, 1995), Făgăraș (Petrescu, 2005) and the neighbouring Cindrel Mountains (Murariu et al., 2009 a), where 92 species were found over a period of more than 135 years of observations. Other articles deal with a series of ecological aspects of bird communities. An ornithological zonation along vertical (elevation) and horizontal gradients, based on data from literature and personal observations, is presented by several authors: Papadopol (1992), Radu (1973), Papadopol and Petrescu (1992) and

others. Recently, Mestecăneanu (2008) published a paper on the monthly dynamics of bird communities from a dam lake in Iezer-Păpușa massif.

In this paper we present the results of the first study on the bird fauna done in Lotru Mountains. Up to the present there are only scarce data available on birds from this area, most of them dating back to the 19th century when Kimakowicz made several observations at Prejba, mentioning *Tetrao urogallus*, *Apus melba*, *Regulus regulus*, *Eremophila alpestris* and *Loxia curvirostra* (Bielz, 1888). The only recently published data concern a female capercaillie (*T. urogallus*) and her 10 chicks (Roberts, 2000).

The present study highlights the variation of the ornithofauna, both in space (along the elevational gradient) and time (seasonally). It also reveals the changes occurred in its trophic structure.

STUDY AREA AND METHODS

Lotrioara River Basin is part of Lotru Mountains (Southern Carpathians), being placed in the middle of Romania (Fig. 1). Lotrioara is a right side tributary of the Olt River. Its river basin has 117 km² and the largest part is covered by natural or planted forests, from deciduous in the lower part, to coniferous in the upper areas. The valleys are mostly narrow, with steep slopes. However, in the lower sector Lotrioara valley is open and wide, and a traditional village was established here, resulting in a large forest clearing, now occupied by orchards and hayfields. Originally stretching on 1.5 km, during the last years the village has expanded by new buildings down- and upstream. In the river basin, small areas are occupied by secondary mountain meadows, resulted from deforestation. Subalpine shrubs are found only on the highest peaks, on the southern slope. On Sterpu Peak (2143 m), above the subalpine shrubs, an alpine meadow can also be distinguished.

The investigations were carried out monthly during one year, using the transect method. Five transects, coded from I to V, were established along the main



Fig. 1 - Position of the research area and the five transects.

valley and in the upper sector on the left side slope, from upstream the confluence with Olt River (420 m), up to Prejba Chalet (1660 m) (Fig. 1). Transect I is a sector in the beech forest near the confluence, including Lotrioara village, II and III are transects in the mixed forest along Lotrioara Valley and one of its tributaries - Pârâul Cailor, IV crosses a slope covered by a young spruce plantation, and V is a transect in an ecotone area, at the limit between an old spruce forest and secondary meadows near Prejba Chalet. Besides these transects other observations were made along the way to Sterpu Peak. The data were included in tab. 1 in a separate column, noted as transect VI, and were included only in some of the analysis (the seasonal dynamics and the trophic structure).

A cluster analysis based on the Jaccard index was performed in order to assess the similarity of bird fauna structure in the four seasons and at different elevations.

The bird species were ascribed to the feeding guilds according to their prevailing food (Bezzel, 1996), while their phenological status was established based on the observations during the present research. The dependence of the trophic structure of bird fauna on season and the altitude were tested by Pearson chi-square test of independence.

RESULTS

During the one year study, 70 species of birds belonging to 9 orders, were identified in Lotrioara River Basin. Among them, the best represented are the orders Passeriformes (49 species), Falconiformes (9 species) and Piciformes (5 species), the systematics being according to Bruun et al. (1999).

The list of the observed species is given in table 1, with the mention of the seasonal and altitudinal occurrence, as well as their inclusion in the annexes II (strictly protected fauna species) and III (protected fauna species) of the Convention on the Conservation of European Wildlife and Natural Habitats (known as the Bern Convention) (<http://conventions.coe.int/Treaty/en/Treaties/Html/104.html>) (column BC in tab. 1), Annex I (species subject of special conservation measures concerning their habitat) of the Directive 2009/147/EC (known as the Birds Directive) (<http://ec.europa.eu/environment/nature/legislation/birdsdirective>) (column BD) and their conservation status (VU-vulnerable, EN-endangered, CR-critically endangered) according to the Red Book of Romanian Vertebrates (Munteanu, 2005) (column RB). The codes used for seasons are: W - winter (observations from December to February), SP - spring (March to May), SM - summer (June to August), A - autumn (September to November).

The species richness remains relatively constant during the warm period of the year, with a slight decrease from spring, when the maximum number of species (41) was recorded, till autumn, but is lower during winter, when the species' number (23) drops to a little more than half.

The number of bird species decreases constantly (a difference of 5 species between consecutive sectors) on altitude. The only exception is represented by the sector V (spruce forest and montane meadow), where a higher number of species than in the previous one was observed. A high number of species (42) was recorded apart from these transects, on the way to Sterpu Peak. This is the sole part of the river basin where subalpine *Pinus mugo* shrubs and rocky meadows can be found, as well as an alpine meadow covering a small area around the peak. The alpine and subalpine meadows are the typical habitats for *Anthus spinoletta* and *Prunella*

Table 1

The bird species observed in Lotrioara River Basin and their seasonal and altitudinal distribution (the codes are explained in the text).

No.	Species	Season				Sector						BC	BD	RB
		W	SP	SM	A	I	II	III	IV	V	VI			
1.	<i>Aquila pomarina</i>			+							+	II	I	VU
2.	<i>Hieraaetus pennatus</i>			+	+				+		+	II	I	CR
3.	<i>Circetus gallicus</i>			+							+	II	I	VU
4.	<i>Buteo buteo</i>	+	+	+	+	+	+	+	+		+	II		
5.	<i>Pernis apivorus</i>			+							+	II	I	VU
6.	<i>Accipiter gentilis</i>		+	+	+	+	+	+	+		+	II		
7.	<i>Accipiter nisus</i>	+		+	+	+	+	+			+	II		
8.	<i>Falco subbuteo</i>			+	+					+	+	II		
9.	<i>Falco tinnunculus</i>			+							+	II		
10.	<i>Tetrao urogallus</i>	+		+	+		+		+	+	+	III	I	
11.	<i>Bonasa bonasia</i>	+		+	+			+	+	+		III	I	
12.	<i>Columba palumbus</i>		+	+						+	+			
13.	<i>Cuculus canorus</i>		+	+		+	+		+			III		
14.	<i>Strix uralensis</i>		+	+			+				+	II	I	
15.	<i>Upupa epops</i>			+			+					II		VU
16.	<i>Picus canus</i>				+			+				II	I	
17.	<i>Dendrocopos major</i>	+	+	+	+	+	+				+	II		
18.	<i>Dendrocopos minor</i>				+		+					II		
19.	<i>Dryocopus martius</i>				+					+		II	I	
20.	<i>Jynx torquilla</i>			+						+		II		EN
21.	<i>Alauda arvensis</i>		+							+		III		
22.	<i>Hirundo rustica</i>		+	+		+						II		
23.	<i>Delichon urbica</i>			+	+	+					+	II		
24.	<i>Anthus spinoletta</i>			+							+	II		
25.	<i>Anthus trivialis</i>			+	+				+	+		II		
26.	<i>Motacilla cinerea</i>		+	+	+	+	+	+			+	II		
27.	<i>Motacilla alba</i>		+	+	+	+	+	+		+	+	II		
28.	<i>Lanius collurio</i>		+	+		+	+		+		+	II		
29.	<i>Sturnus vulgaris</i>		+	+		+								
30.	<i>Garrulus glandarius</i>	+	+	+	+	+	+	+	+	+	+			
31.	<i>Nucifraga caryocatactes</i>	+	+	+	+	+	+	+	+	+	+	II		
32.	<i>Corvus corax</i>	+	+	+	+	+	+	+	+	+	+	III		EN
33.	<i>Cinclus cinclus</i>	+	+	+	+	+	+	+			+	II		
34.	<i>Troglodytes troglodytes</i>	+	+	+	+	+	+	+	+	+	+	II		
35.	<i>Prunella collaris</i>			+							+	II		
36.	<i>Prunella modularis</i>		+	+		+	+	+	+		+	II		
37.	<i>Sylvia atricapilla</i>		+	+	+	+	+	+	+	+	+	II		
38.	<i>Sylvia curruca</i>		+	+		+			+		+	II		
39.	<i>Phylloscopus trochilus</i>		+	+			+	+	+			II		
40.	<i>Phylloscopus collybita</i>		+	+	+	+	+	+	+		+	II		
41.	<i>Phylloscopus sibilatrix</i>			+							+	II		
42.	<i>Regulus regulus</i>	+	+	+	+		+	+	+	+	+	II		
43.	<i>Regulus ignicapillus</i>		+		+	+	+	+				II		
44.	<i>Ficedula parva</i>			+					+			II	I	
45.	<i>Muscicapa striata</i>			+							+	II		
46.	<i>Phoenicurus phoenicurus</i>		+	+		+					+	II		
47.	<i>Phoenichurus ochruros</i>		+	+	+	+				+	+	II		
48.	<i>Erethacus rubecula</i>		+	+	+	+	+	+	+	+	+	II		
49.	<i>Turdus torquatus</i>			+						+		II		
50.	<i>Turdus merula</i>		+	+	+	+	+	+	+	+	+	III		
51.	<i>Turdus philomelos</i>		+	+	+	+	+	+				III		
52.	<i>Turdus viscivorus</i>		+	+	+			+		+		III		
53.	<i>Turdus pilaris</i>		+			+						III		
54.	<i>Parus montanus</i>	+	+	+	+	+	+	+	+	+	+	II		
55.	<i>Parus cristatus</i>	+	+	+	+		+	+		+	+	II		
56.	<i>Parus caeruleus</i>	+	+	+	+	+	+	+	+	+		II		
57.	<i>Parus ater</i>	+	+	+	+	+	+	+	+	+	+	II		
58.	<i>Parus major</i>	+	+	+	+	+	+	+	+			II		
59.	<i>Aegithalos caudatus</i>	+	+		+	+	+	+	+	+		II		
60.	<i>Sitta europaea</i>	+	+	+	+	+	+	+				II		
61.	<i>Certhia familiaris</i>	+	+		+	+	+			+		II		
62.	<i>Fringilla coelebs</i>	+	+	+	+	+	+	+	+	+	+	III		
63.	<i>Pyrrhula pyrrhula</i>	+		+	+	+		+	+	+	+	III		
64.	<i>Coccothraustes coccothraustes</i>			+		+						II		
65.	<i>Carduelis spinus</i>	+			+	+	+	+		+		II		
66.	<i>Carduelis carduelis</i>		+		+	+	+			+		II		
67.	<i>Carduelis cannabina</i>				+	+						II		
68.	<i>Loxia curvirostra</i>	+		+	+					+	+	II		
69.	<i>Emberiza cia</i>		+			+						II		
70.	<i>Emberiza citrinella</i>		+	+		+					+	II		
Total		23	41	40	38	42	37	32	28	29	42	67	10	7

collaris, which were observed only here. Other 6 species were also found only along this transect: *Phylloscopus sibilatrix*, *Muscicapa striata*, *Pernis apivorus*, *Aquila pomarina*, *Falco tinnunculus* and *Delichon urbica*. The last two species were observed near Sterpu Peak as well.

Both the species number and the specific structure of bird communities remain relatively constant during the warm period of the year. Thus, the cluster analysis of the four seasons based on Jaccard similarity index (Fig. 2) shows a high homogeneity of the warm seasons, while during winter, the most distinctive bird fauna is found. The same analysis, performed along the altitudinal gradient, also reveals a gradual change in the ornithofauna, different transects joining by the increase in elevation (Fig. 3). However, the highest similarity (0.73 in terms of Jaccard index) was calculated not for the first two transects, but for transects II and III, both situated in the mixed forest vegetation level, joined at a greater distance (0.57) by transect I, which crosses the village. The most distinctive fauna (0.35) was found in transect V, situated at the highest elevation, but also along an ecotone.

Based on the birds' observed presence in the research area, we established three phenological categories: sedentary species - encountered during the entire study period, warm season species - observed during spring, summer and autumn but not found in winter, and wintering species. As several less abundant species were only seldom observed (some in a single transect), we do not have the evidence of breeding for all the species recorded during the warm period of the year. The

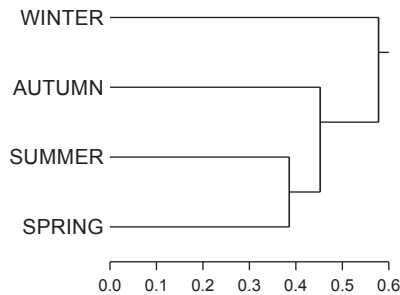


Fig. 2 - Similarity (1-Jaccard index values) between the four seasons based on the bird fauna.

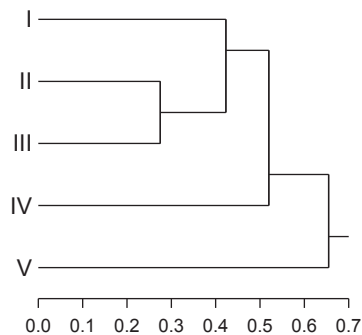


Fig. 3 - Cluster analysis of the five transects, based on the similarity (1-Jaccard index values) between their bird fauna.

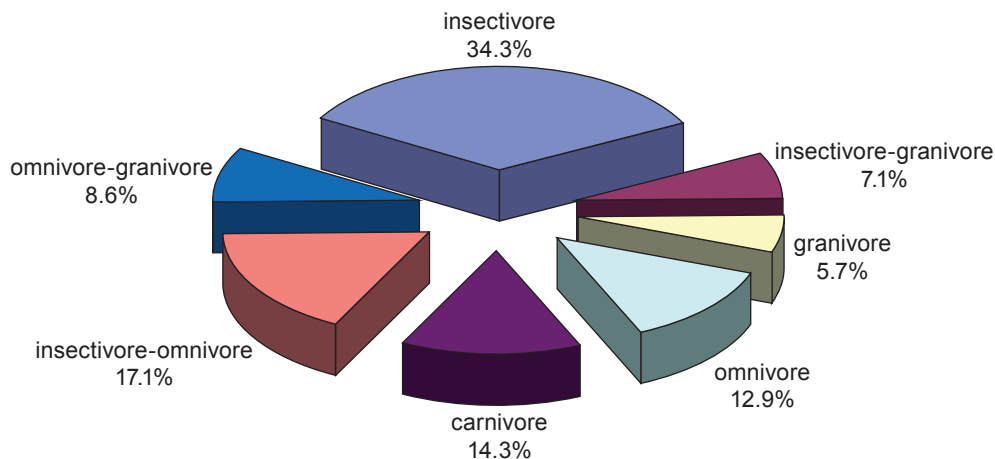


Fig. 4 - Trophic structure of bird community (% of species) from the Lotrioara River Basin during the study period.

warm season birds are the most numerous species, representing 67.1%, while the sedentary birds make up only 31.4% of the species.

Among the feeding guilds the insectivores are prevailing, representing 34.3% (Fig. 4) and, as the antropic impact on the valley is low, the carnivorous species are also well represented in the area (14.3%). However, many bird species, especially insectivores, change their diet during the year, according to the availability of different food sources. Some species feed during the breeding season exclusively (or mainly) on insects, but switch during winter to an exclusively vegetal (e.g. *Emberizidae*) or omnivorous diet (e.g. *Turdidae*), dominated by fruits (berries) and seeds. These species are included in two separate groups with a variable trophic regime, insectivores-granivores (7.1%) and the insectivores-omnivores (17.1%). The omnivores (12.9%) (belonging to *Corvidae* and *Paridae* families) have a mixed trophic regime all year round, although a shift in the prevailing food resource exploited by these birds also occurs with the change of seasons (Bezzel, 1996).

The Pearson chi-square test for independence revealed significant differences ($\chi^2 = 18.56$, d.f.= 3, $p < 0.01$) between the ratios of feeding guilds in the breeding season (from late spring to late summer) and in the rest of the year (from beginning of autumn to early spring), showing a seasonal dynamics of the bird fauna trophic structure.

An important change is recorded by granivores, which increase in ratio from 5.8% during the breeding season to 30.4% in winter (Fig. 5). Omnivores also become more numerous, prevailing during the cold season (43.4%). In contrast, insectivores decrease from 59.4% in the breeding season to 17.7% in winter. Carnivores present a low amplitude of variation along the year.

Concerning the altitudinal distribution of the feeding guilds, the most evident characteristic is the variation of granivores, which reach the highest ratio (10.3%) in the uppermost sector (V), where numerous species which turn in winter to vegetarian diet (*Fringillidae*) also occur. However, the Pearson chi-square test for independence indicates no significant dependence of the trophic structure on the elevation.

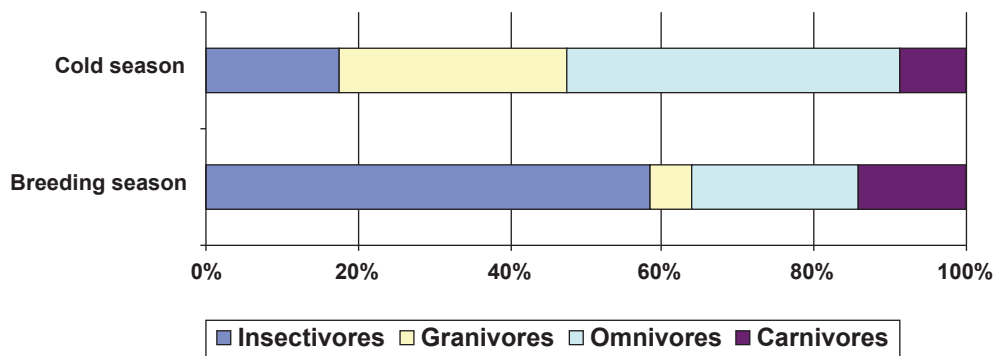


Fig. 5 - Seasonal dynamics of feeding guilds (% of species) in the ornithofauna from Lotrioara River Basin.

DISCUSSIONS

The 70 identified bird species make Lotrioara River Basin comparable to other researched mountain areas. Based on observations during the breeding season Petrescu notes 64 bird species from Făgăraș Mountains (2005) and 76 from Piatra Craiului (1995), Murariu et al. (2009 b) 74 species (among them 10 mentioned only in the literature) from Zarand Mountains. During the 22 months study in the Râșor dam lake area (Iezer-Păpușa Mountains) Mestecăneanu (2008) recorded 69 bird species. However, these results cannot be compared directly, due to the differences in the research methodology and habitat structure from the study areas.

Lotrioara River Basin is a mountain area typical for the Southern Carpathians, characterised by a relatively low human impact, especially in its upper part. The high proportion of species included in the annexes of Bern Convention (95.7%, 80% being strictly protected - annex II), Bird Directive (14.2%) and in the Red Book of Romanian Vertebrates (10%, four species being considered vulnerable, two endangered and one critically endangered) confirms the conservative interest of this area, included in the ROSPA0043 Frumoasa, being one of the Important Bird Areas in Romania - AIA RO051 (Papp & Fântână, 2008).

Considering the elevational distribution some of the bird species from Lotrioara River Basin can be accounted as eurybiotic, being found in a large variety of habitats, at different altitudes (*Nucifraga caryocatactes*, *Corvus corax*, *Erithacus rubecula*, *Turdus merula*, *Fringilla coelebs*, *Phylloscopus collybita*, *Parus montanus*, etc.). Other species were observed only in the lower sector, or exclusively in the village (*Phoenicurus phoenicurus*, *Hirundo rustica*, *Turdus pilaris*, *Sturnus vulgaris*). The number of birds restricted to higher elevations is small, some of them being linked to the subalpine vegetation level (*Anthus spinoletta*, *Prunella collaris*), others to the spruce forest (*Turdus torquatus*, *Loxia curvirostra*). Thus, the species richness decreases constantly with the increase in altitude. The only exception is represented by the last sector, transect V, which shelters a higher number of species than the previous one, because it crosses a variety of habitats and the ecotone effect is strong. Here we observed birds typical both for mature spruce forests, feeding on the abundant seeds (*Loxia curvirostra*) or insects from the tree trunks (*Dendrocopos martius*, *Jynx torquilla*), and for open habitats (*Alauda arvensis*, *Anthus trivialis*).

The monotonic decrease of species' number with increasing altitude was mentioned by several other authors, in different mountains, both in tropical (Terborgh,

1977; MacKinnon & Phillips, 1993) and temperate (Sackl & Samwald, 1997; Sergio & Perdini, 2007) regions. In many cases the continuous decrease observed along the elevational gradient is the effect of area. If the necessary correction is made, the relationship between species richness and elevation gives in several cases a humpshaped curve (Rahbek, 1995).

Compared to the Romanian bird fauna, the ornithofauna from Lotrioara Basin has a very different phenologic structure. Considering the whole Romanian territory, most of the encountered bird species are sedentary, while in mountains, including the research area, most birds only nest here. The breeding species include the migratory birds (*Phylloscopus collybita*, *Sylvia atricapilla*, *Hirundo rustica*, *Cuculus canorus*) but also non-migratory species that during winter are found at lower elevations (*Turdus merula*, *T. viscivorus*, *Coccothraustes coccothraustes*, *Carduelis carduelis*). The relatively small proportion of sedentary species is due to the insufficient resources offered by the area in the cold season. Most of the resident species (*Garrulus glandarius*, *Nucifraga caryocatactes*, *Corvus corax*, *Parus montanus*, *P. ater*) are found during the whole year up to Prejba Chalet, while a smaller number (*P. major*, *Fringilla coelebs*, *Troglodytes troglodytes*) are present during winter only in the lower parts of the valley. The species which descend to lower altitudes during the cold season, whether they leave the basin or not, in spring return gradually up to the maximum elevation. Thus, *Turdus merula* was found in March in sectors I and II, in April in sectors I, II, III and in June up to Prejba Chalet. Contrary, the migratory species advance generally much faster on altitude. Thus, *Phylloscopus collybita* was first observed in April, being noted in the same day up to the maximum altitude where it was recorded, and *Motacilla alba* was observed in March next to Prejba Chalet.

The species not observed in winter are not necessarily completely absent from the research area in this season, but their densities are decreased, most of the individuals having left the valley for some more suitable areas.

Among the feeding guilds, the prevailing insectivores include birds feeding on insects mainly in the canopy (*Phylloscopus* spp., *Regulus* spp., *Aegithalos caudatus*), on the tree stems (*Dendrocopos minor*, *Dryocopus martius*), in the air (*Delichon urbica*, *Hirundo rustica*), on the ground (*Motacilla alba*, *Anthus spinoletta*), and also two species living exclusively along the river courses (*Cinclus cinclus* and *Motacilla cinerea*), which feed on aquatic invertebrates. The latter are included by some authors (Stănescu, 1971) in a separate feeding guild, the potamotrophs. Most species belonging to this group are breeding species, as insects are a resource available mainly in the warm season, being the most important food for the growing chicks. Thus, the strong decrease of the insectivores' ratio during winter is due to the migration of some species (*Phylloscopus* spp., *Delichon urbica*, *Hirundo rustica*, *Lanius collurio*) and to the fact that other species (*Turdus* spp., *Fringilla coelebs*) switch to vegetal food. The shift in the birds' diet occurs at the end of the breeding season, at the end of summer and beginning of autumn, when fruits and seeds become an accessible food resource, and becomes stronger in winter, when insects and other invertebrates are scarce and difficult to reach.

In turn the ratio of granivores increases significantly during the cold season. Their food includes seeds and fruits of trees, both deciduous (*Carduelis spinus*, *Pyrrhula pyrrhula*) and coniferous (*Loxia curvirostra*), but also herbaceous plants (*Carduelis cannabina*, *C. carduelis*). The slight increase of granivores' ratio at higher elevations was observed also in other studies (Klosius, 2008). However, like in our case, the differences were not significant.

Conclusions

During this study in Lotrioara River Basin 70 bird species belonging to 9 orders were recorded. The spatial dynamics of the community is characterised by the decrease of species' number with the increase in altitude. However, this relation is not always linear, being influenced also by the habitat heterogeneity. Transects are clustered depending on altitude and habitat type. The bird community from Lotrioara River Basin is dominated by the breeding species, a few species being adapted to the harsh environmental conditions in the mountain valleys during winter. Insectivores prevail in the community, but significant seasonal variations are recorded, during winter omnivores and granivores becoming dominant.

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AVIFAUNA DIN BAZINUL RÂULUI LOTRIOARA (MUNȚII LOTRULUI, ROMÂNIA)

REZUMAT

Sunt prezentate rezultatele unui studiu asupra comunităților de păsări din bazinul râului Lotrioara (Munții Lotrului, România), desfășurat pe parcursul unui an, utilizând metoda transectelor de-a lungul văii principale. Cercetările au urmărit caracteristicile dinamicii ornitofaunei, atât din punct de vedere spațial cât și temporal. Pe perioada studiului au fost identificate, în zona cercetată, 70 de specii aparținând la 9 ordine. Numărul de specii scade cu creșterea altitudinii, însă această descreștere nu este liniară, ci depinde și de heterogenitatea habitatelor. Pe parcursul anului, numărul speciilor variază de la un minim iarna la un maxim în timpul verii. Structura trofică a comunităților de păsări din bazinul râului Lotrioara este dominată de insectivore, dar în perioada rece a anului dominanța este preluată de omnivore și granivore.

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TERRESTRIAL SMALL MAMMAL COMMUNITIES FROM HÂRTIBACIU PLATEAU (ROMANIA)

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ADRIAN RĂULEA, ADRIANA VORNICU

Abstract. Small mammal communities were studied by live trapping during August-September 2010 and June-September 2011 in three localities from Hârtibaciu Plateau, in southern Transylvania. The area is situated between 420 and 550 m a.s.l., and represents a mosaic of small patches of different land use. 200 traps were set in lines for three consecutive nights, in 80 different habitats representing 12 habitat types, both cultivated and semi-natural. 1235 small mammals belonging to 15 species (four soricomorphs and 11 rodents) were captured. Abundance of small mammals was expressed by means of capture index (number of individuals caught per 100 active trap-nights). The community structure was strongly shaped by habitat type, even in case of small land patches. *Microtus arvalis* prevailed in the investigated area, being the dominant species in open fields with high grassy vegetation. The density of this species increased strongly from the beginning of summer to autumn, when the traps were occasionally saturated with field voles.

