STATUS OF *C. (MORPHOCARABUS) INCOMPSUS* KRAATZ 1880 IN ROMANIA

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Abstract: *The study of literature and the review of the national collections of the Hungarian* Natural *History* Museum Budapest, *the collection of K. Petri from Brukenthal National Museum Sibiu, the collections of the National Museum of Natural History "Grigore Antipa" from Bucharest show that C. (Morphocarabus) incompsus Kr. 1880, is mainly endemic in Romania in Eastern Carpathians (an enclave exists in Ukraine, in Chornogora Mountains). The identification was based on little discriminating morphological criteria having a confusion risk with some taxons of C. Morphocarabus hampei Küst. 1846. C. (Morphocarabus) incompsus Kr. 1880 is a species morphologically difficult to distinguish from certain taxa of hampei, having intervals of the same width and little interrupted by superficial foveolae. This difficulty lies in the origin of the still recent ranking (2007) of some taxa of incompsus as forms of hampei, and of the attachment of this species to the rothi group. Up to recently, several sources of C (Morphocarabus) incompsus Kr. 1880 were considered as hampei taxons. Currently the use of the shape of the aedeagus end, and the aspect of the endophallus allow us to identify males individuals but not the female specimens, often more frequent than males. The 28S rRNA5 nuclear marker ensuring the separation. The study with this marker of several species of G. Morphocarabus identifies incompsus and suggests taxonomic changes. The attachment of C. (Morphocarabus) kollari Pall. at Sg. rothi, and not at Sg scheidleri, C. (Morphocarabus) incompsus Kr. 1880 which has been until then ranked in the Sg. rothi is located in the Sg. scheidleri. The analyse also shows that some populations until then assigned to incompsus belong to hampei, changing the initial distribution map. The marker 28S rRNA5 indicates that certain origins, morphologically the incompsus kind, belong to hampei (Bichigiu, Varghis, Corongis medium altitude), unlike the others (Hăşmaş for the form of mehelyanus Csiki 1906), Bogata-Poiana Braşov for the type. This encourages further investigation in order to determine the exact location of species.*

Key words: *C. (Morphocarabus) incompsus Kr. 1880, 28S rRNA5 nuclear marker, phylogenetics.*

INTRODUCTION

In external morphology *C. (Morphocarabus) incompsus* Kr. 1880 is very difficult to distinguish from *C. (Morphocarabus) hampei* Küst. 1846, especially the shapes with equal length and little interrupted intervals by superficial foveae. This difficulty lies at the origin of the rank made by CSIKI (1906-1946) as *hampei* taxons, of *incompsus* type and of most shapes he has described (*mendax, spectabilis*, *mehelyanus* 1906).

This classification has been recognized for a long time by many authors, until recently (KLEINFELD et *al.* 1999); LIE et *al.* (2001) SZEL et *al.* (2007) for *spectabilis* Csiki 1906 and *mehelyanus* Csiki 1906. However, SZEL et *al.* 2007, based on the shape of the inner bag follows ISHIKAWA (1973) considers C. *(Morphocarabus) incompsus* Kr. as a valid species.

Based on different criteria, other authors, after 1999: BREZINA (2000), LOBL et *al.* (2003), DEUVE (2004) rank *incompsus* (at least its shapes of altitude) as ssp. or subsp. of *rothi*; subgeneric positions generally accepted without many arguments.

Using the shape of endophallus, different between *C. (Morphocarabus) hampei* Küst. and *C. (Morphocarabus) incompsus* Kr. ensure the identification of male individuals. This allows to Panin:

- to identify, in 2011, *mendax* Csiki 1906 as belonging to C. (*Morphocarabus*) *incompsus* and to invalidate this taxon from the list of *hampei* shapes,
- to consider, in 2013, as *hampei* a native population originating from Tibles Mountains (Bichigiu from Bistrita Nasaud County) morphologically_mimetic of *incompsus* for elytra sculpture.

Apart from an enclave in Ukraine (see below) mentioned by POVIGALO (1994) and PANIN (2006) in Chornogora Mountains at the limit of subalpine floor (1800-2020 m). C. (*Morphocarabus*) *incompsus* Kr. is an endemic species of the Eastern Carpathians in Romania (see geographic distribution map) established from the bibliographic references and the collections consultation.

No recent study has been dedicated to C. (*Morphocarabus*) *incompsus* exploiting the new criteria of identification (endophallus molecular biology) and aiming at:

-establish the taxonomic relationship with other species of the *Morphocarabus* genus,
-check the belonging of the populations quoted in the literature,
-specify the geographical distribution.

GEOGRAPHICAL DISTRIBUTION

C. (Morphocarabus) incompsus Kr. does not exist in the Czech Republic (NAKLADAl et *al.* 2012), nor in Hungary (RETEZAR 1997), but appears in Ukraine in the Chornogora Mountains (PANIN 2011), not being signaled in Maramures Mountains by NITU (2008), MERCK (2008). The species seems subservient to Romania, especially to the Eastern Carpathians. (fig 1)

Known localities in Romania:

The list below results from the literature data (including *Carabidae* of the World) and from collections' consultation (HNHM Budapest, collection K. Petri of Brukenthal NM Sibiu, collection NMNH Grigore Antipa Bucharest). The locations mentioned below are presented from north to south of the Carpathian arc:

+ Oaș Mountains - Camârzana-Călinești Oaș (Satu Mare County), RODICA SERAFIM 1987("Grigore Antipa" National Museum of Natural History Bucharest), citation under reserve,
+ Tibles Mountains: Bichigiu (Bistrița Năsăud County) 390 m. initially considered as *incompsus*, disabled (2014) by PANIN by basing itself on the shape of the aedeagus and attributed to hampei (transitus *incompsus*),
+ Rodnei Mountains (Bistrița Năsăud County) taxon *spectabilis* Csiki 1906:
  -Ineu, between 1500-1800 m. (HOLDHAUS et *al.* 1910),
  -Corongis (CSIKI 1906-1946), PETRI (1900), MÜLLER (1930):
    - between 1300-2000 m., SZEL et *al.* (2007),
    -1950 m. LIE et *al.* (2001),
  -Saca Mountain 1600 m. Holdhaus et *al.* (1910),
+ Suhard Mountains: Vatra Dornei (Suceava County): 1500 m. LIE (1982),
+ Calimani Mountains: Colibița (Bistrița Năsăud County) exemplary female; not validated species,
+ Hășmaș Mountains (Harghita and Neamț Counties) taxon *mehelyanus* Csiki 1906:

-Hăşmaşu Mare 1783 m. and Tarcău 1589 in KARL PETRI collections: MEHELY (1891), DEUBEL (1894), CSIKI (1906, 1942, and 1946), BREUNING (1932), Piatra Tarcaului 1963m. (