Résumé. Les communautés de petits mammifères ont été étudiées en utilisant des pièges pour la capture des animaux vivants, pendant Août-Septembre 2010 et Juin-Septembre 2011 dans trois localités du Plateau Hârtibaciu, dans le sud de la Transylvanie. La zone est située entre 420 et 550 m altitude et représente une mosaïque de petites parcelles de différentes utilisations. 200 pièges ont été installés dans les transects linéaires pour trois nuits consécutives, dans 80 habitats différents représentant 12 types d'habitats, cultivés et semi-naturels. 1235 petits mammifères, appartenant à 15 espèces (quatre musaraignes et 11 rongeurs) ont été capturés. L'abondance des petits mammifères a été exprimée par l'index de capture (nombre d'individus capturés par 100 pièges-nuits actifs). La structure de la communauté de petits mammifères a été fortement influencée par le type d'habitat, même en cas de petites parcelles. *Microtus arvalis* a prévalu dans la zone étudiée, étant l'espèce dominante dans les champs ouverts avec végétation herbeuse haute. La densité de cette espèce a augmenté à partir du début de l'été jusqu'à l'automne, lorsque les pièges ont été occasionnellement saturés avec campagnols agrestes.

Key words: rodents, shrews, live trapping, community structure, habitat preferences.

INTRODUCTION

Hârtibaciu Plateau is an area of great conservation importance in Romania, being part of the Site of Community Importance ROSCI0132 Oltul Mijociu-Cibin-Hârtibaciu. It is a mosaic of habitats in an almost natural state, which shelters a high biodiversity. Several studies were made on different groups, mainly plants and birds, but information on the mammal fauna is scarce. The only published research (Benedek, 2007) presents the data obtained by live-trapping in September 2003 from four study sites (Retiș, Brădeni, Stejărișu and Dealu Frumos localities) in the upper part of Hârtibaciu River Basin.

The aim of the present study is to widen the knowledge on small mammal communities from different localities in relation to the habitat types and to highlight the seasonal changes in these communities.

STUDY AREA AND METHODS

Between 2010 and 2011, a survey of small mammal communities from different habitat types was carried out in the Hârtibaciu Plateau. In autumn 2010 a field campaign took place in two localities from Hârtibaciu Plateau, namely Benești (named Benești I) and Iacobeni. In 2011 the survey was accomplished during two campaigns, one in summer and the other in autumn (beginning with late August), in Alțâna and Benești, in another area than during the previous year (named Benești II). The survey was carried out by means of CMR (capture-mark-release) method, using plastic handmade box traps (18x8x6 cm) set in lines in different habitats. Each transect included 33 or 34 traps, placed at intervals of 10 m. Six (in 2010) or five (in 2011) trap lines were set at the same time, and traps were checked for three consecutive nights, at dawn and in the evening. In all, 80 transects were established in 12 habitat types: pastures, hayfields, unused lands with low vegetation - margins of roads and railroads - and high vegetation - river and canal banks, corn, wheat and alfalfa fields, abandoned cultures, pastures with sparse shrubs, shrubby pastures with extensive woody vegetation cover, forest edges and hornbeam (*Carpinus betulus*) forests. The position of sampling localities is indicated in fig. 1. The number of transects in each habitat type was proportional to its ratio in the area, so that the results give a sound image of the structure and abundance of small mammal communities from the investigated zones.

The traps were baited with sunflower seeds and apple slices. No prebaiting was done. No bedding material was provided, but the traps were set in shady places or when not possible, hay cover was provided in order to avoid overheating of captured animals. The captured specimens were identified to species based on morphological characters (Murariu, 2000; Popescu & Murariu, 2001), marked by fur clipping on

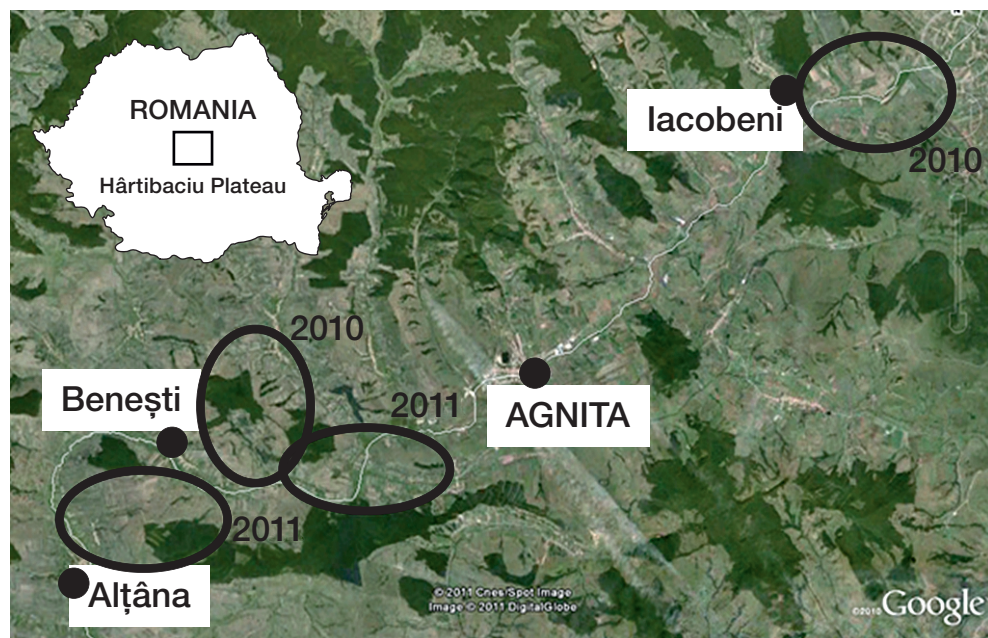


Fig. 1 - Study area in Hârtibaciu Plateau with sampling localities and the year of sampling.

the rear part of the back, and released. In case of mice belonging to *Apodemus* genus (*A. flavicollis*, *A. sylvaticus*, *A. uralensis*) we considered the presence and shape of the collar, the colour of the back and belly, the length of hind foot and the ratio between the lengths of tail and body.

Relative abundance was expressed as the ratio of the species (in percentages) within a sample. Frequency was calculated as the ratio (in percentages) between the trap lines where the species was captured and the total number of trap lines. Abundance, as a measure of population density, was expressed as capture index, meaning the number of captured individuals per 100 active trap-nights (TN). Many traps were disturbed by animals (especially shepherd dogs), rain or wind, destroyed by tractors or cattle, or even stolen, thus of the intended 8010 TN (80 lines with 33-34 traps for 3 consecutive nights) only 5571 TN (69.6%) were effective.

Mystat 12 software was used for data analysis. The significance of correlation between the abundance and frequency of the captured species and between the number of captured species and capture index in different habitat types was tested and its strength expressed by Pearson correlation coefficient. The Pearson χ^2 test of independence was used to test the influence of the locality on the species' ratio (McDonald, 2009). The association between the prevailing species was tested using t test, and its strength was expressed both in qualitative - by means of Fager index (Southwood, 1966) and quantitative terms - proportion of individuals occurring together - we used the modified Whittaker and Fairbanks equation (Southwood & Henderson, 2000), with the range of 0 to 1.

RESULTS

A total number of 1235 individuals were captured, belonging to 15 species, four shrews and 11 rodents. Further three species were identified based on direct or indirect visual observations. The number of specimens captured during the research period, the species' frequency (F%), the trapping effort and the capture index for each site are presented in tab. 1.

The terrestrial small mammal species known to inhabit Hârtibaciu Plateau, based on the data collected during the field campaigns and the previous study carried out in September 2003 (Benedek, 2007), are presented below. Systematics is given according to Wilson & Reeder (2005).

Order Erinaceomorpha

Family Erinaceidae

1. *Erinaceus roumanicus* Barret-Hamilton, 1900 (Eastern hedgehog) – a specimen was found crossing a dirt road in Alțâna in August 2011.

Order Soricomorpha

Family Soricidae

2. *Sorex araneus* Linnaeus, 1758 (Common shrew) – the most abundant and frequent shrew species during this study, but also in September 2003, captured in a great variety of habitat types.

3. *Sorex minutus* Linnaeus, 1766 (Pygmy shrew) – two specimens were captured in one of the research areas (Benești) in August and September 2011. In the 2003 study, this shrew species was captured at the forest edge from Brădeni and Retiș.

Table 1

Terrestrial small mammals captured in the localities from Hârtibaciu Plateau, in 2010 and 2011 (F% stands for frequency).

Species	2010		2011		Total	F%
	Benești	Iacobeni	Alțâna	Benești		
<i>S. araneus</i>	0	4	11	1	16	12.50
<i>S. minutus</i>	0	0	0	2	2	1.25
<i>C. suaveolens</i>	0	1	0	1	2	2.50
<i>C. leucodon</i>	0	1	0	0	1	1.25
<i>M. glareolus</i>	2	0	0	2	4	2.50
<i>A. sherman</i>	1	0	0	5	6	7.50
<i>M. arvalis</i>	55	277	178	108	618	73.75
<i>M. subterraneus</i>	0	0	27	4	31	7.50
<i>M. minutus</i>	0	0	4	0	4	2.50
<i>A. agrarius</i>	29	169	87	55	340	47.50
<i>A. flavicollis</i>	50	12	14	4	80	31.25
<i>A. sylvaticus</i>	0	24	37	6	67	25.00
<i>A. uralensis</i>	0	0	28	2	30	16.25
<i>M. musculus</i>	1	4	28	0	33	10.00
<i>R. norvegicus</i>	0	0	0	1	1	1.25
Total	138	492	414	191	1235	
Trapping effort	763	1010	2121	1677	5571	
Capture index	18.08	48.71	19.51	11.38	22.16	

4. *Neomys fodiens* (Pennant, 1771) (Water shrew) – one specimen captured in the riverside willow thicket at Stejărișu in September 2003.

5. *Crocidura leucodon* (Hermann, 1780) (Bicoloured white-toothed shrew) – was found during both studies, in 2003 in the shrubs from Stejărișu, and in 2010 in the pasture with sparse shrubs from Iacobeni.

6. *Crocidura suaveolens* (Pallas, 1811) (Lesser white-toothed shrew) – two specimens were captured, one in the pasture with sparse shrubs from Iacobeni in September 2010 and the other under a bush in a hayfield from Benești, in September 2011.

Family Talpidae

7. *Talpa europaea* Linnaeus, 1758 (European mole) – was widely spread in the area, its presence being indicated by the numerous mole hills from different habitats. One specimen was found dead in a hayfield in Alțâna in July 2011.

Order Rodentia

Family Castoridae

8. *Castor fiber* Linnaeus, 1758 (Beaver) – probably went extinct in Romania during the first decades of the 19th century, although in 1850 Bielz mentioned the possibility of its presence in Transylvania. In 1998 ICAS (The Institute for Forest Research and Management) Brașov initiated a program of reintroduction on three

rivers from Romania, namely Olt, Mureş and Ialomiţa, which lasted until 2003. 182 specimens brought from Bavaria were released and they established stable populations, which are now in process of expansion (www.beaver.icaswildlife.ro). From the upper sector of the Olt River, the reintroduced beavers colonised its middle course and some of tributaries, including Hârtibaciu (via Cibin River). Local people claim that the beaver is found along the most part of the river. During our study several burrow entrances and footprints were observed downstream Alţâna and more recently fallen and gnawed willow trunks and branches were found downstream Caşolţ, near the confluence with Cibin River and in the upper sector, upstream Netuş.

Family Gliridae

9. *Glis glis* (Linnaeus, 1866) (Fat dormouse) – was captured in the mixed broadleaf forest from Retiş and at the forest edge from Brădeni in 2003.

10. *Muscardinus avellanarius* (Linnaeus, 1758) (Hazel dormouse) – three specimens were captured in September 2003 at Dealu Frumos, in the hornbeam and oak forest, the forest clearing and in the ditch along a dirt road.

Family Cricetidae

11. *Arvicola sherman* (Shaw, 1801) (Montane water vole) – was captured only at Beneşti, both in 2010 and 2011, in hayfields, unused lands with high vegetation and pastures with sparse shrubs.

12. *Myodes* (syn. *Clethrionomys*) *glareolus* (Schreber, 1780) (Bank vole) – was found in 2003 in the forests and at the forest edges from Dealu Frumos, Brădeni and Retiş, in 2010 at the forest edge from Beneşti and in 2011 in the unused land with high vegetation bordering the willow riparian forest on the banks of Hârtibaciu River at Beneşti.

13. *Microtus arvalis* (Pallas, 1778) (Common vole) – captured in 2003 only at Dealu Frumos and Brădeni, in several open habitats, was the most abundant and frequent species during the present study, found in most types of habitat, in all the research areas, both in 2010 and 2011.

14. *Microtus subterraneus* (de Selys-Longchamps, 1836) (Common pine vole) – was found only in 2011, both in Alţâna and Beneşti, in different moist habitats with high and rich vegetation.

Family Muridae

15. *Micromys minutus* (Pallas, 1771) (Harvest mouse) – was captured only at Alţâna, in a hayfield and an unused field with high vegetation, in August 2011.

16. *Apodemus agrarius* (Pallas, 1771) (Striped field mouse) – although not the prevailing species, it was very abundant and frequent both in 2003 and 2010-2011, being present in all the habitat types except for the forest.

17. *Apodemus flavicollis* (Melchior, 1834) (Yellow-necked mouse) – the prevailing species in 2003, was captured during the present study in all the research areas, mainly in forests and at forest edges, but also in other habitats with wooded vegetation or near the forest.

18. *Apodemus sylvaticus* (Linnaeus, 1758) (Wood mouse) – in 2003, was captured at Dealu Frumos (dominant in the clearing), Brădeni (dominant in the reed bed) and at Retiş and during the present study in all the three localities (at Beneşti only in 2011), in cultivated fields and semi-natural habitats with moderate cover of woody vegetation (it was absent both in the hayfields and forests).

19. *Apodemus uralensis* (Pallas, 1811) (Pygmy field mouse) – in 2003, was found only at Dealu Frumos in the cornfield and the adjacent shrubby ditch, during the present study it was found only in 2011, in both areas, in the same habitat types as *A. sylvaticus*.

20. *Mus musculus* Linnaeus, 1758 (House mouse) – was found in all three localities (at Benești only in 2010), mainly in cultivated (corn and wheat) fields, being most numerous in the maize culture near the abandoned farm from Alțâna.

21. *Rattus norvegicus* (Berkenhout, 1769) (Brown rat) – one juvenile was captured in July 2011 in an abandoned cornfield from Benești.

Among the captured small mammals rodents were dominant, and among them the vole *M. arvalis* (50%) and the mice species belonging to *Apodemus* genus (Fig. 2). *M. arvalis* also recorded the highest frequency, being captured in 73.75% of the trap lines. It was followed by *A. agrarius*, both in what relative abundance (27.5%) and frequency (47.5%) are concerned. A significant association was found between these two species ($p < 0.001$; $t = 3.979$; $df = 95$), both preferring open habitats with high vegetation, and being widely distributed in the research area. The affinity between these species was slightly stronger when abundance was considered (the proportion of the individuals occurring together was 0.75, while the Fager affinity index was 0.68).

A. flavicollis and *A. sylvaticus* had similar ratios, the first being slightly more abundant and more frequent, found mainly in forests and at forest edges, as well as in habitats with woody vegetation. All the other small mammals presented low ratios and frequencies. Among the shrews *S. araneus* prevailed, with 16 captured specimens (1.3%).

There was a very significant ($p < 0.001$), positive and strong ($r = 0.950$) correlation between the relative abundance and frequency calculated for the captured small mammals.

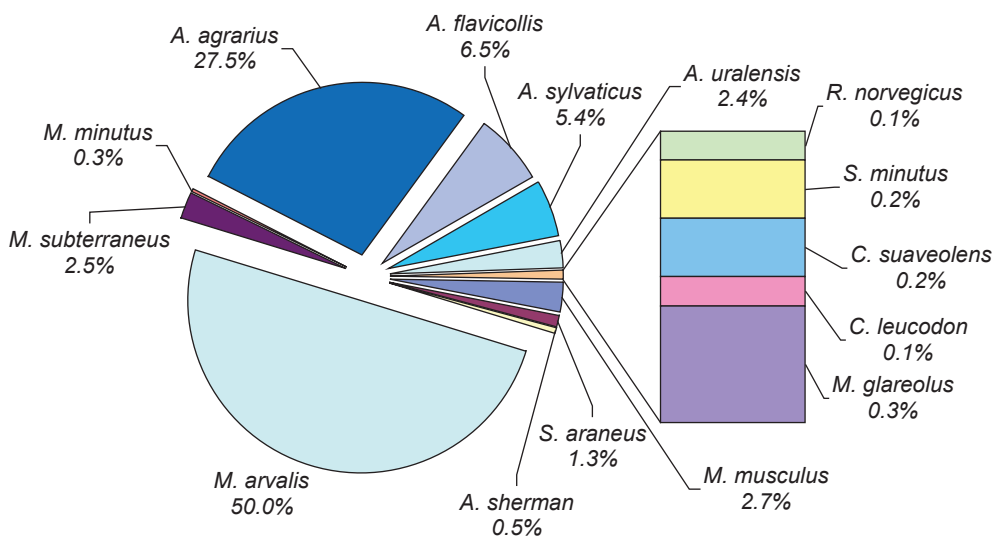


Fig. 2 - Relative abundance of terrestrial small mammal species captured in Hârtibaciu Plateau during the research.

Considering separately the four investigation areas, the Pearson chi-square test for independence showed a very significant ($p < 0.001$, $\chi^2 = 233.737$, $df = 9$) dependence of the relative abundance of the most abundant species (*M. arvalis*, *A. agrarius*, *A. flavicollis* and *A. sylvaticus*) on the locality, the most distinctive being Benești I. Here *A. flavicollis* had a high ratio, outnumbering *A. agrarius*, being second only to *M. arvalis*. However, if we consider only the two prevailing species in the four areas, *M. arvalis* and *A. agrarius*, their abundance did not differ significantly ($p > 0.05$, $\chi^2 = 2.195$, $df = 3$), indicating a homogeneity of the small mammal communities in this type of patchy landscape from southern Transylvania.

In 2011, each transect was set twice, first time in mid-summer and then in late summer and early autumn, enabling us to observe the changes occurred in the small mammal populations as a consequence of the breeding season. There were some similarities but also differences between the patterns of seasonal changes in the two localities. In both cases there was a significant increase of the total capture index. The increase was stronger in Benești, where the capture index rose from 3.3 ind./100 TN in summer to 19.3 in autumn (Fig. 3). At Alțâna the increase was given mainly by *A. agrarius* and at a lesser extent by *A. sylvaticus* and *M. subterraneus*, while *M. arvalis* presented a similar abundance (8.1 ind./100 TN in summer and 8.6 in autumn). *A. flavicollis* was the only species with a lower capture index in autumn (0.4 compared with 0.9 ind./100 TN in summer), indicating that it was present along the trap lines only temporarily, coming from the neighbouring forest. At Benești the strong growth of the community density was given by *A. agrarius* and especially *M. arvalis*, the latter with an increase in the capture index more than tenfold (from 0.9 to 12 ind./100 TN).

In autumn, although the total capture index for *M. arvalis* was around 10 ind./100 TN in both localities, in suitable habitats (e.g. some unmown hayfields) the traps were saturated with field voles, the capture index being occasionally higher than 100 ind./100 TN (due to day-time captures and multiple catches).

The density and diversity of small mammal communities varied greatly among the researched habitat types (Fig. 4). Although the correlation between the species number and capture index is not really significant ($p = 0.06$), if we leave out the forests and consider only the more or less open habitats, the correlation becomes highly significant and strong ($p = 0.003$, $r = 0.805$). The highest capture index (51.1 ind./100 TN) and also species richness (11 species) were recorded for the unused

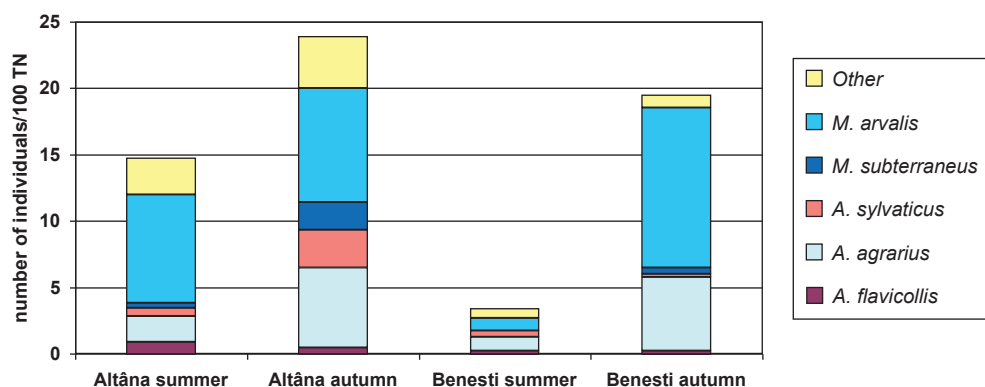


Fig. 3 - The abundance of small mammals from the two localities sampled in summer and autumn 2011.

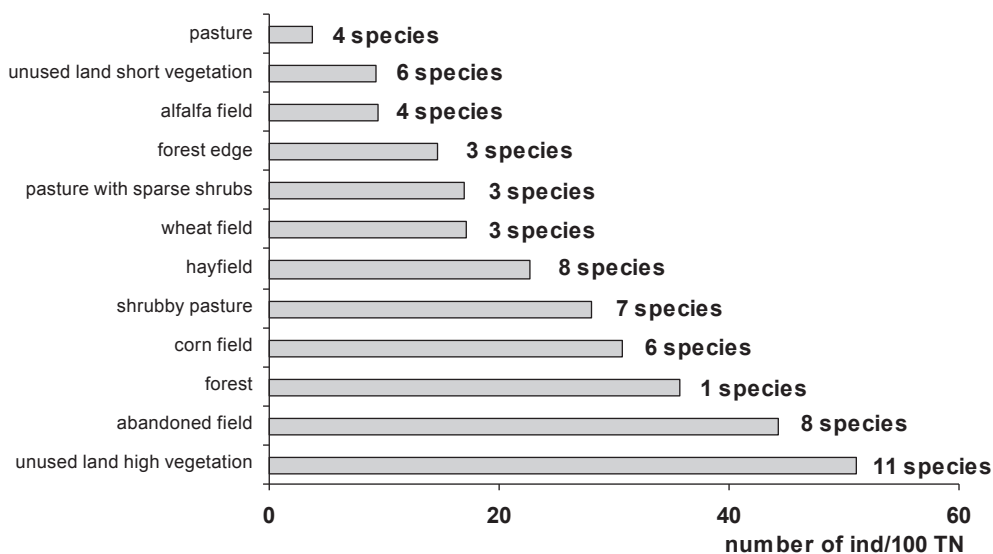


Fig. 4 - Abundance and species richness of small mammal communities in the investigated habitat types (captures from all trap lines in the same habitat type are pooled together).

lands with high vegetation, most of them situated along the willow riparian forest on the bank of Hârtibaciu River and along the canals separating the cultivated fields. Abundant and diverse assemblages were sheltered also by abandoned fields, where 8 species were found, with a total of 44.2 ind./100 TN. Both had a good ground cover by high and diverse vegetation and presented a low human disturbance.

In forests the relatively high density was given by the yellow-necked mouse, the sole species captured in this habitat. The other typical forest species (e.g. dormice, bank vole), well represented in the previous survey, are more exacting in what the habitat conditions are concerned. Thus, they were absent from the two forests due to the lack or poor development of undergrowth (Benești I) or to the disturbance from grazing sheep (Altâna).

Among the cultivated terrains the richest small mammal assemblages were sheltered by cornfields, due to the high vegetation and food availability, their structure being influenced by the presence and density of weeds. In plots where intensive agricultural works were carried out, leaving behind an extremely neat and tidy maize culture, with no other plants among the corn stems, small mammals were poorly represented, with the house mouse among the prevailing species. In contrast, in plots with a rich cover of weeds, where no herbicides were sprayed and no hoeing was done, communities were more abundant and diverse. Several other species of rodents were also abundant in these habitats: the striped field mouse, the wood mouse, the pygmy field mouse and the common vole, the latter being the prevailing species in the wheat and alfalfa fields. However, the presence of rodents in different cultures is usually temporary, depending on the food and shelter resources and the disturbing effect of agricultural works (Hamar & Șutova, 1965, 1968; Theiss, 1962).

The species number and capture index values decreased with the reduction of land cover, vegetation height and human pressure. The poorest habitats in what density is concerned, were the pastures. The same conclusion was drawn also in the Făgăraș Piedmont (Lazăr et al., 2012). In pastures only 3.8 ind./100 TN were

captured, although in all 4 species were identified. The reasons for the scarcity of small mammals in pastures are the frequent disturbance by grazing sheep (or cattle) and the shepherd dogs, the compacted soil, and especially the short vegetation and the lack of cover.

DISCUSSION

The large extent of open habitats in Hârtibaciu Plateau shapes the structure of the small mammal community, favouring the common vole and the striped field mouse. The two species prevail in all the research sites, finding favourable conditions in several habitat types, where they build up populations increasing in density from summer to autumn.

The results of this study show several similarities with those from another plateau area, the Făgăraș Piedmont (Lazăr et al., 2012). However, the shares of the dominant species are reversed in the two research areas. Compared to Hârtibaciu Plateau, the Făgăraș Piedmont is moister, due to the numerous streams and rivers crossing it, the proximity of the mountains and the montane forest belt. The higher humidity favours the striped field mouse, while the numerical development of the common vole populations is limited. The proximity of the mountain forest belt determines also a relatively high capture index for the yellow-necked mouse. The reduced abundance of this species in autumn compared to summer was observed in both areas, indicating a retreat from the open habitats (including cultivated fields), inhabited or more frequently visited during summer, to the forest.

Although the soricomorphs had a low relative abundance, the common shrew had a relatively high frequency, being captured in a large variety of habitat types. This result confirmed that it is an euryoecious species, inhabiting both open and forested habitats in lowlands and mountain areas (Istrate, 1998; Murariu, 2003; Benedek & Sîrbu, 2009). The scarcity of shrews among the captured small mammals was due mainly to the high density of rodents and the large proportion of open lands among the researched habitats, but might be also the result of sampling bias. The relative abundance of soricomorphs was significantly lower than in 2003 (Benedek, 2007) or in some mountain areas, especially when rodent population densities are low (Benedek, 2006; Benedek & Drugă, 2005), but close to their ratio in the Făgăraș Piedmont (Lazăr et al., 2012), where similar habitat types were surveyed.

Conclusions

During the research period a total number of 1235 individuals were captured, belonging to 15 species (four species of shrews and 11 of rodents). *Microtus arvalis* was the prevailing species, followed by the mice from *Apodemus* genus (*A. agrarius*, *A. flavicollis*, and *A. sylvaticus*). They recorded also the highest frequencies. The population densities increased from summer to autumn, as a result of the breeding season, later in the common vole and earlier in other open habitat species. The number of species and the capture index values decreased with the reduction of land cover, vegetation height and increase in the human pressure. The most abundant and diverse assemblages were sheltered by unused lands with high vegetation and abandoned fields, while the poorest communities were found in pastures. Among the cultivated fields the richest small mammal assemblages were sheltered by maize cultures, their structure being influenced by the presence and density of weeds.

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COMUNITĂȚI DE MAMIFERE MICI TERESTRE DIN PODIȘUL HÂRTIBACIU (ROMÂNIA)

REZUMAT

Comunitățile de mamifere mici au fost studiate prin utilizarea capcanelor tip cutie în perioada august-septembrie 2010 și iunie-septembrie 2011, în trei localități din Podișul Hârtibaciu, în sudul Transilvaniei. Zona este situată între 420 și 550 m alt. și reprezintă un mozaic de mici parcele cu diferite folosințe ale terenurilor. 200 de capcane au fost amplasate în transecte liniare timp de trei nopți consecutive, în 80 de habitate diferite reprezentând 12 tipuri de habitate, atât cultivate cât și semi-naturale. 1235 exemplare aparținând la 15 specii (4 soricomorfe și 11 rozătoare) au fost capturate. Structura comunităților de mamifere mici a fost puternic influențată de tipul de habitat, chiar și în cazul parcelelor mici de teren. *Microtus arvalis* a predominat în zona cercetată, fiind specia dominantă în terenuri deschise cu vegetație ierboasă înaltă, densitatea ei crescând puternic de la începutul verii până toamna.

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MOLECULAR CONFIRMATION ON THE PRESENCE OF *ANADARA KAGOSHIMENSIS* (TOKUNAGA, 1906) (MOLLUSCA: BIVALVIA: ARCIDAE) IN THE BLACK SEA

ANA-MARIA KRAPAL, OANA PAULA POPA,
ALEXANDRA FLORINA LEVARDA, ELENA IULIA IORGU,
MARIETA COSTACHE, FABIO CROCETTA, LUIS OVIDIU POPA

Abstract. The use of DNA barcoding in alien invasions has recently proved to be a powerful tool in delineating dispersal pathways and clarifying doubtful identifications. Morphological similarities between *Anadara kagoshimensis* (Tokunaga, 1906) and *Anadara inaequalis* (Bruguière, 1789) require the use of genetic markers in identifying the ark shell species that has recently invaded the Black Sea. The high genetic similarity (99.8-100%) hereby found between COI sequences obtained from the Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to this taxon.

Résumé. L'utilisation des codes-barres ADN dans les invasions étrangères s'est récemment révélé être un outil puissant dans la délimitation des voies de dispersion et de clarifier des identifications douteuses. Les similitudes morphologiques entre *Anadara kagoshimensis* (Tokunaga, 1906) et *Anadara inaequalis* (Bruguière, 1789) exigent l'utilisation des marqueurs génétiques pour identifier l'espèce d'arcidé qui a récemment envahi la Mer Noire. La similarité génétique élevée (de 99,8 à 100%) trouvée entre les séquences COI obtenus à partir des échantillons de la Mer Noire et les japonais *A. kagoshimensis* confirme au niveau moléculaire que l'espèce bivalve de la Mer Noire roumaine fait partie de ce taxon.

Key words: *Scapharca*, alien species, Black Sea, Romanian coast, COI, DNA barcoding.

INTRODUCTION

Anadara kagoshimensis (Tokunaga, 1906) is a bivalve species, belonging to Arcidae Lamarck, 1809, family frequently consumed in Japan, where it was introduced in several coastal areas in order to increase local food production soon after the end of the World War II (Tanaka & Aranishi, 2014). In Europe, this ark clam species was recorded since the early '60s in Ravenna area (Adriatic Sea), where it was thought to be introduced from the Indo-Pacific region with ballast water (Crocetta, 2012). It was initially identified as *Scapharca* (cf.) *cornea* (Reeve, 1844) (Ghisotti, 1973), although, only few years later, it was re-identified as belonging to *Scapharca inaequalis* (Bruguière, 1789) (Ghisotti & Rinaldi, 1976). This taxon was also recorded two decades later from the Black Sea (Gomoiu, 1984). Lutaenko (2006) first noticed morphological differences between *A. inaequalis* specimens from India and Philippines and those from the Black and Adriatic Seas, concluding that European specimens were, most likely, not *A. inaequalis*. Finally, Huber (2010) suggested that the “*S. inaequalis*” invading Europe was in reality *A. kagoshimensis* from Japan.

As a matter of fact, diagnostic characters differentiating *Anadara* nominal species are weak, and indeed *A. kagoshimensis* exhibits high similarities with *A. inaequalis*. Moreover, the native distributions of the two species partially overlap, with the former widespread in the South China Sea, Yellow Sea and Sea of Japan, whilst the latter living in the Indo-Pacific Ocean (India and Philippines), with the

exception of the Red Sea (Huber, 2010). Due to these similarities, a molecular confirmation of the correct identity of the anadardid species found in Europe should be mandatory.

MATERIAL AND METHODS

Twelve specimens from two different Black Sea sampling sites (Romania: Năvodari - 43°48'33.5" N, 28°35'13.8" E; Grindul Chituc - 44°10'43.1" N, 28°39'35" E) were sequenced for the COI (cytochrome oxidase subunit I) marker. Samples were collected by hand in shallow sandy bottoms and kept in 96% ethanol. Total genomic DNA was isolated from mantle muscle tissue, using Macherey-Nagel NucleoSpin® Tissue kit, according to producer's specifications. Partial COI sequence was amplified in a PCR reaction using the COI-4 primer pair (Tanaka and Aranishi, 2013). The PCR reaction was carried out in 30 µl final reaction volume containing 100 ng DNA template, 10 mM Tris-HCl (pH 8.8 at 25°C), 50 mM KCl, 0.08% (v/v) Nonidet P40, 2 mM MgCl₂, 0.2 mM of each dNTP, 0.1 µM of each primer, 1 U of Taq DNA polymerase 5U/µL (Fermentas UAB, Vilnius, Lithuania) and water up to final volume. The temperature profile of the polymerase chain reaction for the COI marker consisted of initial denaturation at 95°C for 2min, followed by 35 cycles at 94°C for 30s, 50°C for 1min, 72°C for 1min, with a final extension step of 5 min at 72°C. The amplified fragments were visualized on a 1.5% agarose gel stained with ethidium bromide, and then purified using innuPREP DOUBLEpure Kit (Analytik Jena AG, Jena, Germany). Single strand sequencing was performed on a Li-Cor 4300L platform using IRD700-labeled M13 primer HCO2198 and DNA Cycle Sequencing Kit (Jena Bioscience GmbH, Jena, Germany). The obtained sequences were aligned using CodonCode Aligner 3.7.1 (CodonCode Corporation, Dedham, MA, USA), manually edited and then used as a query to the CoreNucleotide collection of GenBank database (<http://www.ncbi.nlm.nih.gov/nucleotide/>).

RESULTS AND DISCUSSIONS

To date, with the sole exception of *Anadara transversa* (Say, 1822) (Albano et al., 2009), no genetic analysis have ever been performed on European *Anadara* species, and only morphology has been used to address the *A. cornealinaequivalvis/kagoshimensis* taxonomic question. Huber (2010) most recent suggestion, despite widely accepted, was exclusively based on shell characters (shape, ligament, inequivalvity, number of ribs, rib sculpture) and color. Ten COI sequences (4 from Năvodari and 6 from Grindul Chituc) were finally obtained from our samples, all exhibiting the same haplotype (GenBank Accession Numbers: KM267562 and KM267563). This was used for querying the CoreNucleotide collection of GenBank database, returning a species match with *Anadara kagoshimensis* at similarity levels between 100% and 99.84% (9 matches).

The COI molecular marker is a highly conserved region of the mitochondrial genome, frequently used in discriminating closely related species and uniformly chosen as the best DNA barcode (Hebert et al., 2003 a; Hebert et al., 2003 b). The high genetic similarity hereby found between COI sequences obtained from Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to *Anadara kagoshimensis* (Tokunaga, 1906).

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CONFIRMAREA MOLECULARĂ A PREZENȚEI SPECIEI *ANADARA KAGOSHIMENSIS* (TOKUNAGA, 1906) (MOLLUSCA: BIVALVIA: ARCIDAE) ÎN MAREA NEAGRĂ

REZUMAT

Utilizarea tehnicii ADN barcoding în studiul speciilor invazive s-a dovedit a fi un instrument puternic în delimitarea diferitelor căi de introducere și clarificare a unor determinări incerte. Similaritățile morfologice dintre *Anadara kagoshimensis* (Tokunaga, 1906) și *Anadara inaequalis* (Bruguière, 1789) impun utilizarea markerilor genetici în identificarea taxonomică a speciei care a invadat recent Marea Neagră. Similaritatea foarte înaltă identificată între secvențele de COI obținute de la probele din Marea Neagră și cele existente pentru *A. kagoshimensis* din Japonia, confirmă, la nivel molecular, că specia care a invadat sectorul românesc al Mării Negre aparține acestui taxon.

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**TWO NEW SPECIES OF THE GENUS *Calozodion* GARDINER
(CRUSTACEA: TANAIDACEA: APSEUDOMORPHA)
FROM THE ADRIATIC SEA AND THE INDIAN OCEAN,
AND THE RECLASSIFICATION OF *C. DOLLFUSI* GUȚU, 1989
IN THE GENUS *JULMARICHARDIA* GUȚU**

MODEST GUȚU

Abstract. Two new species, *Calozodion bogoescui* (from the southeast coast of Italy) and *C. tanzaniense* (from Tanzania waters), are described and illustrated. *C. bogoescui* n. sp. represents the first record of the genus *Calozodion* Gardiner, 1973 in the Mediterranean Basin. The main morphological features by which *C. bogoescui* differs from all others of the genus consist in the small number of uropodal endopod articles (only seven, compared to 13–16) combined with the short chelipedal merus (in contrast with the carpus length). *C. tanzaniense* n. sp. is characterized by the following combination of morphological features: (1) antennule first peduncular article with three spiniform apophyses on outer side, (2) antenna with nine articles, (3) pereopod II basis with long plumose setae only on dorsal margin, (4) pereopods III and IV basis with a midventral spiniform apophysis, and (5) pereopod VII merus with five long plumose setae on dorsal side. Also, some comments are made on morphological features belonging to the males of *C. dominiki* Bochert, 2012 and to the status of species *C. dollfusi* Guțu, 1989 (= *Julmarichardia dollfusi*, comb. nov.). An identification key of the currently recognized species of the genus *Calozodion* is presented.

Résumé. On décrit et illustre deux nouvelles espèces, *Calozodion bogoescui* (de la côte sud-est de l'Italie) et *C. tanzaniense* (dans les eaux de la Tanzanie). *C. bogoescui* n. sp. représente le premier mention du genre *Calozodion* Gardiner, 1973 dans le bassin méditerranéen. Les principales caractéristiques morphologiques avec lesquelles *C. bogoescui* diffère de tous les autres espèces du genre consistent dans le petit nombre d'articles de d'endopode uropodale (seulement sept, comparativement à 13–16) combiné avec le merus chelipedal court (en contraste avec la longueur de la carpe). *C. tanzaniense* n. sp. est caractérisé par la combinaison suivante de caractéristiques morphologiques: 1) premier article pédonculaire de l'antennule avec trois apophyses spiniformes sur le côté externe, (2) antenne avec neuf articles, (3) base du péréiopode II avec longues soies plumées seulement sur la marge dorsale, (4) base des péréiopodes III et IV avec une apophyse spiniforme médio ventrale, et (5) merus du péréiopode VII avec cinq longues soies plumées sur la face dorsale. En outre, certains commentaires sont faits sur les caractéristiques morphologiques appartenant aux mâles de *C. dominiki* Bochert 2012 et le statut d'espèces *C. dollfusi* Guțu, 1989 (= *Julmarichardia dollfusi*, comb. nov.). On présente une clé d'identification des espèces actuellement reconnues du genre *Calozodion*.

Key words: Tanaidacea, Apseudomorpha, *Calozodion*, *Julmarichardia*, Adriatic Sea, Indian Ocean.

In the tanaidacean material which remained unstudied by the late Prof. Mihai Băcescu, I have discovered two females of the genus *Calozodion* Gardiner, 1973, each representing an unknown species. One of these which came from the Adriatic Sea (south-east Italy), was collected by the research vessel “Calypso”, during the campaign of the French oceanographer Jaques-Yves Cousteau in his research on pollution of the Mediterranean Basin in 1977. The second species was collected from West Indian Ocean by the members of the expedition initiated and led by Mihai Băcescu, along the coasts of Tanzania, during in 1973.

If for the Mediterranean Basin it is the first report of the genus *Calozodion*, the species from the eastern coast of Africa was reported for the first time (Guțu, 2006: 209) as *Calozodion* cf. *wadei* Gardiner, 1973.

The descriptions of these two new species and discussion of the status of *Calozodion dollfusi* Guțu, 1989 (which was re-classified in the genus *Julmarichardia* Guțu, 1989) and on several morphological particularities of the males of *Calozodion dominiki* Bochert, 2012 are presented herein. With this contribution, the number of the species classified in the genus *Calozodion*, increases to eleven, as can be seen in the identification key.

Family Metapseudidae Lang, 1972
Subfamily Chondropodinae Guțu, 2008
Genus *Calozodion* Gardiner, 1973

***Calozodion bogoescai* n. sp.**
(Figs 1-3)

Material: one female with oostegites, Adriatic Sea, Southeast of Italy, adjacent to the town of Bari, collected in shallow waters by the “Calypso” Expedition, 1977 (without other data).

Holotype, female with oostegites (dissected), preserved in the Collections of the „Grigore Antipa” National Museum of Natural History, Bucharest, No 250015.

Etymology. The specie was named in memory of Prof. Dr. Constantin Bogoescu, from the Biological Faculty of Bucharest.

Description of the female

Body (Fig. 1 A) dorsoventrally flattened, six times as long as wide; standard length, 2.85 mm.

Carapace 1.2 times as long as broad. Rostrum short, rounded, with a small median denticular prominence and some tubercles on its sides. Ocular lobes well defined; eyes pigmented.

Pereon 2.8 times as long as carapace. First pereonite shortest, rounded laterally, 2.6 times as wide as long. Second pereonite a little shorter than each of following three pereonites, but as long as the last pereonite. Third pereonite slightly shorter than the fourth pereonite. Fifth pereonite shorter than the fourth pereonite. Pereonites 3-6 narrower anteriorly, with a small tubercle on half anterior sides and two-three short setulated setae.

Pleon 1.5 times as long as carapace, decreasing in width from the first pleon to pleotelson. Each pleonite short. Pleotelson, as long as last two pleonites together, pointed terminally and with one rounded conspicuous prominence on lateral margins. Pleonites and pleotelson with some setulated short setae on lateral margins.

Antennule (Fig. 1 B) about as long as carapace and first two pereonites combined. First peduncular article four times as long as wide, with some setae and two spiniform apophyses on each side. Second article, narrower than the first article, twice as long as wide, with several unequal broom and simple setae. Third article narrower and shorter than the second. Common article of flagella slightly longer than the first article of outer flagellum. Inner flagellum, as long as first three articles of outer flagellum, with two thin but long articles; terminally with three long simple setae. Outer flagellum with seven short articles, some of them having one to four unequal setae; fourth and sixth articles with an aesthetasc.

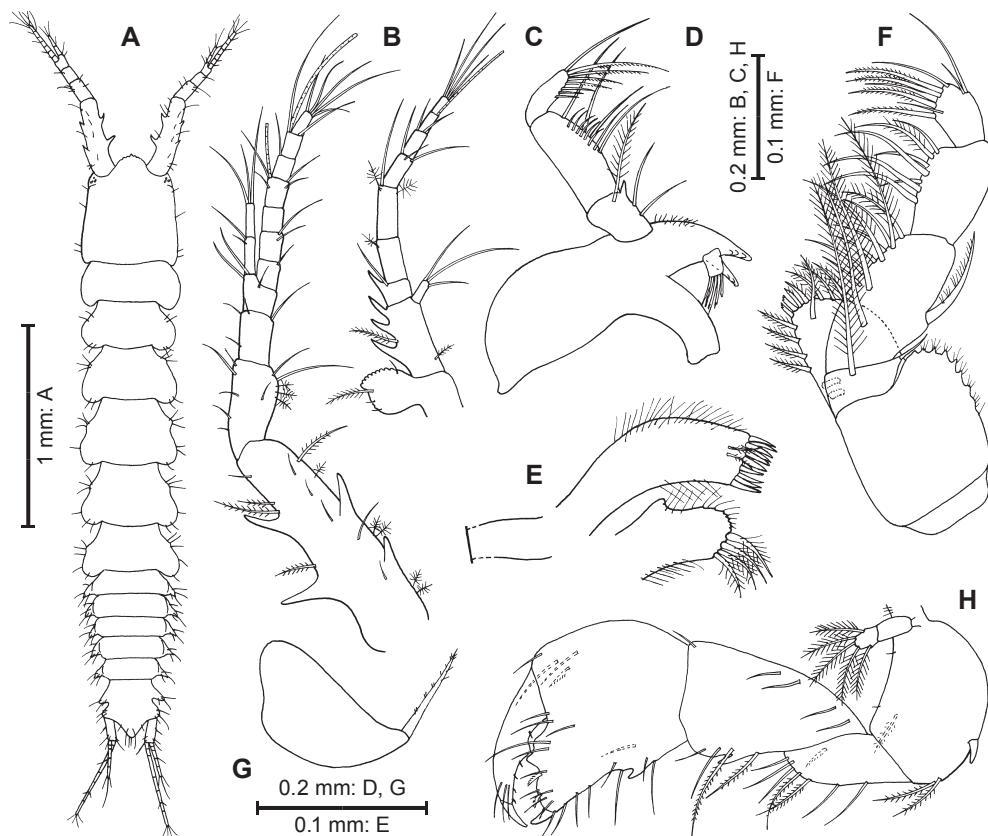


Fig. 1 - *Calozodion bogoeskui* n. sp., female, holotype: A, body, dorsal; B, antennule, right; C, antenna, right; D, mandible, left; E, maxillule, palp unshown; F, maxilliped, right; G, epignath; H, cheliped, left.

Antenna (Fig. 1 C) of nine articles; first article with a large rounded inner expansion having a long setulated seta; second article twice as long as wide, with three (or four?) long denticles and a setulated seta on the outer side; squama small, with three simple setae; third article shorter than squama, with a spiniform apophysis and a simple seta, distoinnerly; fourth article twice as long as third article, about twice as long as wide; fifth article slightly longer than preceding article, with two broom and one long simple setae, distally. Last four articles as long as previous three articles together; sixth, seventh and ninth articles with two-three simple setae; penultimate article with one simple seta and a long aesthetasc.

Epistome well developed, acute.

Mandibles (Fig. 1 D) with well developed pars molaris. Pars incisiva and lacinia mobilis of the left mandible with four and three teeth, respectively. Setiferous lobe with five long furcate setae. Palp three-articled; first article short, with one distoinner denticle and three setae; second article approximately 1.8 times as long as first article, with four long simple and about seven short ciliate setae; third article as long as first article but narrower, with eight unequal setae on distal half of inner margin and terminally. Right mandible with four-denticled pars incisiva.

Labium as in other species of genus. Terminal lobe triangular, with numerous long setulae on sides and one long setiform spine in top.

Maxillule (Fig. 1 E) with two-articled palp; number of terminal setae unknown (broken at time of dissection). Inner endite with four distal setulated setae and long setulae on both sides. Outer endite with numerous setulae on sides, two subterminal setulated setae and ten distal stout spines.

Maxilla unstudied.

Maxilliped (Fig. 1 F) as in other species of genus. Coxa short. Basis a little longer than wide, with some conspicuous denticles and numerous setulae on distoexternal corner. Palp four-articled; first article short, with one very long circumplumose seta on distoinner corner and other one distoexternal, simple and short; second article 1.8 times as long as wide, with five circumplumose setae (three very long) and five simple, short, on the inner margin, and one very long midouter ciliate spine; third article about 0.65 times as long as previous article and 1.4 times as long as wide with one long circumplumose and six simple setae (three relatively short) on inner margin; fourth article of palp with nine long simple and ciliate setae. Endite well developed, with about nine different setae on rostral side, four plumose setae on inner margin, and two blunt couplers; distoinner seta well developed, plumose.

Epignath (Fig. 1 G) cup-shaped, with a long spinulate spine, as illustrated.

Cheliped (Fig. 1 H) well developed. Exopod present, with five long plumose setae. Basis stout, 1.5 times as long as wide, with a median robust spine and two distal circumplumose setae on ventral margin; distally, on inner face, also with a circumplumose seta. Merus rounded distoventrally, much smaller than carpus, having seven long setae on ventral margin. Carpus enlarged distally, 1.6 times as long as maximum width; ventrally with one denticle and four setae, and dorsally with five setae. Propodus large, as long as wide (excluding fixed finger); proximoventrally with one denticle and some simple setae, and three setae near dactylus joint; fixed finger short and thick with a large dentiform expansion on midinner margin and some short setae; claw stout. Dactylus, much thinner than fixed finger, curved, with a small median apophysis and five spinules on inner margin; distolaterally with three simple setae; claw well developed, slightly longer than that of fixed finger.

Pereopod II (Fig. 2 A) thick and strong. Exopodite present, with five long plumose setae. Coxa small, with several short circumplumose setae. Basis thick, two times as long as broad, with one long and one short proximodorsal spiniform apophyses, and a row of seven long plumose setae, dorsally; distoventrally with a seta and one spine. Ischium very short, with two ventral setae. Merus, wider distally, much longer than carpus; distodorsally with one long spine and one long seta; ventrally with around of nine unequal setae and one distal robust spine. Carpus short and thick; dorsally with nine setae and one distal robust spine but ventrally with four setae and one distal stout spine, as figured. Propodus narrower but longer than carpus, 1.8 times as long as wide, with two short and three long simple setae, and one stout spine on dorsal side and four simple setae and three spines on ventral margin; distally with a ciliate seta, near dactylus joint. Dactylus stout, slightly shorter than carpus, curved, with one dorsal seta and one ventral spine; unguis shorter than last ventral spine of propodus.

Pereopod III (Fig. 2 B) slender. Coxa short, with several circumplumose short setae. Basis three times as long as wide, with five ventral and four dorsal small setae; proximodorsally with a curved spiniform apophysis. Ischium with two ventral setae. Merus, about twice as long as ischium, with two distoventral spines,

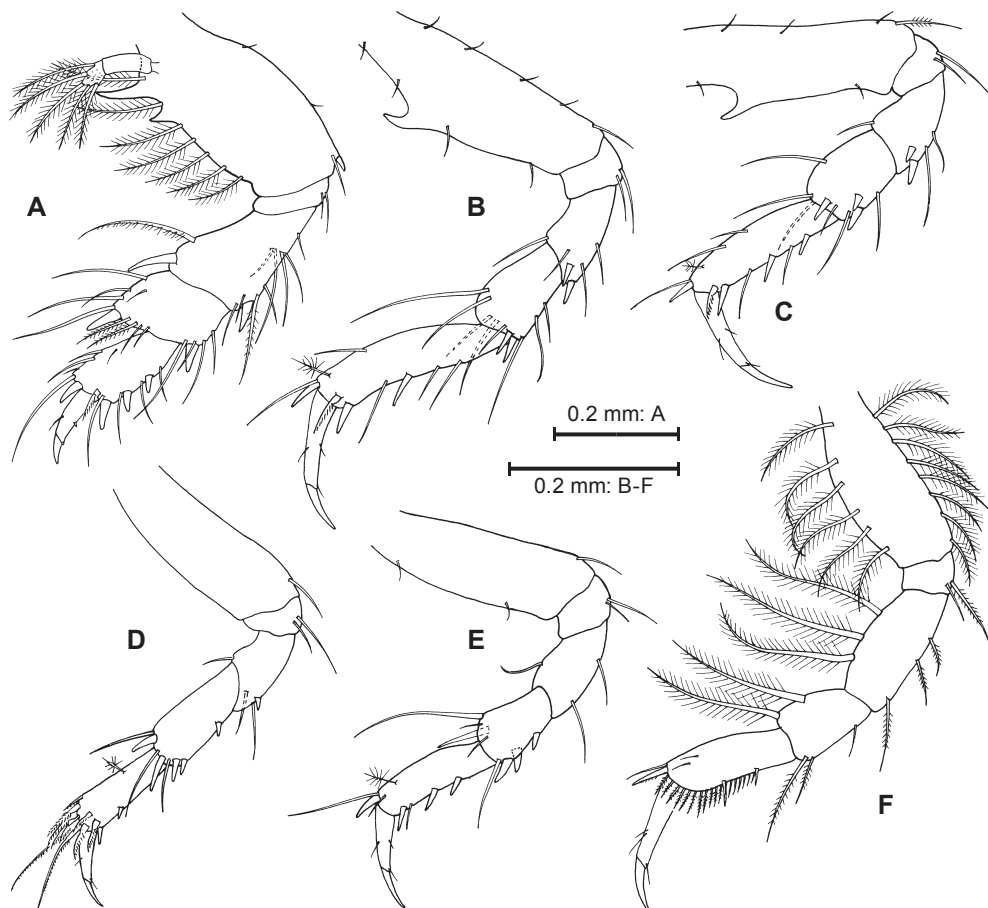


Fig. 2 - *Calozodion bogoeskui* n. sp., female, holotype: A-F, pereopods II-VII, respectively.

one distodorsal, two ventral and one distal setae. Carpus, slightly longer than merus, with eight setae and two spines, as illustrated. Propodus slender, curved ventrally, about as long as merus and carpus together, with two stout spines and three setae on ventral margin and one distal spine and three setae on dorsal side; distally, near dactylus joint with a ciliate seta. Dactylus long and thin, curved, with two ventral and one dorsal short setae; unguis well developed, acute.

Pereopod IV (Fig. 2 C) similar to pereopod III, excepting some features of carpus and propodus; carpus with six setae and three spines and propodus with two setae and three spines on ventral, tergal and distal margins, as figured.

Pereopod V (Fig. 2 D, 3A) as long as pereopod IV. Basis three times as long as wide, with a distoventral seta. Ischium with two setae. Merus one third as basis length, with one spine and two setae, distoventrally, and a distotergal seta. Carpus, 1.8 times as long as merus; midventrally with a small spine and distally with four unequal spines and three setae. Propodus as long as carpus, with two ventral spines; distally with ten setae, eight of them short and ciliate and other two very long, as illustrated. Dactylus similar to that of pereopod III or IV, but smaller.

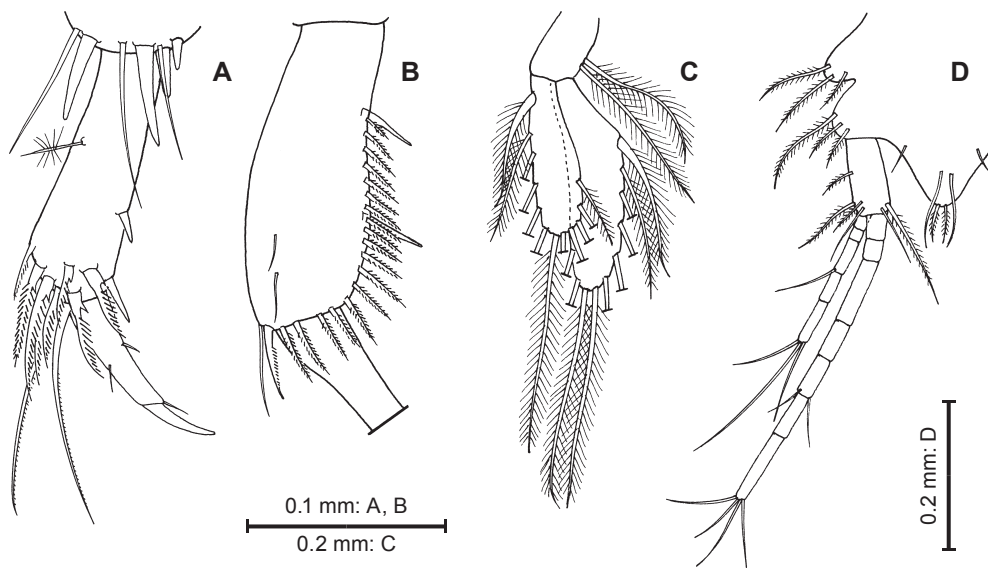


Fig. 3 - *Calozodion bogoescui* n. sp., female, holotype: A, pereopod V propodus and dactylus; B, pereopod VII propodus; C, pleopod; D, pleotelson, left half, and corresponding uropod.

Pereopod VI (Figs 2 E) relatively similar to pereopod III or IV. Basis without ventral spiniform process. Merus with three setae. Carpus, as long as merus, with three spine and one seta, ventrally, and two short and one very long seta and one spine, distodorsally. Propodus, 1.3 times as long as carpus; ventrally with three spines and one small seta and distodorsally with one broom and two simple setae (one of them very long) and one spine. Dactylus as in previous pereopods.

Pereopod VII (Figs 2 F, 3 B) slightly stonger than pereopods III-VI. Basis 2.5 times as long as wide, with six and eight long plumose setae, dorsally and ventrally, respectively. Ischium with two setae. Merus, 2.1 times as long as wide, with three very long and three short plumose setae, dorsally and ventrally, respectively. Carpus much shorter than merus, with two long plumose setae on dorsal margin and three short but unequal, on ventral side. Propodus, as long as merus, with a row of 18 short ciliate setae, three spines and one short seta, as figured. Dactylus as in pereopods III-VI.

Pleopods (Fig. 3 C) well developed, biramous, in five pairs. Basal article 1.5 times as long as wide, with two long plumose setae on the outer side. Endopod twice as long as basal article, but shorter than exopod, with twelve plumose setae of various lengths. Exopod with ten plumose setae.

Uropod (Fig. 3 D) biramous. Basal article stout, with six setae. Exopod as long as pleotelson length, four-articled, with one and three setae on second and last articles, respectively. Endopod 2.2 times as long as exopod, with seven articles; fifth and seventh articles with two and four simple setae, respectively.

Remarks. *Calozodion bogoescui* n. sp. is distinguished from other species of the genus by the combination of two features: chelipedal merus much smaller than the carpus (Fig. 1 H) and the uropodal endopod with only seven articles (Fig. 3 D). *C. bogoescui* resembles *C. suluk* by its distinctively short uropod (Bamber &

Shedder, 2005, fig. 5 f) and with the two species belonging to genus *Vestigiramus* Guțu, 2009 (Guțu, 1996, 2009), a genus related to *Calozodion*.

***Calozodion tanzaniense* n. sp.**

(Figs 4, 5)

Calozodion cf. *wadei* Guțu, 2006: 209

Material: one female with oostegites, Western Indian Ocean, Mbudya Island (coast of Tanzania), collected in shallow waters; December 1973; Leg. Romanian Expedition leading by Prof. Mihai Băcescu.

Holotype, female with oostegites (dissected), preserved in the Collections of the „Grigore Antipa” National Museum of Natural History, Bucharest, No 250016.

Etymology. After the collected place.

Description of the female

Body (Fig. 4 A) dorsoventrally flattened, five times as long as maximum width; length, 2.75 mm.

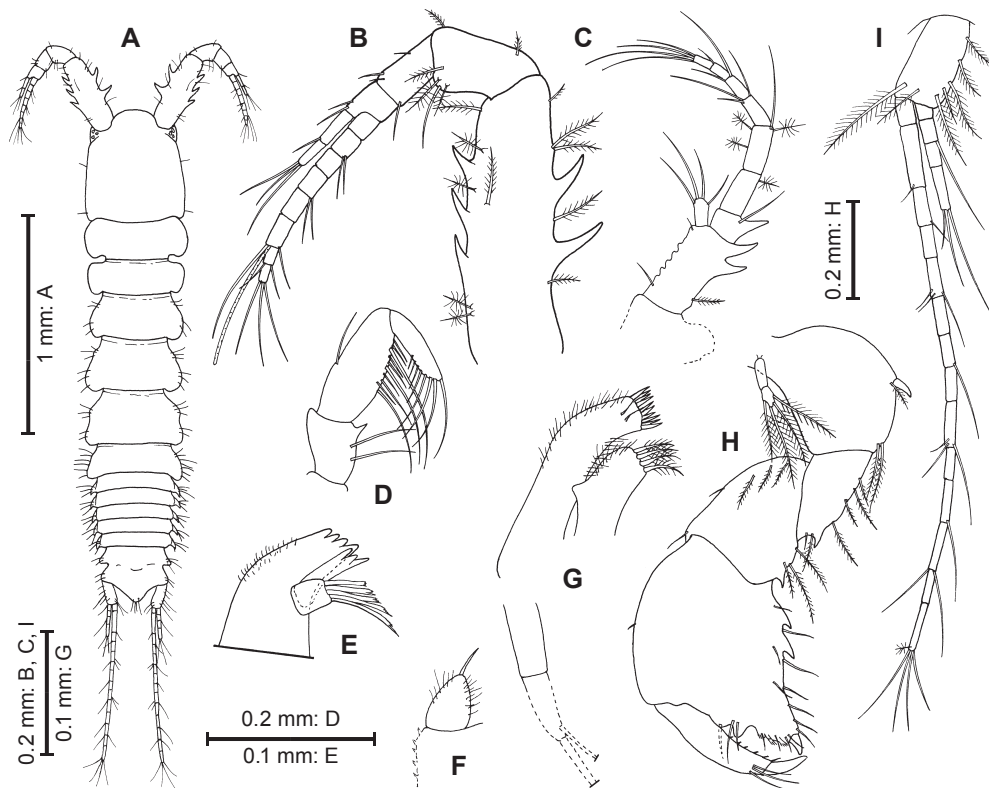


Fig. 4 - *Calozodion tanzaniense* n. sp., female, holotype: A, body, dorsal; B, antennule; C, antenna; D, mandible palp; E, pars incisiva, lacinia mobilis and setiferous lobe of left mandible; F, labium terminal lobe (schematic); G, maxillule; H, cheliped, left; I, uropod, right.

Carapace, 1.1 times as long as broad, with two short setae on each side. Rostrum short, rounded and smooth anteriorly. Ocular lobes well defined; visual elements pigmented.

Pereon about 2.4 times as long as wide and 2.1 times as long as carapace length. First pereonite rounded laterally, 2.7 times as wide as long. Second pereonite slightly shorter than the first pereonite. Third, fourth and fifth pereonites narrower anteriorly, approximately equal, each being a little longer than first pereonite. Sixth pereonite shortest. Each pereonite with a few short setae on lateral margins.

Pleon, about 1.2 times as long as carapace, decreasing in width from the first pleon to pleotelson; laterally with short circumplumose setae. Each pleonite very short, all together as long as last two pereonites. Pleotelson, approximately as long as last three pleonites together, pointed terminally and with one rounded conspicuous prominence on lateral margins.

Antennule (Fig. 4 B) as long as carapace and first two pereonites together. First peduncular article stout, 3.3 times as long as median width, with three spiniform apophyses and some broom and two circumplumose setae on outer side; inner margin with two spiniform apophyses (larger than the same of outer margin) and four circumplumose setae. Second peduncular article, about one third as long as first article and 1.5 times as long as wide, with two and several broom and circumplumose setae on inner margin and distoexternal corner, respectively. Third article shorter and narrower than second article, with one distoextern simple seta and other three on inner margin. Fourth article short. Outer flagellum, one half as long as first three peduncular articles combined, with eight short articles; second, fourth, sixth and seventh articles with two and eight one with three simple setae; sixth article with one very long aesthetasc. Inner flagellum, a little longer than first three articles of outer flagellum with one and three simple setae on first and second articles, respectively.

Antenna (Fig. 4 C) nine-articled, as long as first two peduncular articles of antennule. First article short, with a large inner rounded expansion. Second article twice as long as wide with two proximal setae, several tubercles on outer side and two spiniform apophyses on distoinner margin; squama small, with four setae. Third article very short with one seta and one spiniform apophysis on inner corner. Fourth article 1.5 times as long as third article but narrower, with one distoinner broom seta. Fifth article as long as fourth article, with one distoinner long simple and several broom setae. Each of following four articles thin and short, with one to four simple setae, as illustrated.

Epistome well developed, acute.

Mandibles (Fig. 4 D, E) with pars incisiva four-denticulated. Lacinia mobilis of left mandible with three denticles. Setiferous lobe with five furcate setae. Pars molaris without special features. Palp three-articled; first article one half as long as second article, with two simple setae and one dentiform process on distoinner side; second article 2.5 times as long as wide, with one simple seta on outer side, and four long and seven short setae on inner margin; third article 1.3 times as long as first article but narrower, with eight unequal setae.

Labium (Fig. 4 F) as in other species of the genus. Terminal lobe triangular, with a long setiform spine in top and numerous long setulae on inner margin.

Maxillule (Fig. 4 G) with two-articled palp, second article having two simple setae, one of them very long. Outer endite with many long setulae on sides and ten distal stout denticles. Inner endite with long setae on outer margin and four terminal setulated setae.

Maxilla without special features.

Maxilliped and *epignath* similar to those of the previously described species.

Cheliped (Fig. 4 H) with exopod having four long plumose setae on last article. Basis large, 1.3 times as long as broad; ventrally with one robust spine and a short seta, and distroventrally with three unequal circumplumose setae. Merus, relatively triangular, with ventral free margin longer than that of carpus, having a distovetral spiniform apophysis and five circumplumose setae. Carpus broad, as wide as median length; ventrally with a spiniform apophysis and three circumplumose setae, and dorsally with three circumplumose and two simple setae. Propodus palm as long as wide; proximoventrally with two spiniform apophyses and several simple setae; fixed finger short, much wider proximally, with several setae on outer and inner sides; also, the inner side with a rounded proximal apophysis; claw stout. Dactylus

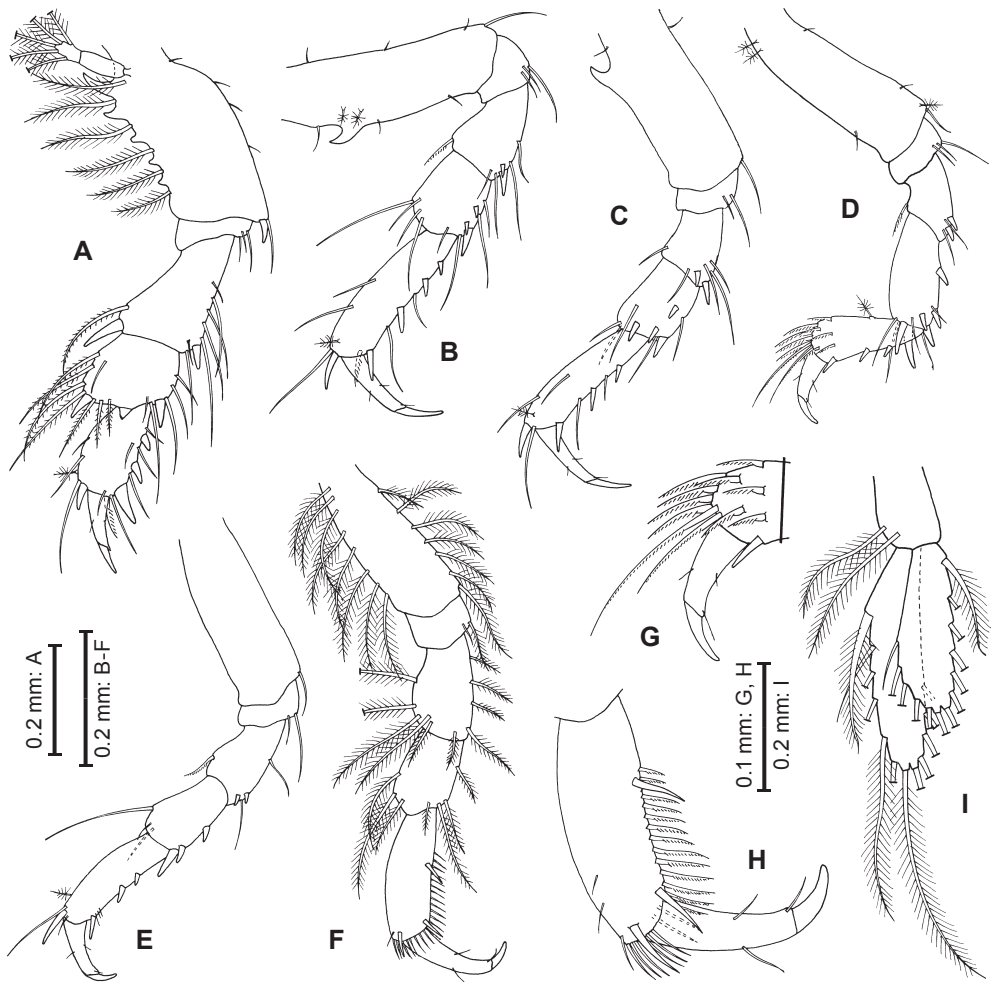


Fig. 5 - *Calozodion tanzaniense* n. sp., female, holotype: A-F, pereopods II-VII, respectively; G, distal part of pereopod V propodus and dactylus; H, pereopod VII propodus and dactylus; I, pleopod.

curved, thin, approximately four times as long as median width, with six spinules on inner margin and three distal setae; claw curved, longer than that of fixed finger.

Pereopod II (Fig. 5 A) larger than following pereopods. Exopodite present, with five plumose setae on last article. Coxa small, rounded distally, bearing several short circumplumose setae. Basis thick, 2.2 times as long as wide; dorsally with six long plumose setae and five spiniform apophyses; ventrally with four short simple setae and distoventrally with one spine and one simple seta. Ischium very short with three setae. Merus wider distally, twice as long as median width, with seven setae and one stout spine on ventral margin and one spine and one circumplumose seta on distodorsal corner. Carpus much shorter than merus and slightly wider than long, with three spines and 13 setae, as illustrated. Propodus 1.3 times as long as carpus but narrower, with three stout spines, one ciliate and six simple setae on ventral margin; dorsally with one broom and three simple setae, and one robust spine. Dactylus curved, about twice shorter than propodus, with one dorsal seta and two ventral spinules; unguis as long as distodorsal spine of propodus.

Pereopod III (Fig. 5 B) much thinner than pereopod II, with a small coxa, bearing several short circumplumose setae. Basis three times as long as wide, with a curved proximodorsal spiniform apophysis and several short setae on both margins. Ischium with three setae. Merus 2.5 times shorter than basis, with five setae and two spines. Carpus about as long as merus with four distodorsal setae; ventrally with three spines and four setae. Propodus slender, curved ventrally, about as long as merus and carpus combined, with four stout spines, two simple and one ciliate setae on ventral margin; distodorsally with one broom and three simple setae, and a robust spine. Dactylus long, slightly curved, with two ventral and one dorsal setulae; unguis curved, acute.

Pereopod IV (Fig. 5 C) relatively similar to previous pereopod. Carpus with five setae and four spines. Propodus with three spines and two setae, ventrally, and one spine and four setae on dorsal margin.

Pereopod V (Fig. 5 D, G) basis 3.5 times as long as wide, with several broom and simple setae. Ischium with three setae. Merus short, one third as long as basis; distoventrally with two spines and two setae, and distotergally with a ciliate seta. Carpus, 1.8 times as long as median length of merus, with four spines and five setae. Propodus as long as carpus, with three ventral spines; dorsally with a broom seta and distodorsally with two long and nine short ciliate setae. Dactylus similar to that of pereopods III or IV.

Pereopod VI (Fig. 5 E) relatively similar to pereopods III or IV, as illustrated.

Pereopod VII (Fig. 5 F, H) not stronger than pereopod VI. Basis with eight and seven long plumose setae on dorsal and ventral margins, respectively. Ischium with two setae. Merus, 1.5 times as long as wide, with five dorsal and five ventral long plumose setae. Carpus about as long as merus, with three and four plumose setae, dorsally and ventrally, respectively. Propodus 1.5 times as long as carpus, with a row of about 24 short ciliate setae and three spines, as figured. Dactylus as in other pereopods.

Pleopods (Fig. 5 I) biramous, in five pairs. Basal article with two long plumose setae on the outer side. Endopod ovate, three times as long as broad, with 13 plumose setae of various lengths, around. Exopod, about 1.3 times as long as endopod and 4.4 times as long as wide, with 12 plumose setae.

Uropod (Fig. 4 I) biramous. Basal article stout, with eight circumplumose setae, as illustrated. Exopod four-articled, about as long as first three articles of endopod, with one and three setae on second and last articles, respectively. Endopod

slightly longer than last pereonite and pleon combined, with 14 articles; several articles with one to three setae; last article with one broom and four simple setae.

Remarks. *Calozodion tanzaniense* n. sp. belongs to a group of species (i. e., *C. bogoescui* n. sp., *C. dominiki* Bochert, 2012, *C. moyas* Menioui, 2013, *C. simile* Guțu, 2006 and *C. wadei* Gardiner, 1973) characterized by a mediodorsal spiniform apophysis on the basis of the pereopods III and IV. The differences between *C. tanzaniense* and these other five species are: (1) antennule first peduncular article with three spiniform apophyses on outer margin (other species have at most two apophyses; only *C. simile* in rare cases has three), (2) antenna with nine articles (ten in *C. simile*), (3) squama with four setae (three in *C. bogoescui* n. sp., *C. dominiki* and *C. wadei*), (4) pereopod VII merus with five long plumose setae on dorsal side (at most four setae in other species), and (5) uropod endopod with 13-16 articles (only seven articles in *C. bogoescui* n. sp. but relatively similar in other species).

Some remarks on Calozodion dollfusi Guțu, 1989 and *C. dominiki* Bochert, 2012

After a detailed analysis of the characteristic morphological features of the type species, *C. wadei* Gardiner, 1973, as well as other species within the genus *Calozodion* (based on the descriptions from literature: Bamber & Sheader, 2005; Bochert, 2012; Gardiner, 1973; Guțu, 1984, 1989a, 1996, 2002, 2006; Menioui, 2013), my attention was drawn by some specific particularities of the species *C. dollfusi* Guțu, 1989 and *C. dominiki* Bochert, 2012.

Thus, the main differences among the species of the genus *Calozodion* and that of *C. dollfusi*, which was described from a single manca (Guțu, 1989 a: 129), consist of (1) terminal lobe of labium with a single spiniform seta in top (three in *C. dollfusi*), (2) maxillule endite with four distal setae (five in *C. dollfusi*), (3) first article of maxillipedal palp with one very long distal inner plumose seta (absent in *C. dollfusi*), (4) second article of maxillipedal palp with one long spiniform seta on midouter side (two distally in *C. dollfusi*), (5) pereopod II carpus (or pereopod 1 as used by other specialists) with a single ventral spine (two in *C. dollfusi*) and (6) pereopod II propodus with a single distodorsal spine (two in *C. dollfusi*).

By the morphological features mentioned above (notably 1, 2, 5 and 6), the species *C. dollfusi* resembles those of the genus *Julmarichardia* Guțu, 1989 (Bamber & Sheader, 2005; Guțu, 1989 b; Ritger & Heard, 2007). Although these features might be considered unimportant for systematics by some specialists, their constant difference in the species of *Calozodion* and *Julmarichardia* is an undeniable fact. Moreover, in this situation it would have been enough to analyse only the terminal lobe of the labium, whose configuration is almost identical in the genera correctly defined (Guțu, 2006: 35). In conclusion *C. dollfusi* is here transferred to become *Julmarichardia dollfusi* (Guțu, 1989), comb. nov. In addition, the morphological features I referred should be considered amendments for the diagnoses of *Calozodion* and *Julmarichardia*.

The species *C. dominiki* Bochert, 2012 is in a special situation. If in the case of the female there is no doubt that it belongs to the genus *Calozodion*; however the situation is not the same for the male described by Bochert (2012). The male's obvious degree of sexual dimorphism in the carapace, rostrum, antennules, antenna and cheliped level is in contradiction with the characteristic features of *Calozodion*. By the great size of the rostrum, combined with the great length of the first article of the antennule peduncle and of the second article of antenna (Bochert, 2012: 47 and figs 8 A-F and 9 H, I), the male of *C. dominiki* resembles the species of

- 6 – Antennule main flagellum and antenna each with ten articles *C. simile* Guțu, 2006 (♀, ♂)
 – Antennule main flagellum and antenna with eight and nine articles, respectively *C. tanzaniense* n. sp. (♀; ♂ unknown)
- 7 – Pereopods III and IV basis with a median spiniform apophysis 8
 – Pereopods III and IV basis without a median spiniform apophysis 10
- 8 – Mandibles with an acute process on the first article of palp *C. moyas* Menioui, 2013 (♀, ♂)
 – Mandibles without an acute process on the first article of palp 9
- 9 – Cheliped propodus with acute processes on proximoventral margin *C. wadei* Gardiner, 1973 (♀, ♂)
 – Cheliped propodus without acute processes on proximoventral margin *C. dominiki* Bochart, 2012 (♀, ♂)
- 10 – Pereopod III with long plumose setae on twice margins, dorsally and ventrally *C. multispinosum* Guțu, 1984 (♀, ♂)
 – Pereopod III without long plumose setae on twice margins, dorsally and ventrally *C. singularis* Guțu, 2002 (♀; ♂ unknown)

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DOUĂ SPECII NOI DIN GENUL *CALOZODION* GARDINER
 (CRUSTACEA: TANAIDACEA: APSEUDOMORPHA)
 DIN MAREA ADRIATICĂ ȘI OCEANUL INDIAN ȘI RECLASIFICAREA
 SPECIEI *C. DOLLFUSI* GUȚU, 1989 ÎN GENUL *JULMARICHARDIA* GUȚU

REZUMAT

Sunt descrise două specii noi pentru știință, *Calozodion bogoescui* și *C. tanzaniense*, provenind din apele sud-estice italiene ale Mării Adriatice și, respectiv, cele tanzaniene ale Oceanului Indian. Prin descrierea speciei *C. bogoescui* n. sp. este menționată pentru prima dată prezența genului *Calozodion* Gardiner, 1973 în bazinul mediteranean. Principalele trăsături morfologice caracteristice speciei mediteraneene constau în numărul mic al articulelor endopodului uropodal (numai șapte, în comparație cu 13-16, cât au celelalte specii ale genului) și lungimea mică a merusului chelipedului (comparativ cu cea a carpului). Specia *C. tanzaniense* n. sp. se deosebește de celelalte cunoscute prin următoarea combinație de trăsături morfologice: (1) antenula cu trei apofize spiniforme pe marginea externă a primului articol peduncular, (2) antena formată din nouă aticule, (3) bazisul pereopodului II cu sete penate lungi numai pe marginea dorsală, (4) bazisul pereopodelor III și IV cu câte o apofiză spiniformă pe marginea dorsală și (5) merusul pereopodului VII cu cinci sete penate lungi pe marginea dorsală.

Totodată specia *C. dollfusi* Guțu, 1989 este transferată în alt gen, devenind *Julmarichardia dollfusi* (Guțu, 1989), comb. nov., iar în cazul masculilor speciei *C. dominiki* Bochart, 2012 sunt comentate unele particularități morfologice neîntâlnite la alte specii ale genului. În partea finală a lucrării este prezentată cheia de identificare a celor 11 specii ale genului *Calozodion*.

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FIRST RECORD OF *THEMIRA NIGRICORNIS* (MEIGEN, 1826) (SEPSIDAE: DIPTERA) IN ROMANIA

LAVINIA IANCU, CRISTINA PURCĂREA

Abstract. This report on the occurrence of *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) on Romanian territory represents the first record of this species within south-eastern Europe. Adults of *T. nigricornis* were collected in spring, in the second half of April, from an experimental setting placed in an urban location (Bucharest) in southern Romania. The bait consisted of domestic pig carcass in advanced decomposition stage, placed on soil ground and surrounded by vegetation. The visiting specimens were located around the posterior segment of the pig carcass. The registered abundance of adult individuals was relatively low, with 10 specimens distinguished during two weeks interval. The species was taxonomically characterized and identified. This study, documenting the presence of *T. nigricornis* in the southern part of Romania, expanded the Fauna Europaea distribution range record of this species, assigning the southernmost location of *T. nigricornis* in Europe.

Résumé. Ce rapport sur la présence de *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) sur le territoire roumain représente la première mention de cette espèce dans l'Europe du Sud-Est. Les adultes de *T. nigricornis* ont été recueillies pendant le printemps, dans la seconde moitié d'Avril, à partir d'un cadre expérimental placé dans un emplacement urbain (Bucarest) dans le sud de la Roumanie. L'appât consistait en une carcasse de porc en phase de décomposition avancée, placée sur le sol et entourée de végétation. Les spécimens en visite ont été trouvés dans le segment postérieur de la carcasse de porc. L'abondance enregistrée des individus adultes a été relativement faible, avec 10 spécimens démarqués au cours de deux semaines. Cette étude, en documentant la présence de *T. nigricornis* dans la partie du sud de la Roumanie, a élargi l'aire de répartition de cette espèce dans la Faune Europaea, par l'attribution de *T. nigricornis* au point le plus au sud d'Europe.

Key words: *Themira nigricornis*, first mention, pig carcass, Romania, distribution.

INTRODUCTION

The Sepsidae family, known as the black scavengers flies because of their coprophagous preference, comprises 37 genera and 318 species worldwide (Ozerov, 2005). The adults were found on dung (Snowball, 1944), animal and plant decaying material (Ozerov, 1989, 1999 a). These insects were predominantly located on human and animal excrements (Iwasa, 1980; Ozerov, 1991), playing an important role in faeces decomposition processes (Papp, 1971).

Species belonging to this family (Pont & Meier, 2002) are of relatively small size, reaching 6–12 mm in length. Morphologically, they resemble ants with narrow waist, the majority of individuals presenting pronounced sexual dimorphisms, of the legs and the male's 4th sternites. The forelegs of the male are used during courtship and mounting for holding onto the base of the female wing.

Themira species are characterized by the absence of supraalar seta (Pont & Meier, op. cit.). Adult males are easily recognized by the ornate fore-legs, and by the prominent form and colour that varies from black to yellow of the mid tarsomeres. The females are recognised by the absence of postpronotal setae, pruinose katepisternum, and partially yellow legs.

T. nigricornis, fully described and illustrated by Ozerov (1999 b), was first identified almost two centuries ago (1826) by Meigen, but no certain location and

holotype/syntype of female were indicated for this incidence (Ozerov, 2005). An earlier report of this species was recorded on American territory by Steyskal (1946). Since then, the presence of *T. nigricornis* was reported in western, central, eastern and northern European countries including Austria, Great Britain (Incl. Shetlands, Orkneys, Hebrides and Man Is.), Czech Republic, Danish mainland (Incl. Borhalm I.), Finland, French mainland, Germany, Hungary, Latvia, Lithuania, Norwegian mainland, Poland, Central, East, South and Northwest Russia, Slovakia, Sweden (Incl. Gotland I.), Switzerland, The Netherlands, Ukraine (Fauna Europaea, Version 2.6.2, de Jong, 2013) and Italy (Ozerov, 2005). So far, the south-eastern limit for the spread range of this species did not include Romania.

The current study reports the first occurrence of *T. nigricornis* on Romanian territory, in the southern part of the country, containing a brief description of the associated experimental settings, taxonomic identification of adult specimens collected from a pig decomposed carcass.

MATERIAL AND METHODS

Experimental setting

T. nigricornis specimens were identified during a forensic experimental model investigation in Bucharest, Romania. This urban site is located 100 m above sea level (44°27'10"N, 26°05'04"E) and belongs to a temperate climate region. The experimental setting consisted of a pig carcass weighing approximately 15 kg, placed on the ground, in a natural park area surrounded by spring vegetation (grass and trees), and protected by 50 cm x 100 cm metal cage against vertebrate scavengers (Fig. 1). The bait was exposed for approximately 5 months during cold period (December-February) and beginning of warm period (March-April). The spatial-temporal, environmental and experimental model features describing the occurrence of this species in Romania were summarized in table 1.

Sampling and taxonomical characterization

Insect sampling was performed using an entomological net, and the specimens were preserved in 75% ethanol at room temperature, until further investigations.

T. nigricornis taxonomic identification was performed according to the taxonomic keys for this species (Pont & Meier, 2002). The identification of main



Fig. 1 - Experimental setting for *T. nigricornis* appearance site. Pig carcass after 5 month exposure.

Table 1

Characteristics of experimental settings for *T. nigricornis* occurrence.

Characteristic	Experimental data
Location	Bucharest, Romania, 44°27'10"N L26°05'04"E
Period	15 – 30.IV.2013
Environmental temperature (°C)	20.05 ± 2.1°C
Relative humidity (%)	57.06 ± 8.0%
Precipitation (mm)	0.53 ± 0.09 mm
Experimental model	Pig carcass in advanced decomposition stage after 5 months of outdoor exposure in a park type setting
Environmental conditions	Arboreal vegetation (<i>Aesculus hyppocastanum</i> , <i>Tilia</i> sp., <i>Ulmus</i> sp.), rich cover of small plants and shrubs
Abundance	10 specimens (7 males and 3 females)

diagnosis characters was performed using a stereomicroscope Stemi2000 (Zeiss) at 3 x (1.9 to 225x) magnification scale.

DNA barcoding

T. nigricornis genomic DNA was extracted from two different adult individuals using DNeasy Blood & Tissue Kit (Qiagen), following an adapted protocol that included an additional initial cellular disruption step. The insect habitus suspended in 200 µl TE was disrupted at 20°C using a Cell Homogenizer SpeedMill PLUS (Analytik Jena), by applying continuous 50 Hz-power for 12 minutes at 20°C, in the presence of 5 Zirconia Beads II per tub (Invitex). After centrifugation of the cell extract at 10.000 x g for 1 min, the soluble fraction was further purified following the manufacturer procedure. The concentration and purity of the resulted DNA were measured with a NanoDrop1000 (Thermo Scientific).

DNA barcoding was performed based on PCR amplification of cytochrome oxidase subunit I (COI) mitochondrial gene fragment (Folmer et al., 1994). PCR amplification was carried out using a Mastercycler ProS System (Eppendorf). The reaction mixture contained 200 ng insect genomic DNA, 100 pmols of forward (LCO1490: 5'-GGTCAACAAATCATAAAGATATTGG-3') and reverse (HC02198: 5'-TAAACTTCAGGGTGACCAAAAAATCA-3') invertebrates' COI gene specific primers (Folmer et al., 1994), 1 unit of Taq DNA polymerase (Thermo Scientific), 1x Taq buffer, 2.5 mM MgCl₂, 0.1 mM dNTP (Thermo Scientific), in a total volume of 50 µl. The amplification reaction consisted of an initial incubation step of 1 min at 94°C, followed by 5 cycles of 30 sec at 94°C (denaturation), 1.5 min at 45°C (annealing) and 1 min at 72°C (extension), followed by 35 cycles of 30 sec at 94°C, 1.5 min at 51°C, 1 min at 72°C and a final extension step of 5 min at 72°C. The reaction performed in the absence of DNA was used as negative control.

The resulted DNA fragments (710 bp) were analysed by electrophoresis on 1% agarose gels. The amplified COI gene fragments were purified using QIAquick PCR Purification Kit (Qiagen), and sequenced (Macrogen) on both strands, using the cloning primers. Sequence similarity was determined by BLAST-NCBI screening tool (<http://www.ncbi.nlm.nih.gov>).

RESULTS

Spatial and temporal characteristics of T. nigricornis occurrence in Bucharest – Romania

The insects were observed in the second half of April, 2013, when the average temperature raised to $20.05 \pm 2.1^{\circ}\text{C}$. The precipitation and relative humidity during this interval corresponded to 0.53 ± 0.09 mm and $57.06 \pm 8.0\%$, respectively. The insects were located on the surface of the pig carcass, in the vicinity of the posterior section. A total of ten specimens, counting seven males and three females, were collected during midday period over the two week interval. Noteworthy, the presence of *T. nigricornis* on the carcass was simultaneous with other necrophagous species belonging to Diptera and Coleoptera Orders, including members of Calliphoridae, Muscidae, Cleridae and Silphidae families.

Taxonomic identification of T. nigricornis

Taxonomic identification of this species was carried out based on the taxonomic keys provided by Pont & Meier (2002). The analysis of male adult specimen (Fig. 2) indicates a series of characteristics of *T. nigricornis* species, as follow: black thorax and abdomen, and habitus presenting orange-yellow genal area (Fig. 2A); the front femure (Fig. 2B) exhibiting several posterodorsal setae

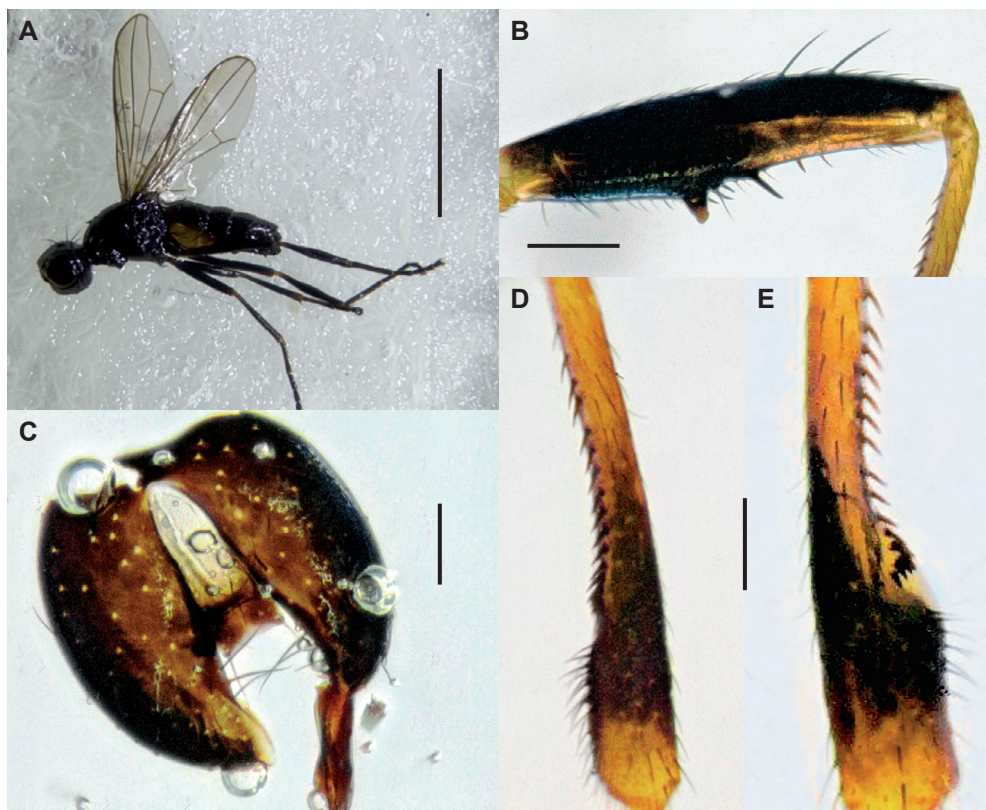


Fig. 2 - Stereomicroscopic images of *T. nigricornis*. A, habitus; B, fore femure anterior view; C, hypopygium; D, fore tibia, anterior view; E, fore tibia, view posterior. Scales (in mm): A – 2; B-E – 0.5.

in the apical half, and hypopygium as part of the copulatory apparatus (Fig. 2 C); yellow coloured fore tibia except of the apical half region, as shown by the anterior (Fig. 2 D) and posterior (Fig. 2 E) views.

These corroborated elements correspond to key morphological characteristics of *T. nigricornis*, indicating that the isolated organism corresponds to this species.

DNA barcoding identification of T. nigricornis

PCR amplification of mitochondrial cytochrome C oxidase I gene (COI) using specific primers for invertebrates was obtained for 2 distinct adult individuals. DNA sequencing of both TN1 and TN2 amplicons indicate 100% sequence identity over a 622-bp gene fragment.

The TN1 sequence was assigned GenBank accession number KJ007735.

Sequence similarity search using BLAST screening indicated the closest match of TN1 sequence (99% identity) with the *T. nigricornis* COI gene fragment (Laamanen et al., 2005; accession number AJ832117).

DISCUSSION

This report represents the first mentioning of *T. nigricornis* presence in Romania.

The location of the insect on a pig carcass in advanced decomposition stage confirmed the preference of this species for such environments.

The adult abundance in the forensic experimental setting was relatively low, only 10 individuals (males and females) being observed on the site over 2 weeks period. Such low density is in accordance with previous statements (Pont & Meier, 2002) mentioning that *T. nigricornis* was only occasionally abundant. Moreover, the appearance season of *T. nigricornis* on Romanian territory in early spring, when temperatures raised to about 20°C, is in accordance with prior reports on the main occurrence period of this species within end of March - August interval, corresponding to the warm season (Pont & Meier, op. cit.). The identity of this species was confirmed both taxonomically and by DNA barcoding based on mitochondrial cytochrome C oxidase I gene (COI) amplification and sequencing.

To date, the worldwide spread range of this species covered the nearctic USA region (Alaska, Connecticut, Illinois, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania), and Palaearctic regions of Asia including Kazakhstan, Korea, Kyrgyzstan, Pakistan, Turkmenistan, South Korea and Japan (Pont & Meier, op. cit.; Ozerov, 2005).

In Europe, the distribution of *T. nigricornis* species covered 19 countries (Pont & Meier, op. cit.), with a species widespread incidence in the central and northern European zones and eastwards to Russia (Far East province), but with only specific locations in certain European countries such as Denmark (East Jutland and North East Zealand), Norway (northwards to Nord Trøndelag), Sweden (Skane to Torne Lappmark), and Finland (northwards to Kuusamo).

In this respect, the current report on the presence of *T. negricornis* on the southern Romanian territory contributed to update the distribution map of this species on the European range (Fig. 3), indicating the southernmost location of this Sepsidae species within Eastern Europe.

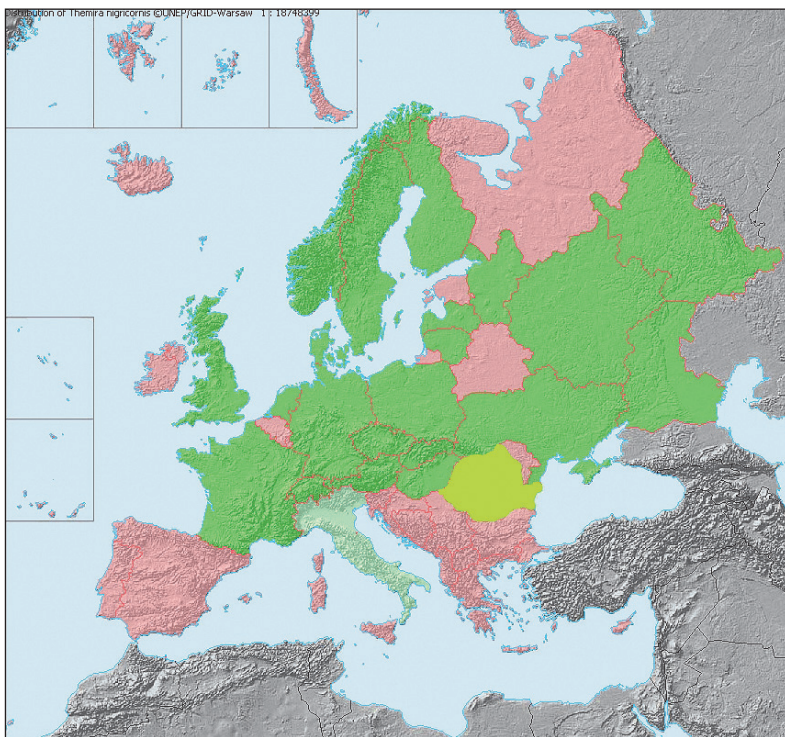


Fig. 3 - Updated map of *T. nigricornis* distribution in Europe (modified from <http://www.faunaeur.org>). Legend: Presence - dark green, doubtful presence - light green, absence - pink, new record - bright green.

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PRIMA SEMNALARE A SPECIEI *THEMIRA NIGRICORNIS* (MEIGEN, 1826) (SEPSIDAE: DIPTERA) ÎN ROMÂNIA

REZUMAT

Acest raport privind semnalarea speciei *Themira nigricornis* (Meigen, 1826) (Sepsidae: Diptera) pe teritoriul românesc reprezintă prima înregistrare a acestei specii în sud-estul Europei. Adulții speciei *T. nigricornis* au fost colectați în anotimpul primăvara, în a doua jumătate a lunii aprilie, în cadrul unui experiment amplasat în spațiu urban (București), în partea de sud a României. Au fost utilizate carcase de porc domestic (*Sus scrofa domesticus*) aflate într-un stadiu de descompunere avansată, amplasate direct pe sol și înconjurată de vegetație. Exemplarele de *T. nigricornis* au fost localizate în segmentul posterior al carcaselor. Abundența a fost relativ scăzută, constând în 10 exemplare colectate într-un interval de două săptămâni. Specia a fost caracterizată și identificată taxonomic. Acest studiu, ce documentează prezența speciei *T. nigricornis* în sudul României, extinde arealul de distribuție semnalat de Fauna Europaea, desemnând localizarea în partea de sud a Europei.

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NESTING PREFERENCES FOR TWO WOODPECKER SPECIES (*DENDROCOPOS MAJOR* AND *DENDROCOPOS MEDIUS*) IN COMANA FOREST, SOUTHERN ROMANIA

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MIHAELA ION, LOTUS ELENA MEȘTER

Abstract. The main goal of this study is to get a better insight of the habitat requirements for the Great- and Middle Spotted Woodpeckers. Woodpeckers are forest specialists, threatened all over Europe mainly by the loss of forest habitats and also by the loss in quality of the habitat by reducing the food sources and nesting sites. Both species showed a strong preference for oaks, lime, large trees and dead wood for nesting, but Middle Spotted Woodpecker proved to be more selective in terms of tree species. Nest-height was influenced by tree diameter. Both species have the same nesting preferences for Turkey oak, lime and Pedunculate oak, in a *Quercetum farnetto-cerris* type of forest. The orientation of the nest hole on the tree was mainly NE-E-SE for Middle Spotted Woodpecker and N-NE-E for Great Spotted Woodpecker.

Résumé. L'objectif principal de cette étude est de mieux connaître les besoins en matière d'habitat pour le pic épeiche et le pic mar. Les pics sont des spécialistes de la forêt, menacés dans toute l'Europe principalement par la perte d'habitats forestiers et aussi par la perte de la qualité de l'habitat en réduisant les sources de nourriture et les sites de nidification. Les deux espèces ont montré une forte préférence pour les chênes, de chaux, de grands arbres et du bois mort pour la nidification, mais le pic mar s'est avéré être plus sélectif en termes d'espèces d'arbres. Nid-hauteur a été influencé par le diamètre de l'arbre. Les deux espèces ont les mêmes préférences de nidification pour le chêne Turquie, les tilleuls et le chêne pédonculé, dans un *Quercetum farnetto-cerris* type de forêt. L'orientation du trou de nid sur l'arbre était principalement NE-E-SE pour le pic mar et N-NE-E pour le pic épeiche.

Key words: nest-site parameters, Middle Spotted Woodpecker, Great Spotted Woodpecker, Comana Forest.

INTRODUCTION

All over Europe, conservation of forest habitats is of great importance, this biotope being dominant in the continent before massive human intervention; now only one third of the post-glacial forest is still present (Thirgood, 1989; Mikusinski et al., 2001). Regarding the loss of biodiversity, this took place not only by reducing the forest area, but also by reducing the quality of this biotope.

Woodpeckers are a special group among forest birds, with very selective ecological requirements (Angelstam et al., 1994) being regarded as the group with the greatest affinity for forests, also as indicators of forest biodiversity. European woodpeckers are dependent on trees for nesting-sites and they forage for food in old, dying or dead trees. For this reason, woodpeckers are declining in population, especially in the countries with intensive forest management, or where the conversion for agriculture has been massively made (Pettersson, 1985).

Woodpeckers are threatened mainly by the loss of forest habitats and also by the loss in quality of the habitat by reducing the food sources and nesting sites. Cutting the old trees and removing the decaying wood from the forest is the main cause for the declining of those species (Mikusinski, et al., op. cit.; Angelstam et al., op. cit.; Munteanu, 2009).

In Romania, woodpeckers have been studied since the beginning of the 1930 period (Cătuneanu, 1933). Papers dedicated to this group dealt with the distribution, taxonomy, reproduction biology, diet, anatomy, habitat requirements and, within the last years, conservation (Paşcovschi, 1937; Papadopol, 1973, 1974; Papadopol & Mândru, 1977; Popovici, 1971; Korodi Gal, 1970, 1975; Glăvan, 2004; Dorresteijn et al., 2013; Domokos et al., 2014).

Middle spotted woodpecker, *Dendrocopos medius* (Linnaeus, 1758) (MSW), is considered an oak forest specialist (Pasinelli, 2000). Because it prefers mature woods, inhabiting old forests at optimal harvest age, the species decline severely in those regions. Oaks are requiring several decades to become suitable habitats (60-100 years) (Pasinelli, 2003). Losing suitable habitat increases fragmentation and reduces density which in extreme cases can cause extinction, as the southern population from Sweden (Pettersson, op. cit.). Middle spotted woodpecker is listed in Annex I of the Birds Directive of the European Union listing threatened species that require special conservation measures.

Great Spotted Woodpecker, *Dendrocopos major* (Linnaeus, 1758) (GSW), is regarded as the most numerous and widespread European woodpecker and is not listed as threatened. Being primary cavity excavators, woodpeckers are considered as 'key species', producing nest sites and roosting places for other animals (Kosiński & Winiecki, 2004; Kosiński et al., 2006; Wesolowski, 1989), especially Great Spotted Woodpecker which builds more than one cavity in search for the final nesting place, offering more opportunities for the secondary nesters (Cramp, 1985).

It has been reported that although Great- and Middle Spotted Woodpecker are taxonomically related species, coexisting in deciduous forests (del Hoyo et al., 2002; Kosiński et al., op. cit.), both species differ with respect to nest-tree selection, nest height and orientation of the hole entrance (Kosiński & Winiecki, op. cit.; Kosiński et al., op. cit.).

The main goal of this study is to get a better insight of the habitat requirements for the two species, by characterising the nest sites used by Great and Middle Spotted Woodpeckers and to compare the nest sites between species in a lowland forest, a remaining fragment of the secular forest that dominated in the past the southern part of Romania.

MATERIALS AND METHODS

Study area. The study was conducted in Comana Forest, Southern Romania (44°09'N, 26°07'E), 30 km south of the capital of Bucharest. This woodland is a remnant of an ancient vast forest which dominated this part of the country, being in time fragmented and cleared for agriculture and human settlements. Now, the forest (8000 ha) is included together with a mosaic of habitats: wetlands, agriculture fields and atrophic areas in Comana Natural Park and is part of the Special Protection Area Comana (ROSPA0022) and the Community Importance Site Comana (ROSCI0043). Since 2012 the area is a RAMSAR site. The deciduous forest is situated on the right bank of the Neajlov River and Lake Comana and it belongs to several plant associations: *Quercetum cerris* Georgescu, 1941, *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949, *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992, *Ornithogalo-Tilio-Quercetum* A. Dihoru, 1976, *Fraxino pallisae-angustifoliae-Quercetum roboris* Popescu et al., 1979 (Paucă-Comănescu et al., 2000; Paucă-Comănescu et al., 2001). The area is

known as an important *hot spot* for the biodiversity of this part of the country, here being mentioned over 240 bird species (Petrescu et al., 2009).

Data collection and analysis. Data were collected during the pre-breeding and breeding season of 2013. From March to the end of April, the number and distribution of territorial birds was established by responses to the play-back of taped calls (Kosiński et al., 2004). After the bird's response, the territories were checked for occupied nest-holes. Searches continued especially in May and June, identifying the nest by the calls of the nestlings. The position of the nests was recorded with a GPS and revisited after fledging for recording nest-site parameters. The following parameters were recorded to describe the nest site: tree species, diameter of the tree at breast height (Dbh), health of the tree on a scale from 1 to 5 describing the decaying state (1-dead, 5-alive), exact position of the tree, nest and tree height, orientation of the nest, vegetation on a 10 m radius around the nest tree.

Statistical analyses were performed at a confidence level $\alpha = 0.05$, using PAST software (Hammer et al., 2001). Where data did not fit a normal distribution, normalization was carried out by means of Box-Cox transformation and tested again for normality. If normalization was not successful, non-parametric tests were used to test data for statistical significance.

Statistical procedures included Kruskal-Wallis non-parametric ANOVA with Tukey post-hoc analysis to test woodpecker-tree species association, one-way ANOVA for species-tree circumference relationship and χ^2 test for independence to test any existing relationship between tree circumference and height at which the nest was built.

RESULTS AND DISCUSSIONS

In 2013, we found 20 nests for Middle Spotted Woodpecker and 29 nests for Great Spotted Woodpecker (Figs 1, 2). Both species prefers oaks as nesting tree

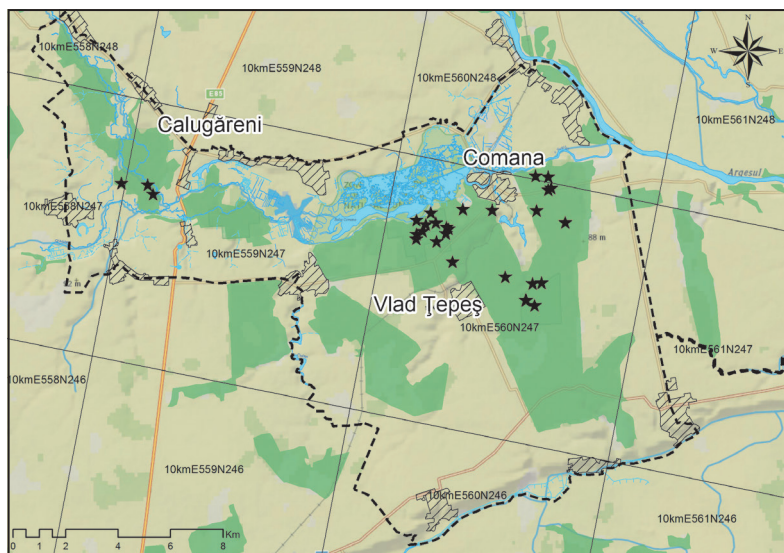


Fig. 1 - Distribution of the nest sites for Great Spotted Woodpecker in Comana Forest (★) - GSW nests, (- -) - limit of Comana Natural Park.

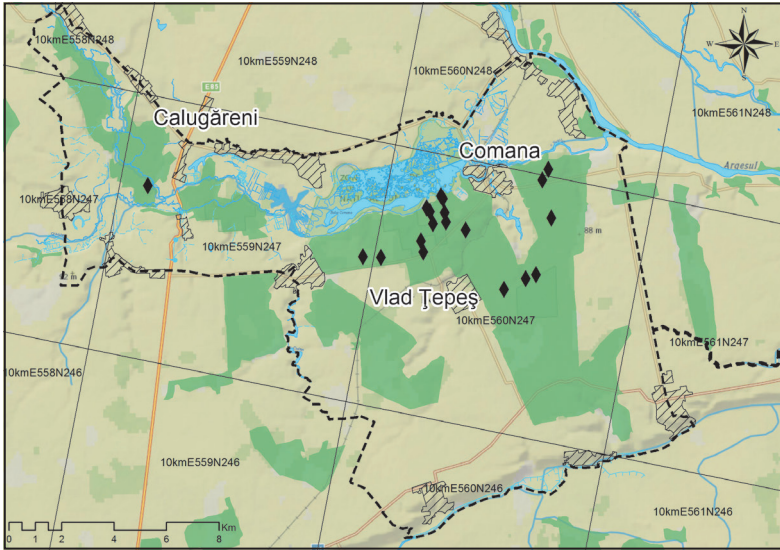


Fig. 2 - Distribution of the nest sites for Middle Spotted Woodpecker in Comana Forest (◆) - nests, (- -) - limit of Comana Natural Park.

(Tab. 1, fig. 3), Turkey oak *Quercus cerris* was the most commonly used tree by *Dendrocopos major* and *D. medius*, followed by Pedunculate oak *Q. robur* and Silver lime *Tilia tomentosa*. For *D. medius*, the differences between selected trees are not significant, although there can be observed a preference for Turkey oak and Silver lime (binomial exact test, $p=0.07$, $\alpha=0.05$). Same for *D. major* (binomial exact test, $p=0.012$, $\alpha=0.05$), it can be observed a preference for Turkey oak and Pedunculate oak. There was also a highly positive selection for dead trees (Fig. 4).

The average breast height diameter (Dbh) of the nesting tree was 33 ± 13.7 cm ($n=20$) in Middle Spotted Woodpecker and 36 ± 12.8 cm ($n=29$) in Great Spotted Woodpecker. Median nest tree Dbh differed significantly between the two species

Table 1
Trees used by Great- and Middle Spotted Woodpecker (N-sample size, dbh-diameter at breast height, *-mean \pm standard deviation).

Species	<i>Dendrocopos medius</i>				<i>Dendrocopos major</i>			
	N	%	dbh*	nest height*	N	%	dbh*	nest height*
<i>Quercus robur</i>	4	20	51 \pm 18.2	9 \pm 1.41	8	28	49 \pm 13.5	11 \pm 3.1
<i>Quercus cerris</i>	7	35	27 \pm 6.2	7.2 \pm 5.11	10	34	27 \pm 3	5.4 \pm 1.8
<i>Tilia tomentosa</i>	6	30	34 \pm 5.2	8.66 \pm 4.71	5	17	30 \pm 2.2	6.7 \pm 3.2
<i>Carpinus betulus</i>	1	5	25	9	1	3	29	4.5
<i>Fraxinus excelsior</i>	0	0	0	0	3	10	37 \pm 3	5.2 \pm 2.4
<i>Quercus frainetto</i>	0	0	0	0	1	3	27	5
<i>Salix alba</i>	0	0	0	0	1	3	65	5
<i>Robinia pseudoacacia</i>	2	10	15	3	0	0	0	0
Total	20	100			29	100		

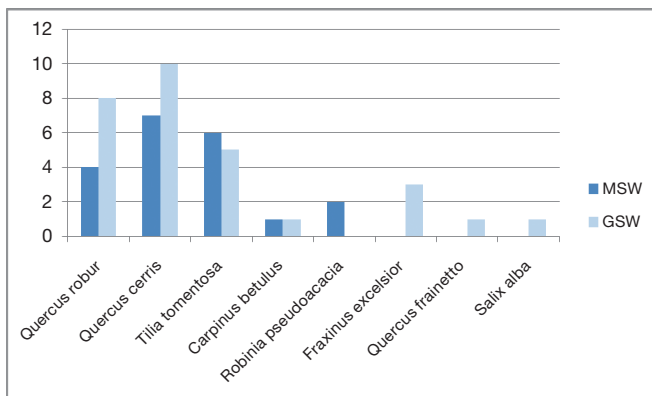


Fig. 3 - Trees used by Great- (GSW) and Middle Spotted Woodpecker (MSW).

($t = 67.464$, $p = 4.3282 \cdot 10^{-24}$) (Fig. 5). The average height of the nest hole from the ground was 7.7 ± 3.6 cm ($n=20$) for Middle Spotted Woodpecker and 7.1 ± 3.4 cm ($n=29$) for Great Spotted Woodpecker. For *Dendrocopos medius* it was found that there is a positive association between tree circumference and nest height $\chi^2=386.84$; $df=19$; $p=2.378 \cdot 10^{-70}$) (Fig. 6). Also, the association was positive for Great Spotted Woodpecker ($\chi^2=779.33$; $df=28$; $p=4.684 \cdot 10^{-146}$) (Fig. 7).

Comparing preferences of woodpeckers for specific trees species as nesting places (seven tree species for *Dendrocopos major* and five for *D. medius*), applying Kruskal-Wallis non-parametric ANOVA, it showed a significant difference between species ($p=1.01 \cdot 10^{-8}$). Applying Tukey post-hoc test we found that there is a significant difference about the selection preferences for nesting regarding tree species. Hereby, for Great Spotted Woodpecker, there are significant differences between the preference for hornbeam *Carpinus betulus* and Turkey oak *Quercus cerris* (Tukey post-hoc, $p=0.00014$), the woodpecker strongly preferring the Turkey oak. The same, regarding Turkey oak and other tree species, ash *Fraxinus excelsior* ($p=0.00049$), Hungarian oak *Q. frainetto* ($p=3.36 \cdot 10^{-05}$) and White willow *Salix alba* ($p=3.36 \cdot 10^{-05}$). Also, between selection of Turkey oak, Pedunculate oak and

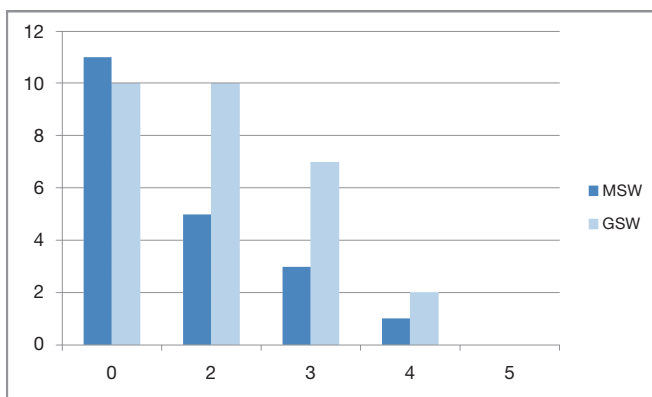


Fig. 4 - Decaying state of trees used by Great- (GSW) and Middle Spotted Woodpecker (MSW), on a 1 to 5 scale: 1- dead, 5-alive.

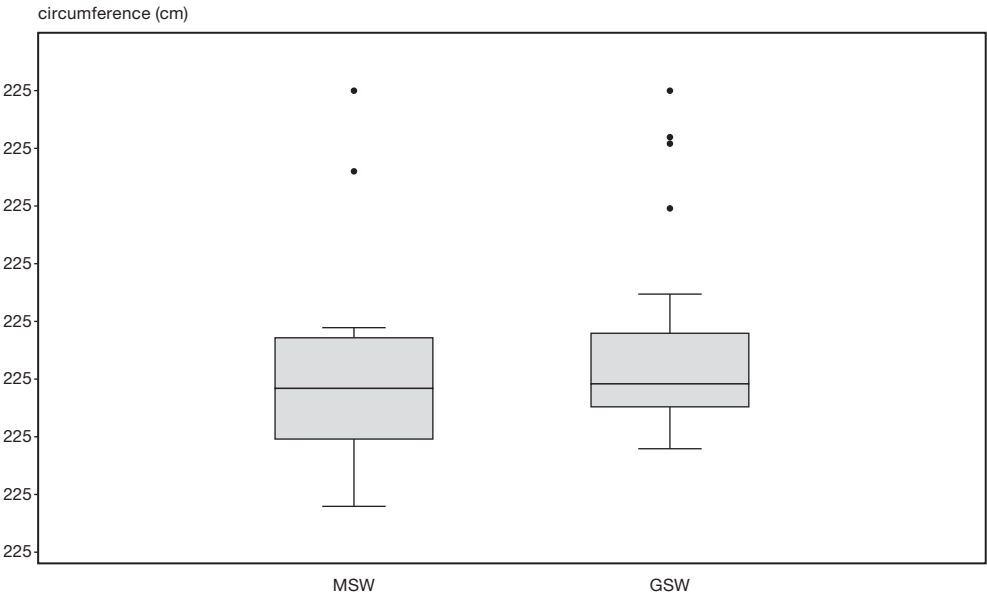


Fig. 5 - Differences of nest-trees circumference between *Dendrocopos medius* (MSW) and *D. major* (GSW).

lime, there are no differences regarding the nesting preferences, Great Spotted Woodpecker nesting often in those trees.

Middle Spotted Woodpecker has the same nesting preferences for Turkey oak, lime and Pedunculate oak, but it can choose also hornbeam *C. betulus* and

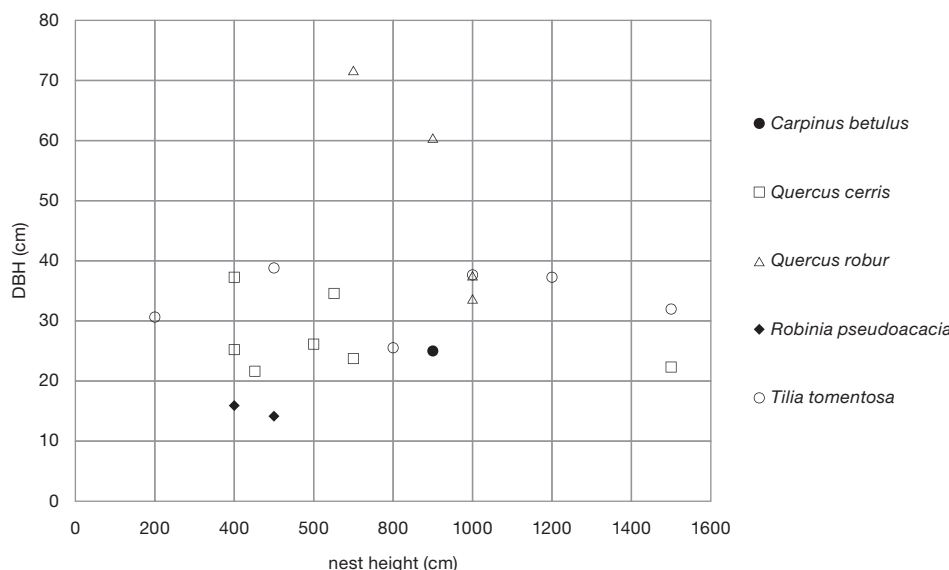


Fig. 6 - Relation between tree diameter (DBH) and nest height in Middle Spotted Woodpecker.

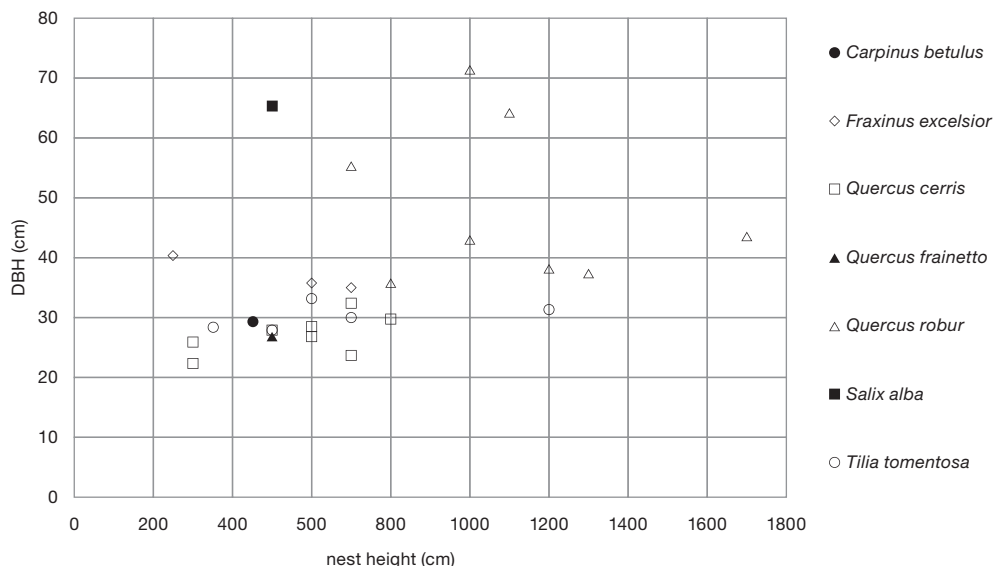


Fig. 7 - Relation between tree diameter (DBH) and nest height in Great Spotted Woodpecker.

even black locust *Robinia pseudoacacia*. Choosing between Turkey oak and hornbeam there are statistic significant differences ($p = 0.00014$), *Dendrocopos medius* preferring the Turkey oak for nesting, but between Turkey oak and lime ($p = 0.1834$) or Pedunculate oak ($p = 0.2729$), data do not differ significantly. Hereby, Middle Spotted Woodpecker is more selective in terms of tree species than the Great Spotted Woodpecker, choosing only five species of trees for nesting.

The orientation of the nest hole on the tree was mainly NE-E-SE for Middle Spotted Woodpecker (Fig. 8) and N-NE-E for Great Spotted Woodpecker (Fig. 9). In other studies, the orientation of the nest hole was SE and NE for *D. medius* and S, NE and NW for *D. major*, but the orientation is believed to be related with the slope (Glăvan, 2004). In our case, the slope was not a criteria factor.

Vegetation around the nest tree was recorded on 10 m radius from the tree and identified according to Habitats of Romania (Doniță et al., 2005). We recorded 5 plant association for nesting habitat of Middle Spotted Woodpecker, 50% of the nest being placed in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski type of association, followed by *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu 1971), corr Popescu et Sanda, 1992 and *Lychnio coronariae-Quercetum cerris* Sanda et Popescu, 2003 (Tab. 2). Also, 45% of Great Spotted Woodpecker nests were identified in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949 type of forest, followed by *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992 (Tab. 3).

In conclusion, Great Spotted Woodpecker and Middle Spotted Woodpecker in Comana forest do not differ very much in terms of nesting preferences, with the difference that *D. medius* is more selective about tree species. The woodpeckers nesting preferences depends on the forest composition. In a mosaic of forest plant associations, the two woodpecker species choose to nest more frequently in *Quercetum farnetto-cerris* (Georgescu, 1945) Rudski, 1949 and *Melico uniflorae-Tilietum tomentosae* (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992. In

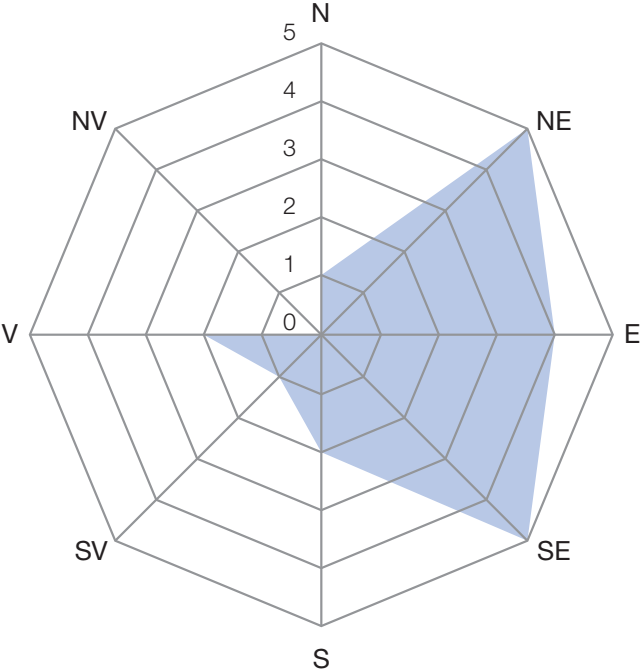


Fig. 8 - Nest hole orientation for *Dendrocopos medius*.

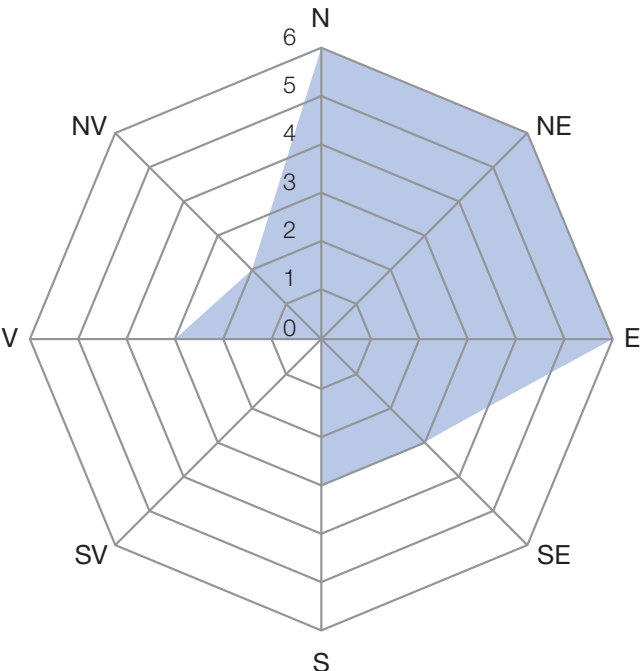


Fig. 9 - Nest hole orientation for *Dendrocopos major*.

Table 2

Plant associations selected by *Dendrocopos medius* as nesting habitat (N - sample size, * - mean±standard deviation).

%	N	Plant association	Cover (%)*
5	1	<i>Bromo sterilis-Robinetum pseodacaciae</i> (Pócs, 1954) Soó, 1964	75
20	4	<i>Lychnio coronariae-Quercetum cerris</i> Sanda et Popescu, 2003	80±9.1
20	4	<i>Melico uniflorae-Tilietum tomentosae</i> (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992	80±7.1
5	1	<i>Ornithogalo-Tilio-Quercetum</i> A. Dihoru, 1976	90
50	10	<i>Quercetum farnetto-cerris</i> (Georgescu, 1945) Rudski, 1949	75.5±10.9
100	20	Total	

Table 3

Plant associations selected by *Dendrocopos major* as nesting habitat (N - sample size, * - mean±standard deviation).

%	N	Plant association	Cover (%)*
3	1	<i>Fraxino pallisae-angustifoliae-Quercetum roboris</i> Popescu et al., 1979	80
14	4	<i>Lychnio coronariae-Quercetum cerris</i> Sanda et Popescu, 2003	76.3±7.5
28	8	<i>Melico uniflorae-Tilietum tomentosae</i> (Sanda et Popescu, 1971), corr Popescu et Sanda, 1992	83.7±5.2
7	2	<i>Ornithogalo-Tilio-Quercetum</i> A. Dihoru, 1976	82.5
3	1	<i>Polygonato latifolio - Quercetum roboris</i> (Hargitai, 1940) Borhidi, 1966 in Borhidi et Kevey, 1996	70
45	13	<i>Quercetum farnetto -cerris</i> (Georgescu, 1945) Rudski, 1949	80±9.1
100	29	Total	

related literature, it was found that *D. major* prefers living trees from species like *Populus tremula*, *Fagus sylvatica*, *Quercus petrea*, *Quercus robur*, *Tilia cordata* and *D. medius* nests mostly in dead wood, preferring *Fagus sylvatica*, *Tilia cordata*, *Fraxinus excelsior* as nesting trees (Glăvan, 2004).

We found that *D. medius* can choose as nesting site Black locust *Robinia pseudoacacia*, a tree with extremely hard wood, resistant to rot and toxic when is alive, woodpeckers avoiding it as nesting place, except for Great Spotted Woodpecker. The nests were found in decaying snags, probably old nests of Great Spotted Woodpecker, which proofs again the importance of old and decaying trees for woodpeckers, especially when other tree species are not available. In literature, we found only one case of nesting in Black locust for *D. medius* (Mazgajski, 1997 in Pasinelli, 2003). This aspect, together with the results related to the preference for large oaks and lime and decaying wood bring the base information for a specific management action plan for the conservation of the species and the forest in this protected area.

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PREFERINȚELE DE CUIBĂRIT LA DOUĂ SPECII DE CIOCĂNITORI
(*DENDROCOPOS MAJOR* ȘI *DENDROCOPOS MEDIUS*), ÎN PĂDUREA COMANA,
SUDUL ROMÂNIEI

REZUMAT

Scopul principal al acestui studiu este de a obține o mai bună înțelegere a nevoilor pe care ciocănitoarea pestriță mare și ciocănitoarea de stejar le au pentru habitatul în care trăiesc. Ciocănitorele sunt specialiști pădurii, fiind amenințate cu dispariția în întreaga Europă, mai ales prin distrugerea habitatelor forestiere precum și prin pierderea calității habitatului, prin reducerea surselor de hrană și a locurilor de cuibărit. Ambele specii au aratat o preferință puternică pentru stejari, tei, arbori mari și lemn mort pentru cuiburi, dar Ciocănitoarea de stejar s-a dovedit a fi mai selectivă în ceea ce privește speciile de arbori. Înălțimea cuibului a fost influențată de diametrul copacului. Ambele specii au aceleași preferințe de cuibărit pentru cer, tei și stejarul pedunculat, într-o pădure de tipul *Quercetum farnetto-cerris*. Orientarea intrării în cuibul din arbore a fost în principal NE-E-SE pentru ciocănitoarea de stejar și N-NE-E pentru ciocănitoarea pestriță mare.

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THE BIRD FAUNA FROM LOTRIOARA RIVER BASIN (LOTRU MOUNTAINS, ROMANIA)

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Abstract. The results of a one year study of bird communities from the Lotrioara River Basin (Lotru Mountains, Romania), using the transect method along the main valley, are presented. The study aimed to reveal the characteristics of the community's dynamics, both from spatial and temporal point of view. During the research period 70 species belonging to 9 orders were identified in the investigated area. The number of species decreases with the altitude, but it is also related to the heterogeneity of habitats. During the year the species' number varies from a minimum in winter to a maximum in spring. Insectivores are the prevailing feeding guild in the bird communities from Lotrioara basin, but during the cold season the dominance is taken over by omnivorous and granivorous species.

Résumé. On présente les résultats d'une étude des communautés des oiseaux du bassin de la rivière Lotrioara (Lotru Montagnes, Roumanie), en utilisant la méthode des transects au long de la vallée principale. L'étude visait à révéler les caractéristiques de la dynamique de l'ornithofaune, du point de vue spatial et temporel. Au cours de la période de recherche 70 espèces appartenant à 9 ordres ont été identifiées dans la zone étudiée. Le nombre d'espèces diminue avec l'altitude, mais il dépend aussi de l'hétérogénéité des habitats. Au cours de l'année, le nombre des espèces varie d'un minimum en hiver à un maximum en printemps. La structure trophique des communautés d'oiseaux dans le bassin Lotrioara est dominée par les insectivores, mais pendant la saison froide, la domination est prise par les omnivores et granivores.

Key words: elevational gradient, species richness, feeding guilds, bird phenology.

INTRODUCTION

Birds are a well studied group in Romania, with many papers concerning the ornithofauna of different areas. Although most of them deal with wetlands and lowlands, some researches were carried out also in the Carpathians. The first data concerning birds from mountain areas in Romania date back to the 19th century. Stetter made the first avifaunal list of Transylvania, published in 1845. Several other naturalists working in the Carpathians made notes also on birds, among them A. Berger, J. Csato, W. Hausmann, O. Hermann, M. von Kimakovicz. Their data, along with his own observations, were synthesized by Bielz (1888) in the volume concerning the vertebrates of Transylvania. He cites among others, species that are currently extinct from Romania, like the three species of vultures: *Aegypius monachus*, *Gyps fulvus* and *Gypaetus barbatus*.

During the 20th century several ornithologists published papers concerning the bird fauna from different mountain areas. In the last two decades some studies were carried out in some of the South Carpathian massifs, namely Piatra Craiului (Petrescu, 1995), Făgăraș (Petrescu, 2005) and the neighbouring Cindrel Mountains (Murariu et al., 2009 a), where 92 species were found over a period of more than 135 years of observations. Other articles deal with a series of ecological aspects of bird communities. An ornithological zonation along vertical (elevation) and horizontal gradients, based on data from literature and personal observations, is presented by several authors: Papadopol (1992), Radu (1973), Papadopol and Petrescu (1992) and

others. Recently, Mestecăneanu (2008) published a paper on the monthly dynamics of bird communities from a dam lake in Iezer-Păpușa massif.

In this paper we present the results of the first study on the bird fauna done in Lotru Mountains. Up to the present there are only scarce data available on birds from this area, most of them dating back to the 19th century when Kimakowicz made several observations at Prejba, mentioning *Tetrao urogallus*, *Apus melba*, *Regulus regulus*, *Eremophila alpestris* and *Loxia curvirostra* (Bielz, 1888). The only recently published data concern a female capercaillie (*T. urogallus*) and her 10 chicks (Roberts, 2000).

The present study highlights the variation of the ornithofauna, both in space (along the elevational gradient) and time (seasonally). It also reveals the changes occurred in its trophic structure.

STUDY AREA AND METHODS

Lotrioara River Basin is part of Lotru Mountains (Southern Carpathians), being placed in the middle of Romania (Fig. 1). Lotrioara is a right side tributary of the Olt River. Its river basin has 117 km² and the largest part is covered by natural or planted forests, from deciduous in the lower part, to coniferous in the upper areas. The valleys are mostly narrow, with steep slopes. However, in the lower sector Lotrioara valley is open and wide, and a traditional village was established here, resulting in a large forest clearing, now occupied by orchards and hayfields. Originally stretching on 1.5 km, during the last years the village has expanded by new buildings down- and upstream. In the river basin, small areas are occupied by secondary mountain meadows, resulted from deforestation. Subalpine shrubs are found only on the highest peaks, on the southern slope. On Sterpu Peak (2143 m), above the subalpine shrubs, an alpine meadow can also be distinguished.

The investigations were carried out monthly during one year, using the transect method. Five transects, coded from I to V, were established along the main



Fig. 1 - Position of the research area and the five transects.

valley and in the upper sector on the left side slope, from upstream the confluence with Olt River (420 m), up to Prejba Chalet (1660 m) (Fig. 1). Transect I is a sector in the beech forest near the confluence, including Lotrioara village, II and III are transects in the mixed forest along Lotrioara Valley and one of its tributaries - Pârâul Cailor, IV crosses a slope covered by a young spruce plantation, and V is a transect in an ecotone area, at the limit between an old spruce forest and secondary meadows near Prejba Chalet. Besides these transects other observations were made along the way to Sterpu Peak. The data were included in tab. 1 in a separate column, noted as transect VI, and were included only in some of the analysis (the seasonal dynamics and the trophic structure).

A cluster analysis based on the Jaccard index was performed in order to assess the similarity of bird fauna structure in the four seasons and at different elevations.

The bird species were ascribed to the feeding guilds according to their prevailing food (Bezzel, 1996), while their phenological status was established based on the observations during the present research. The dependence of the trophic structure of bird fauna on season and the altitude were tested by Pearson chi-square test of independence.

RESULTS

During the one year study, 70 species of birds belonging to 9 orders, were identified in Lotrioara River Basin. Among them, the best represented are the orders Passeriformes (49 species), Falconiformes (9 species) and Piciformes (5 species), the systematics being according to Bruun et al. (1999).

The list of the observed species is given in table 1, with the mention of the seasonal and altitudinal occurrence, as well as their inclusion in the annexes II (strictly protected fauna species) and III (protected fauna species) of the Convention on the Conservation of European Wildlife and Natural Habitats (known as the Bern Convention) (<http://conventions.coe.int/Treaty/en/Treaties/Html/104.html>) (column BC in tab. 1), Annex I (species subject of special conservation measures concerning their habitat) of the Directive 2009/147/EC (known as the Birds Directive) (<http://ec.europa.eu/environment/nature/legislation/birdsdirective>) (column BD) and their conservation status (VU-vulnerable, EN-endangered, CR-critically endangered) according to the Red Book of Romanian Vertebrates (Munteanu, 2005) (column RB). The codes used for seasons are: W - winter (observations from December to February), SP - spring (March to May), SM - summer (June to August), A - autumn (September to November).

The species richness remains relatively constant during the warm period of the year, with a slight decrease from spring, when the maximum number of species (41) was recorded, till autumn, but is lower during winter, when the species' number (23) drops to a little more than half.

The number of bird species decreases constantly (a difference of 5 species between consecutive sectors) on altitude. The only exception is represented by the sector V (spruce forest and montane meadow), where a higher number of species than in the previous one was observed. A high number of species (42) was recorded apart from these transects, on the way to Sterpu Peak. This is the sole part of the river basin where subalpine *Pinus mugo* shrubs and rocky meadows can be found, as well as an alpine meadow covering a small area around the peak. The alpine and subalpine meadows are the typical habitats for *Anthus spinoletta* and *Prunella*

Table 1

The bird species observed in Lotrioara River Basin and their seasonal and altitudinal distribution
(the codes are explained in the text).

No.	Species	Season				Sector						BC	BD	RB
		W	SP	SM	A	I	II	III	IV	V	VI			
1.	<i>Aquila pomarina</i>			+							+	II	I	VU
2.	<i>Hieraaetus pennatus</i>			+	+				+		+	II	I	CR
3.	<i>Circetus gallicus</i>			+							+	II	I	VU
4.	<i>Buteo buteo</i>	+	+	+	+	+	+	+	+		+	II		
5.	<i>Pernis apivorus</i>			+							+	II	I	VU
6.	<i>Accipiter gentilis</i>		+	+	+	+	+	+	+		+	II		
7.	<i>Accipiter nisus</i>	+		+	+	+	+	+			+	II		
8.	<i>Falco subbuteo</i>			+	+					+	+	II		
9.	<i>Falco tinnunculus</i>			+							+	II		
10.	<i>Tetrao urogallus</i>	+		+	+		+		+	+	+	III	I	
11.	<i>Bonasa bonasia</i>	+		+	+			+	+	+		III	I	
12.	<i>Columba palumbus</i>		+	+						+	+			
13.	<i>Cuculus canorus</i>		+	+		+	+		+			III		
14.	<i>Strix uralensis</i>		+	+			+				+	II	I	
15.	<i>Upupa epops</i>			+			+					II		VU
16.	<i>Picus canus</i>				+			+				II	I	
17.	<i>Dendrocopos major</i>	+	+	+	+	+	+				+	II		
18.	<i>Dendrocopos minor</i>				+		+					II		
19.	<i>Dryocopus martius</i>				+					+		II	I	
20.	<i>Jynx torquilla</i>			+						+		II		EN
21.	<i>Alauda arvensis</i>		+							+		III		
22.	<i>Hirundo rustica</i>		+	+		+						II		
23.	<i>Delichon urbica</i>			+	+	+					+	II		
24.	<i>Anthus spinoletta</i>			+							+	II		
25.	<i>Anthus trivialis</i>			+	+				+	+		II		
26.	<i>Motacilla cinerea</i>		+	+	+	+	+	+			+	II		
27.	<i>Motacilla alba</i>		+	+	+	+	+	+		+	+	II		
28.	<i>Lanius collurio</i>		+	+		+	+		+		+	II		
29.	<i>Sturnus vulgaris</i>		+	+		+								
30.	<i>Garrulus glandarius</i>	+	+	+	+	+	+	+	+	+	+			
31.	<i>Nucifraga caryocatactes</i>	+	+	+	+	+	+	+	+	+	+	II		
32.	<i>Corvus corax</i>	+	+	+	+	+	+	+	+	+	+	III		EN
33.	<i>Cinclus cinclus</i>	+	+	+	+	+	+	+			+	II		
34.	<i>Troglodytes troglodytes</i>	+	+	+	+	+	+	+	+	+	+	II		
35.	<i>Prunella collaris</i>			+							+	II		
36.	<i>Prunella modularis</i>		+	+		+	+	+	+		+	II		
37.	<i>Sylvia atricapilla</i>		+	+	+	+	+	+	+	+	+	II		
38.	<i>Sylvia curruca</i>		+	+		+			+		+	II		
39.	<i>Phylloscopus trochilus</i>		+	+			+	+	+			II		
40.	<i>Phylloscopus collybita</i>		+	+	+	+	+	+	+		+	II		
41.	<i>Phylloscopus sibilatrix</i>			+							+	II		
42.	<i>Regulus regulus</i>	+	+	+	+		+	+	+	+	+	II		
43.	<i>Regulus ignicapillus</i>		+		+	+	+	+				II		
44.	<i>Ficedula parva</i>			+					+			II	I	
45.	<i>Muscicapa striata</i>			+							+	II		
46.	<i>Phoenicurus phoenicurus</i>		+	+		+					+	II		
47.	<i>Phoenichurus ochruros</i>		+	+	+	+				+	+	II		
48.	<i>Erethacus rubecula</i>		+	+	+	+	+	+	+	+	+	II		
49.	<i>Turdus torquatus</i>			+						+		II		
50.	<i>Turdus merula</i>		+	+	+	+	+	+	+	+	+	III		
51.	<i>Turdus philomelos</i>		+	+	+	+	+	+				III		
52.	<i>Turdus viscivorus</i>		+	+	+			+		+		III		
53.	<i>Turdus pilaris</i>		+			+						III		
54.	<i>Parus montanus</i>	+	+	+	+	+	+	+	+	+	+	II		
55.	<i>Parus cristatus</i>	+	+	+	+		+	+		+	+	II		
56.	<i>Parus caeruleus</i>	+	+	+	+	+	+	+	+	+		II		
57.	<i>Parus ater</i>	+	+	+	+	+	+	+	+	+	+	II		
58.	<i>Parus major</i>	+	+	+	+	+	+	+	+			II		
59.	<i>Aegithalos caudatus</i>	+	+		+	+	+	+	+	+		II		
60.	<i>Sitta europaea</i>	+	+	+	+	+	+	+				II		
61.	<i>Certhia familiaris</i>	+	+		+	+	+	+		+		II		
62.	<i>Fringilla coelebs</i>	+	+	+	+	+	+	+	+	+	+	III		
63.	<i>Pyrrhula pyrrhula</i>	+		+	+	+		+	+	+	+	III		
64.	<i>Coccothraustes coccothraustes</i>			+		+						II		
65.	<i>Carduelis spinus</i>	+			+	+	+	+		+		II		
66.	<i>Carduelis carduelis</i>		+		+	+	+			+		II		
67.	<i>Carduelis cannabina</i>				+	+						II		
68.	<i>Loxia curvirostra</i>	+		+	+					+	+	II		
69.	<i>Emberiza cia</i>		+			+						II		
70.	<i>Emberiza citrinella</i>		+	+		+					+	II		
Total		23	41	40	38	42	37	32	28	29	42	67	10	7

collaris, which were observed only here. Other 6 species were also found only along this transect: *Phylloscopus sibilatrix*, *Muscicapa striata*, *Pernis apivorus*, *Aquila pomarina*, *Falco tinnunculus* and *Delichon urbica*. The last two species were observed near Sterpu Peak as well.

Both the species number and the specific structure of bird communities remain relatively constant during the warm period of the year. Thus, the cluster analysis of the four seasons based on Jaccard similarity index (Fig. 2) shows a high homogeneity of the warm seasons, while during winter, the most distinctive bird fauna is found. The same analysis, performed along the altitudinal gradient, also reveals a gradual change in the ornithofauna, different transects joining by the increase in elevation (Fig. 3). However, the highest similarity (0.73 in terms of Jaccard index) was calculated not for the first two transects, but for transects II and III, both situated in the mixed forest vegetation level, joined at a greater distance (0.57) by transect I, which crosses the village. The most distinctive fauna (0.35) was found in transect V, situated at the highest elevation, but also along an ecotone.

Based on the birds' observed presence in the research area, we established three phenological categories: sedentary species - encountered during the entire study period, warm season species - observed during spring, summer and autumn but not found in winter, and wintering species. As several less abundant species were only seldom observed (some in a single transect), we do not have the evidence of breeding for all the species recorded during the warm period of the year. The

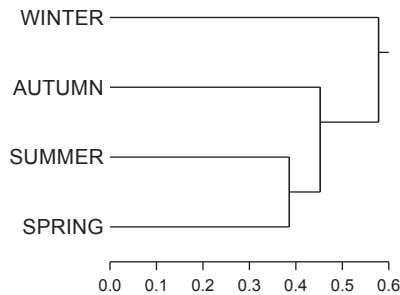


Fig. 2 - Similarity (1-Jaccard index values) between the four seasons based on the bird fauna.

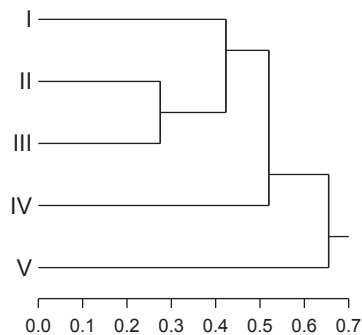


Fig. 3 - Cluster analysis of the five transects, based on the similarity (1-Jaccard index values) between their bird fauna.

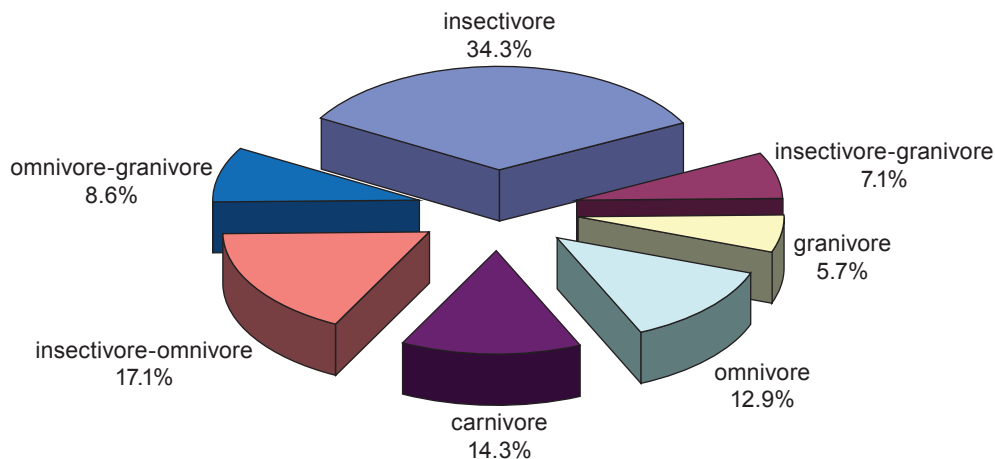


Fig. 4 - Trophic structure of bird community (% of species) from the Lotrioara River Basin during the study period.

warm season birds are the most numerous species, representing 67.1%, while the sedentary birds make up only 31.4% of the species.

Among the feeding guilds the insectivores are prevailing, representing 34.3% (Fig. 4) and, as the antropic impact on the valley is low, the carnivorous species are also well represented in the area (14.3%). However, many bird species, especially insectivores, change their diet during the year, according to the availability of different food sources. Some species feed during the breeding season exclusively (or mainly) on insects, but switch during winter to an exclusively vegetal (e.g. *Emberizidae*) or omnivorous diet (e.g. *Turdidae*), dominated by fruits (berries) and seeds. These species are included in two separate groups with a variable trophic regime, insectivores-granivores (7.1%) and the insectivores-omnivores (17.1%). The omnivores (12.9%) (belonging to *Corvidae* and *Paridae* families) have a mixed trophic regime all year round, although a shift in the prevailing food resource exploited by these birds also occurs with the change of seasons (Bezzel, 1996).

The Pearson chi-square test for independence revealed significant differences ($\chi^2 = 18.56$, d.f.= 3, $p < 0.01$) between the ratios of feeding guilds in the breeding season (from late spring to late summer) and in the rest of the year (from beginning of autumn to early spring), showing a seasonal dynamics of the bird fauna trophic structure.

An important change is recorded by granivores, which increase in ratio from 5.8% during the breeding season to 30.4% in winter (Fig. 5). Omnivores also become more numerous, prevailing during the cold season (43.4%). In contrast, insectivores decrease from 59.4% in the breeding season to 17.7% in winter. Carnivores present a low amplitude of variation along the year.

Concerning the altitudinal distribution of the feeding guilds, the most evident characteristic is the variation of granivores, which reach the highest ratio (10.3%) in the uppermost sector (V), where numerous species which turn in winter to vegetarian diet (*Fringillidae*) also occur. However, the Pearson chi-square test for independence indicates no significant dependence of the trophic structure on the elevation.

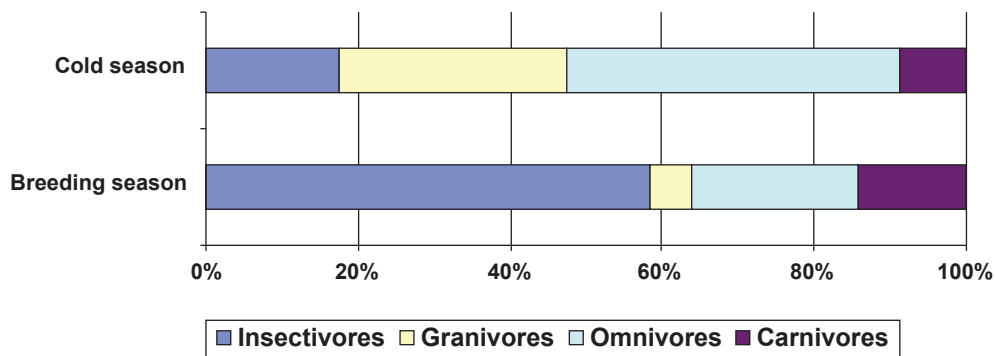


Fig. 5 - Seasonal dynamics of feeding guilds (% of species) in the ornithofauna from Lotrioara River Basin.

DISCUSSIONS

The 70 identified bird species make Lotrioara River Basin comparable to other researched mountain areas. Based on observations during the breeding season Petrescu notes 64 bird species from Făgăraș Mountains (2005) and 76 from Piatra Craiului (1995), Murariu et al. (2009 b) 74 species (among them 10 mentioned only in the literature) from Zarand Mountains. During the 22 months study in the Râșor dam lake area (Iezer-Păpușa Mountains) Mestecăneanu (2008) recorded 69 bird species. However, these results cannot be compared directly, due to the differences in the research methodology and habitat structure from the study areas.

Lotrioara River Basin is a mountain area typical for the Southern Carpathians, characterised by a relatively low human impact, especially in its upper part. The high proportion of species included in the annexes of Bern Convention (95.7%, 80% being strictly protected - annex II), Bird Directive (14.2%) and in the Red Book of Romanian Vertebrates (10%, four species being considered vulnerable, two endangered and one critically endangered) confirms the conservative interest of this area, included in the ROSPA0043 Frumoasa, being one of the Important Bird Areas in Romania - AIA RO051 (Papp & Fântână, 2008).

Considering the elevational distribution some of the bird species from Lotrioara River Basin can be accounted as eurybiotic, being found in a large variety of habitats, at different altitudes (*Nucifraga caryocatactes*, *Corvus corax*, *Erithacus rubecula*, *Turdus merula*, *Fringilla coelebs*, *Phylloscopus collybita*, *Parus montanus*, etc.). Other species were observed only in the lower sector, or exclusively in the village (*Phoenicurus phoenicurus*, *Hirundo rustica*, *Turdus pilaris*, *Sturnus vulgaris*). The number of birds restricted to higher elevations is small, some of them being linked to the subalpine vegetation level (*Anthus spinoletta*, *Prunella collaris*), others to the spruce forest (*Turdus torquatus*, *Loxia curvirostra*). Thus, the species richness decreases constantly with the increase in altitude. The only exception is represented by the last sector, transect V, which shelters a higher number of species than the previous one, because it crosses a variety of habitats and the ecotone effect is strong. Here we observed birds typical both for mature spruce forests, feeding on the abundant seeds (*Loxia curvirostra*) or insects from the tree trunks (*Dendrocopos martius*, *Jynx torquilla*), and for open habitats (*Alauda arvensis*, *Anthus trivialis*).

The monotonic decrease of species' number with increasing altitude was mentioned by several other authors, in different mountains, both in tropical (Terborgh,

1977; MacKinnon & Phillips, 1993) and temperate (Sackl & Samwald, 1997; Sergio & Perdini, 2007) regions. In many cases the continuous decrease observed along the elevational gradient is the effect of area. If the necessary correction is made, the relationship between species richness and elevation gives in several cases a humpshaped curve (Rahbek, 1995).

Compared to the Romanian bird fauna, the ornithofauna from Lotrioara Basin has a very different phenologic structure. Considering the whole Romanian territory, most of the encountered bird species are sedentary, while in mountains, including the research area, most birds only nest here. The breeding species include the migratory birds (*Phylloscopus collybita*, *Sylvia atricapilla*, *Hirundo rustica*, *Cuculus canorus*) but also non-migratory species that during winter are found at lower elevations (*Turdus merula*, *T. viscivorus*, *Coccothraustes coccothraustes*, *Carduelis carduelis*). The relatively small proportion of sedentary species is due to the insufficient resources offered by the area in the cold season. Most of the resident species (*Garrulus glandarius*, *Nucifraga caryocatactes*, *Corvus corax*, *Parus montanus*, *P. ater*) are found during the whole year up to Prejba Chalet, while a smaller number (*P. major*, *Fringilla coelebs*, *Troglodytes troglodytes*) are present during winter only in the lower parts of the valley. The species which descend to lower altitudes during the cold season, whether they leave the basin or not, in spring return gradually up to the maximum elevation. Thus, *Turdus merula* was found in March in sectors I and II, in April in sectors I, II, III and in June up to Prejba Chalet. Contrary, the migratory species advance generally much faster on altitude. Thus, *Phylloscopus collybita* was first observed in April, being noted in the same day up to the maximum altitude where it was recorded, and *Motacilla alba* was observed in March next to Prejba Chalet.

The species not observed in winter are not necessarily completely absent from the research area in this season, but their densities are decreased, most of the individuals having left the valley for some more suitable areas.

Among the feeding guilds, the prevailing insectivores include birds feeding on insects mainly in the canopy (*Phylloscopus* spp., *Regulus* spp., *Aegithalos caudatus*), on the tree stems (*Dendrocopos minor*, *Dryocopus martius*), in the air (*Delichon urbica*, *Hirundo rustica*), on the ground (*Motacilla alba*, *Anthus spinoletta*), and also two species living exclusively along the river courses (*Cinclus cinclus* and *Motacilla cinerea*), which feed on aquatic invertebrates. The latter are included by some authors (Stănescu, 1971) in a separate feeding guild, the potamotrophs. Most species belonging to this group are breeding species, as insects are a resource available mainly in the warm season, being the most important food for the growing chicks. Thus, the strong decrease of the insectivores' ratio during winter is due to the migration of some species (*Phylloscopus* spp., *Delichon urbica*, *Hirundo rustica*, *Lanius collurio*) and to the fact that other species (*Turdus* spp., *Fringilla coelebs*) switch to vegetal food. The shift in the birds' diet occurs at the end of the breeding season, at the end of summer and beginning of autumn, when fruits and seeds become an accessible food resource, and becomes stronger in winter, when insects and other invertebrates are scarce and difficult to reach.

In turn the ratio of granivores increases significantly during the cold season. Their food includes seeds and fruits of trees, both deciduous (*Carduelis spinus*, *Pyrrhula pyrrhula*) and coniferous (*Loxia curvirostra*), but also herbaceous plants (*Carduelis cannabina*, *C. carduelis*). The slight increase of granivores' ratio at higher elevations was observed also in other studies (Klosius, 2008). However, like in our case, the differences were not significant.

Conclusions

During this study in Lotrioara River Basin 70 bird species belonging to 9 orders were recorded. The spatial dynamics of the community is characterised by the decrease of species' number with the increase in altitude. However, this relation is not always linear, being influenced also by the habitat heterogeneity. Transects are clustered depending on altitude and habitat type. The bird community from Lotrioara River Basin is dominated by the breeding species, a few species being adapted to the harsh environmental conditions in the mountain valleys during winter. Insectivores prevail in the community, but significant seasonal variations are recorded, during winter omnivores and granivores becoming dominant.

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AVIFAUNA DIN BAZINUL RÂULUI LOTRIOARA (MUNȚII LOTRULUI, ROMÂNIA)

REZUMAT

Sunt prezentate rezultatele unui studiu asupra comunităților de păsări din bazinul râului Lotrioara (Munții Lotrului, România), desfășurat pe parcursul unui an, utilizând metoda transectelor de-a lungul văii principale. Cercetările au urmărit caracteristicile dinamicii ornitofaunei, atât din punct de vedere spațial cât și temporal. Pe perioada studiului au fost identificate, în zona cercetată, 70 de specii aparținând la 9 ordine. Numărul de specii scade cu creșterea altitudinii, însă această descreștere nu este liniară, ci depinde și de heterogenitatea habitatelor. Pe parcursul anului, numărul speciilor variază de la un minim iarna la un maxim în timpul verii. Structura trofică a comunităților de păsări din bazinul râului Lotrioara este dominată de insectivore, dar în perioada rece a anului dominanța este preluată de omnivore și granivore.

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TERRESTRIAL SMALL MAMMAL COMMUNITIES FROM HÂRTIBACIU PLATEAU (ROMANIA)

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ADRIAN RĂULEA, ADRIANA VORNICU

Abstract. Small mammal communities were studied by live trapping during August-September 2010 and June-September 2011 in three localities from Hârtibaciu Plateau, in southern Transylvania. The area is situated between 420 and 550 m a.s.l., and represents a mosaic of small patches of different land use. 200 traps were set in lines for three consecutive nights, in 80 different habitats representing 12 habitat types, both cultivated and semi-natural. 1235 small mammals belonging to 15 species (four soricomorphs and 11 rodents) were captured. Abundance of small mammals was expressed by means of capture index (number of individuals caught per 100 active trap-nights). The community structure was strongly shaped by habitat type, even in case of small land patches. *Microtus arvalis* prevailed in the investigated area, being the dominant species in open fields with high grassy vegetation. The density of this species increased strongly from the beginning of summer to autumn, when the traps were occasionally saturated with field voles.

Résumé. Les communautés de petits mammifères ont été étudiées en utilisant des pièges pour la capture des animaux vivants, pendant Août-Septembre 2010 et Juin-Septembre 2011 dans trois localités du Plateau Hârtibaciu, dans le sud de la Transylvanie. La zone est située entre 420 et 550 m altitude et représente une mosaïque de petites parcelles de différentes utilisations. 200 pièges ont été installés dans les transects linéaires pour trois nuits consécutives, dans 80 habitats différents représentant 12 types d'habitats, cultivés et semi-naturels. 1235 petits mammifères, appartenant à 15 espèces (quatre musaraignes et 11 rongeurs) ont été capturés. L'abondance des petits mammifères a été exprimée par l'index de capture (nombre d'individus capturés par 100 pièges-nuits actifs). La structure de la communauté de petits mammifères a été fortement influencée par le type d'habitat, même en cas de petites parcelles. *Microtus arvalis* a prévalu dans la zone étudiée, étant l'espèce dominante dans les champs ouverts avec végétation herbeuse haute. La densité de cette espèce a augmenté à partir du début de l'été jusqu'à l'automne, lorsque les pièges ont été occasionnellement saturés avec campagnols agrestes.

Key words: rodents, shrews, live trapping, community structure, habitat preferences.

INTRODUCTION

Hârtibaciu Plateau is an area of great conservation importance in Romania, being part of the Site of Community Importance ROSCI0132 Oltul Mijociu-Cibin-Hârtibaciu. It is a mosaic of habitats in an almost natural state, which shelters a high biodiversity. Several studies were made on different groups, mainly plants and birds, but information on the mammal fauna is scarce. The only published research (Benedek, 2007) presents the data obtained by live-trapping in September 2003 from four study sites (Retiș, Brădeni, Stejărișu and Dealu Frumos localities) in the upper part of Hârtibaciu River Basin.

The aim of the present study is to widen the knowledge on small mammal communities from different localities in relation to the habitat types and to highlight the seasonal changes in these communities.

STUDY AREA AND METHODS

Between 2010 and 2011, a survey of small mammal communities from different habitat types was carried out in the Hârtibaciu Plateau. In autumn 2010 a field campaign took place in two localities from Hârtibaciu Plateau, namely Benești (named Benești I) and Iacobenii. In 2011 the survey was accomplished during two campaigns, one in summer and the other in autumn (beginning with late August), in Alțâna and Benești, in another area than during the previous year (named Benești II). The survey was carried out by means of CMR (capture-mark-release) method, using plastic handmade box traps (18x8x6 cm) set in lines in different habitats. Each transect included 33 or 34 traps, placed at intervals of 10 m. Six (in 2010) or five (in 2011) trap lines were set at the same time, and traps were checked for three consecutive nights, at dawn and in the evening. In all, 80 transects were established in 12 habitat types: pastures, hayfields, unused lands with low vegetation - margins of roads and railroads - and high vegetation - river and canal banks, corn, wheat and alfalfa fields, abandoned cultures, pastures with sparse shrubs, shrubby pastures with extensive woody vegetation cover, forest edges and hornbeam (*Carpinus betulus*) forests. The position of sampling localities is indicated in fig. 1. The number of transects in each habitat type was proportional to its ratio in the area, so that the results give a sound image of the structure and abundance of small mammal communities from the investigated zones.

The traps were baited with sunflower seeds and apple slices. No prebaiting was done. No bedding material was provided, but the traps were set in shady places or when not possible, hay cover was provided in order to avoid overheating of captured animals. The captured specimens were identified to species based on morphological characters (Murariu, 2000; Popescu & Murariu, 2001), marked by fur clipping on

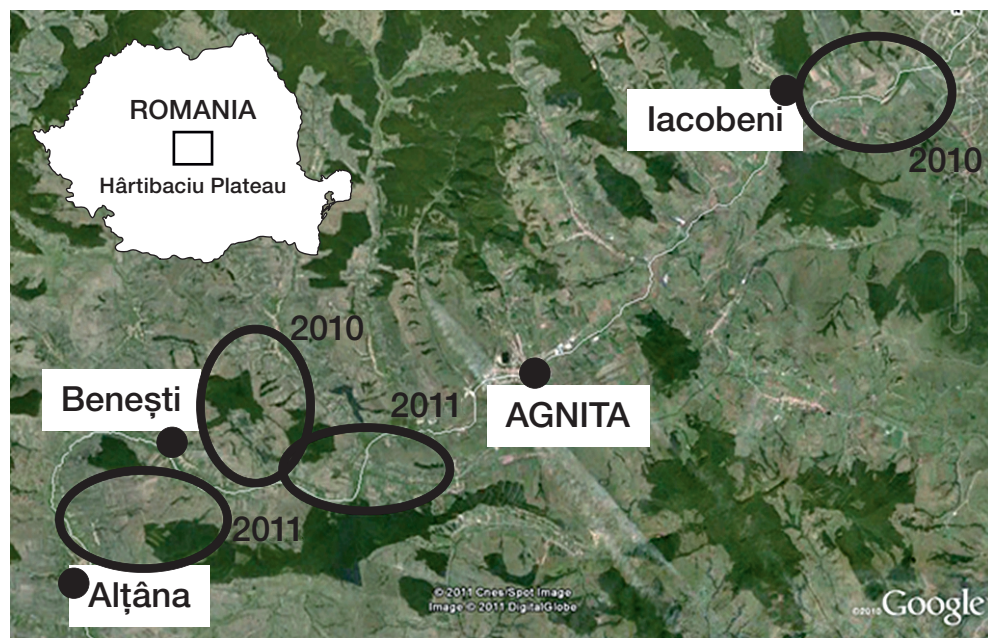


Fig. 1 - Study area in Hârtibaciu Plateau with sampling localities and the year of sampling.

the rear part of the back, and released. In case of mice belonging to *Apodemus* genus (*A. flavicollis*, *A. sylvaticus*, *A. uralensis*) we considered the presence and shape of the collar, the colour of the back and belly, the length of hind foot and the ratio between the lengths of tail and body.

Relative abundance was expressed as the ratio of the species (in percentages) within a sample. Frequency was calculated as the ratio (in percentages) between the trap lines where the species was captured and the total number of trap lines. Abundance, as a measure of population density, was expressed as capture index, meaning the number of captured individuals per 100 active trap-nights (TN). Many traps were disturbed by animals (especially shepherd dogs), rain or wind, destroyed by tractors or cattle, or even stolen, thus of the intended 8010 TN (80 lines with 33-34 traps for 3 consecutive nights) only 5571 TN (69.6%) were effective.

Mystat 12 software was used for data analysis. The significance of correlation between the abundance and frequency of the captured species and between the number of captured species and capture index in different habitat types was tested and its strength expressed by Pearson correlation coefficient. The Pearson χ^2 test of independence was used to test the influence of the locality on the species' ratio (McDonald, 2009). The association between the prevailing species was tested using t test, and its strength was expressed both in qualitative - by means of Fager index (Southwood, 1966) and quantitative terms - proportion of individuals occurring together - we used the modified Whittaker and Fairbanks equation (Southwood & Henderson, 2000), with the range of 0 to 1.

RESULTS

A total number of 1235 individuals were captured, belonging to 15 species, four shrews and 11 rodents. Further three species were identified based on direct or indirect visual observations. The number of specimens captured during the research period, the species' frequency (F%), the trapping effort and the capture index for each site are presented in tab. 1.

The terrestrial small mammal species known to inhabit Hârtibaciu Plateau, based on the data collected during the field campaigns and the previous study carried out in September 2003 (Benedek, 2007), are presented below. Systematics is given according to Wilson & Reeder (2005).

Order Erinaceomorpha

Family Erinaceidae

1. *Erinaceus roumanicus* Barret-Hamilton, 1900 (Eastern hedgehog) – a specimen was found crossing a dirt road in Alțâna in August 2011.

Order Soricomorpha

Family Soricidae

2. *Sorex araneus* Linnaeus, 1758 (Common shrew) – the most abundant and frequent shrew species during this study, but also in September 2003, captured in a great variety of habitat types.

3. *Sorex minutus* Linnaeus, 1766 (Pygmy shrew) – two specimens were captured in one of the research areas (Benești) in August and September 2011. In the 2003 study, this shrew species was captured at the forest edge from Brădeni and Retiș.

Table 1

Terrestrial small mammals captured in the localities from Hârtibaciu Plateau, in 2010 and 2011 (F% stands for frequency).

Species	2010		2011		Total	F%
	Benești	Iacobeni	Alțâna	Benești		
<i>S. araneus</i>	0	4	11	1	16	12.50
<i>S. minutus</i>	0	0	0	2	2	1.25
<i>C. suaveolens</i>	0	1	0	1	2	2.50
<i>C. leucodon</i>	0	1	0	0	1	1.25
<i>M. glareolus</i>	2	0	0	2	4	2.50
<i>A. sherman</i>	1	0	0	5	6	7.50
<i>M. arvalis</i>	55	277	178	108	618	73.75
<i>M. subterraneus</i>	0	0	27	4	31	7.50
<i>M. minutus</i>	0	0	4	0	4	2.50
<i>A. agrarius</i>	29	169	87	55	340	47.50
<i>A. flavicollis</i>	50	12	14	4	80	31.25
<i>A. sylvaticus</i>	0	24	37	6	67	25.00
<i>A. uralensis</i>	0	0	28	2	30	16.25
<i>M. musculus</i>	1	4	28	0	33	10.00
<i>R. norvegicus</i>	0	0	0	1	1	1.25
Total	138	492	414	191	1235	
Trapping effort	763	1010	2121	1677	5571	
Capture index	18.08	48.71	19.51	11.38	22.16	

4. *Neomys fodiens* (Pennant, 1771) (Water shrew) – one specimen captured in the riverside willow thicket at Stejărișu in September 2003.

5. *Crocidura leucodon* (Hermann, 1780) (Bicoloured white-toothed shrew) – was found during both studies, in 2003 in the shrubs from Stejărișu, and in 2010 in the pasture with sparse shrubs from Iacobeni.

6. *Crocidura suaveolens* (Pallas, 1811) (Lesser white-toothed shrew) – two specimens were captured, one in the pasture with sparse shrubs from Iacobeni in September 2010 and the other under a bush in a hayfield from Benești, in September 2011.

Family Talpidae

7. *Talpa europaea* Linnaeus, 1758 (European mole) – was widely spread in the area, its presence being indicated by the numerous mole hills from different habitats. One specimen was found dead in a hayfield in Alțâna in July 2011.

Order Rodentia

Family Castoridae

8. *Castor fiber* Linnaeus, 1758 (Beaver) – probably went extinct in Romania during the first decades of the 19th century, although in 1850 Bielz mentioned the possibility of its presence in Transylvania. In 1998 ICAS (The Institute for Forest Research and Management) Brașov initiated a program of reintroduction on three

rivers from Romania, namely Olt, Mureş and Ialomiţa, which lasted until 2003. 182 specimens brought from Bavaria were released and they established stable populations, which are now in process of expansion (www.beaver.icaswildlife.ro). From the upper sector of the Olt River, the reintroduced beavers colonised its middle course and some of tributaries, including Hârtibaciu (via Cibin River). Local people claim that the beaver is found along the most part of the river. During our study several burrow entrances and footprints were observed downstream Alţâna and more recently fallen and gnawed willow trunks and branches were found downstream Caşolt, near the confluence with Cibin River and in the upper sector, upstream Netuș.

Family Gliridae

9. *Glis glis* (Linnaeus, 1866) (Fat dormouse) – was captured in the mixed broadleaf forest from Retiș and at the forest edge from Brădeni in 2003.

10. *Muscardinus avellanarius* (Linnaeus, 1758) (Hazel dormouse) – three specimens were captured in September 2003 at Dealu Frumos, in the hornbeam and oak forest, the forest clearing and in the ditch along a dirt road.

Family Cricetidae

11. *Arvicola sherman* (Shaw, 1801) (Montane water vole) – was captured only at Benești, both in 2010 and 2011, in hayfields, unused lands with high vegetation and pastures with sparse shrubs.

12. *Myodes* (syn. *Clethrionomys*) *glareolus* (Schreber, 1780) (Bank vole) – was found in 2003 in the forests and at the forest edges from Dealu Frumos, Brădeni and Retiș, in 2010 at the forest edge from Benești and in 2011 in the unused land with high vegetation bordering the willow riparian forest on the banks of Hârtibaciu River at Benești.

13. *Microtus arvalis* (Pallas, 1778) (Common vole) – captured in 2003 only at Dealu Frumos and Brădeni, in several open habitats, was the most abundant and frequent species during the present study, found in most types of habitat, in all the research areas, both in 2010 and 2011.

14. *Microtus subterraneus* (de Selys-Longchamps, 1836) (Common pine vole) – was found only in 2011, both in Alţâna and Benești, in different moist habitats with high and rich vegetation.

Family Muridae

15. *Micromys minutus* (Pallas, 1771) (Harvest mouse) – was captured only at Alţâna, in a hayfield and an unused field with high vegetation, in August 2011.

16. *Apodemus agrarius* (Pallas, 1771) (Striped field mouse) – although not the prevailing species, it was very abundant and frequent both in 2003 and 2010-2011, being present in all the habitat types except for the forest.

17. *Apodemus flavicollis* (Melchior, 1834) (Yellow-necked mouse) – the prevailing species in 2003, was captured during the present study in all the research areas, mainly in forests and at forest edges, but also in other habitats with wooded vegetation or near the forest.

18. *Apodemus sylvaticus* (Linnaeus, 1758) (Wood mouse) – in 2003, was captured at Dealu Frumos (dominant in the clearing), Brădeni (dominant in the reed bed) and at Retiș and during the present study in all the three localities (at Benești only in 2011), in cultivated fields and semi-natural habitats with moderate cover of woody vegetation (it was absent both in the hayfields and forests).

19. *Apodemus uralensis* (Pallas, 1811) (Pygmy field mouse) – in 2003, was found only at Dealu Frumos in the cornfield and the adjacent shrubby ditch, during the present study it was found only in 2011, in both areas, in the same habitat types as *A. sylvaticus*.

20. *Mus musculus* Linnaeus, 1758 (House mouse) – was found in all three localities (at Benești only in 2010), mainly in cultivated (corn and wheat) fields, being most numerous in the maize culture near the abandoned farm from Alțâna.

21. *Rattus norvegicus* (Berkenhout, 1769) (Brown rat) – one juvenile was captured in July 2011 in an abandoned cornfield from Benești.

Among the captured small mammals rodents were dominant, and among them the vole *M. arvalis* (50%) and the mice species belonging to *Apodemus* genus (Fig. 2). *M. arvalis* also recorded the highest frequency, being captured in 73.75% of the trap lines. It was followed by *A. agrarius*, both in what relative abundance (27.5%) and frequency (47.5%) are concerned. A significant association was found between these two species ($p < 0.001$; $t = 3.979$; $df = 95$), both preferring open habitats with high vegetation, and being widely distributed in the research area. The affinity between these species was slightly stronger when abundance was considered (the proportion of the individuals occurring together was 0.75, while the Fager affinity index was 0.68).

A. flavicollis and *A. sylvaticus* had similar ratios, the first being slightly more abundant and more frequent, found mainly in forests and at forest edges, as well as in habitats with woody vegetation. All the other small mammals presented low ratios and frequencies. Among the shrews *S. araneus* prevailed, with 16 captured specimens (1.3%).

There was a very significant ($p < 0.001$), positive and strong ($r = 0.950$) correlation between the relative abundance and frequency calculated for the captured small mammals.

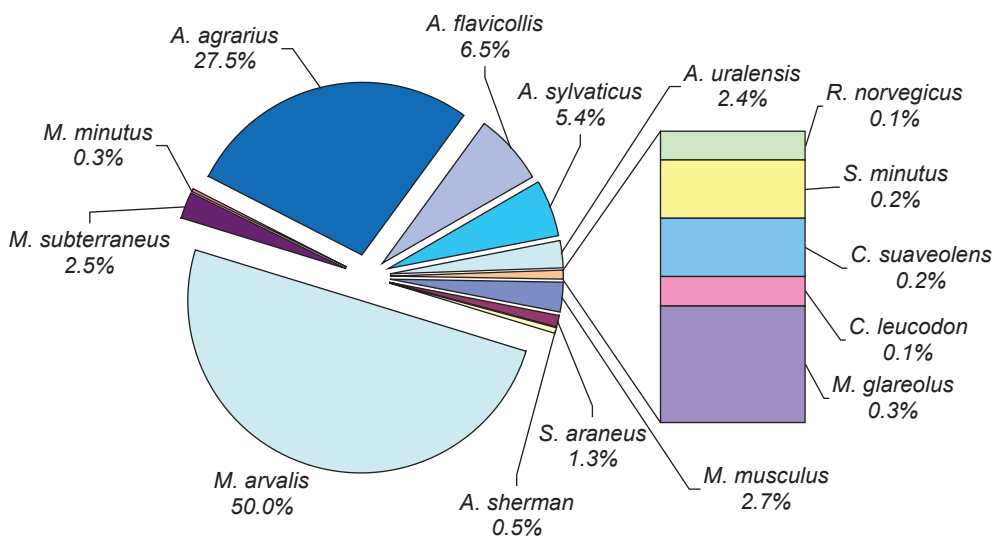


Fig. 2 - Relative abundance of terrestrial small mammal species captured in Hârtibaciu Plateau during the research.

Considering separately the four investigation areas, the Pearson chi-square test for independence showed a very significant ($p < 0.001$, $\chi^2 = 233.737$, $df = 9$) dependence of the relative abundance of the most abundant species (*M. arvalis*, *A. agrarius*, *A. flavicollis* and *A. sylvaticus*) on the locality, the most distinctive being Benești I. Here *A. flavicollis* had a high ratio, outnumbering *A. agrarius*, being second only to *M. arvalis*. However, if we consider only the two prevailing species in the four areas, *M. arvalis* and *A. agrarius*, their abundance did not differ significantly ($p > 0.05$, $\chi^2 = 2.195$, $df = 3$), indicating a homogeneity of the small mammal communities in this type of patchy landscape from southern Transylvania.

In 2011, each transect was set twice, first time in mid-summer and then in late summer and early autumn, enabling us to observe the changes occurred in the small mammal populations as a consequence of the breeding season. There were some similarities but also differences between the patterns of seasonal changes in the two localities. In both cases there was a significant increase of the total capture index. The increase was stronger in Benești, where the capture index rose from 3.3 ind./100 TN in summer to 19.3 in autumn (Fig. 3). At Alțâna the increase was given mainly by *A. agrarius* and at a lesser extent by *A. sylvaticus* and *M. subterraneus*, while *M. arvalis* presented a similar abundance (8.1 ind./100 TN in summer and 8.6 in autumn). *A. flavicollis* was the only species with a lower capture index in autumn (0.4 compared with 0.9 ind./100 TN in summer), indicating that it was present along the trap lines only temporarily, coming from the neighbouring forest. At Benești the strong growth of the community density was given by *A. agrarius* and especially *M. arvalis*, the latter with an increase in the capture index more than tenfold (from 0.9 to 12 ind./100 TN).

In autumn, although the total capture index for *M. arvalis* was around 10 ind./100 TN in both localities, in suitable habitats (e.g. some unmown hayfields) the traps were saturated with field voles, the capture index being occasionally higher than 100 ind./100 TN (due to day-time captures and multiple catches).

The density and diversity of small mammal communities varied greatly among the researched habitat types (Fig. 4). Although the correlation between the species number and capture index is not really significant ($p = 0.06$), if we leave out the forests and consider only the more or less open habitats, the correlation becomes highly significant and strong ($p = 0.003$, $r = 0.805$). The highest capture index (51.1 ind./100 TN) and also species richness (11 species) were recorded for the unused

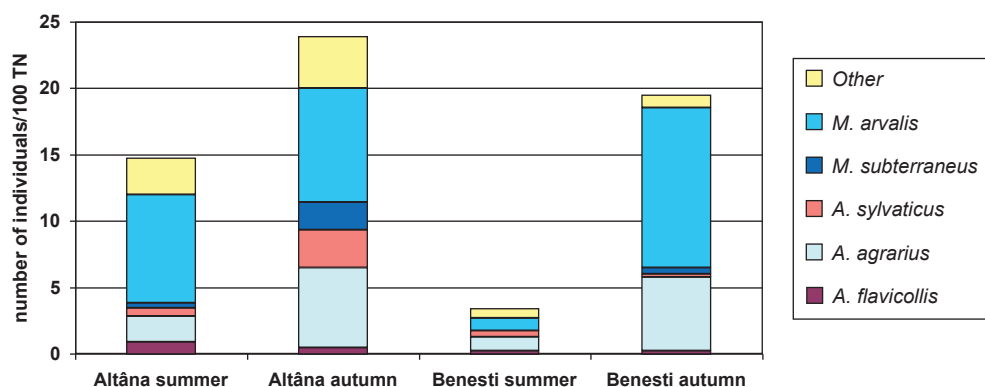


Fig. 3 - The abundance of small mammals from the two localities sampled in summer and autumn 2011.



Fig. 4 - Abundance and species richness of small mammal communities in the investigated habitat types (captures from all trap lines in the same habitat type are pooled together).

lands with high vegetation, most of them situated along the willow riparian forest on the bank of Hârtibaciu River and along the canals separating the cultivated fields. Abundant and diverse assemblages were sheltered also by abandoned fields, where 8 species were found, with a total of 44.2 ind./100 TN. Both had a good ground cover by high and diverse vegetation and presented a low human disturbance.

In forests the relatively high density was given by the yellow-necked mouse, the sole species captured in this habitat. The other typical forest species (e.g. dormice, bank vole), well represented in the previous survey, are more exacting in what the habitat conditions are concerned. Thus, they were absent from the two forests due to the lack or poor development of undergrowth (Benești I) or to the disturbance from grazing sheep (Altâna).

Among the cultivated terrains the richest small mammal assemblages were sheltered by cornfields, due to the high vegetation and food availability, their structure being influenced by the presence and density of weeds. In plots where intensive agricultural works were carried out, leaving behind an extremely neat and tidy maize culture, with no other plants among the corn stems, small mammals were poorly represented, with the house mouse among the prevailing species. In contrast, in plots with a rich cover of weeds, where no herbicides were sprayed and no hoeing was done, communities were more abundant and diverse. Several other species of rodents were also abundant in these habitats: the striped field mouse, the wood mouse, the pygmy field mouse and the common vole, the latter being the prevailing species in the wheat and alfalfa fields. However, the presence of rodents in different cultures is usually temporary, depending on the food and shelter resources and the disturbing effect of agricultural works (Hamar & Șutova, 1965, 1968; Theiss, 1962).

The species number and capture index values decreased with the reduction of land cover, vegetation height and human pressure. The poorest habitats in what density is concerned, were the pastures. The same conclusion was drawn also in the Făgăraș Piedmont (Lazăr et al., 2012). In pastures only 3.8 ind./100 TN were

captured, although in all 4 species were identified. The reasons for the scarcity of small mammals in pastures are the frequent disturbance by grazing sheep (or cattle) and the shepherd dogs, the compacted soil, and especially the short vegetation and the lack of cover.

DISCUSSION

The large extent of open habitats in Hârtibaciu Plateau shapes the structure of the small mammal community, favouring the common vole and the striped field mouse. The two species prevail in all the research sites, finding favourable conditions in several habitat types, where they build up populations increasing in density from summer to autumn.

The results of this study show several similarities with those from another plateau area, the Făgăraș Piedmont (Lazăr et al., 2012). However, the shares of the dominant species are reversed in the two research areas. Compared to Hârtibaciu Plateau, the Făgăraș Piedmont is moister, due to the numerous streams and rivers crossing it, the proximity of the mountains and the montane forest belt. The higher humidity favours the striped field mouse, while the numerical development of the common vole populations is limited. The proximity of the mountain forest belt determines also a relatively high capture index for the yellow-necked mouse. The reduced abundance of this species in autumn compared to summer was observed in both areas, indicating a retreat from the open habitats (including cultivated fields), inhabited or more frequently visited during summer, to the forest.

Although the soricomorphs had a low relative abundance, the common shrew had a relatively high frequency, being captured in a large variety of habitat types. This result confirmed that it is an euryoecious species, inhabiting both open and forested habitats in lowlands and mountain areas (Istrate, 1998; Murariu, 2003; Benedek & Sîrbu, 2009). The scarcity of shrews among the captured small mammals was due mainly to the high density of rodents and the large proportion of open lands among the researched habitats, but might be also the result of sampling bias. The relative abundance of soricomorphs was significantly lower than in 2003 (Benedek, 2007) or in some mountain areas, especially when rodent population densities are low (Benedek, 2006; Benedek & Drugă, 2005), but close to their ratio in the Făgăraș Piedmont (Lazăr et al., 2012), where similar habitat types were surveyed.

Conclusions

During the research period a total number of 1235 individuals were captured, belonging to 15 species (four species of shrews and 11 of rodents). *Microtus arvalis* was the prevailing species, followed by the mice from *Apodemus* genus (*A. agrarius*, *A. flavicollis*, and *A. sylvaticus*). They recorded also the highest frequencies. The population densities increased from summer to autumn, as a result of the breeding season, later in the common vole and earlier in other open habitat species. The number of species and the capture index values decreased with the reduction of land cover, vegetation height and increase in the human pressure. The most abundant and diverse assemblages were sheltered by unused lands with high vegetation and abandoned fields, while the poorest communities were found in pastures. Among the cultivated fields the richest small mammal assemblages were sheltered by maize cultures, their structure being influenced by the presence and density of weeds.

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COMUNITĂȚI DE MAMIFERE MICI TERESTRE DIN PODIȘUL HÂRTIBACIU (ROMÂNIA)

REZUMAT

Comunitățile de mamifere mici au fost studiate prin utilizarea capcanelor tip cutie în perioada august-septembrie 2010 și iunie-septembrie 2011, în trei localități din Podișul Hârtibaciu, în sudul Transilvaniei. Zona este situată între 420 și 550 m alt. și reprezintă un mozaic de mici parcele cu diferite folosințe ale terenurilor. 200 de capcane au fost amplasate în transecte liniare timp de trei nopți consecutive, în 80 de habitate diferite reprezentând 12 tipuri de habitate, atât cultivate cât și semi-naturale. 1235 exemplare aparținând la 15 specii (4 soricomorfe și 11 rozătoare) au fost capturate. Structura comunităților de mamifere mici a fost puternic influențată de tipul de habitat, chiar și în cazul parcelelor mici de teren. *Microtus arvalis* a predominat în zona cercetată, fiind specia dominantă în terenuri deschise cu vegetație ierboasă înaltă, densitatea ei crescând puternic de la începutul verii până toamna.

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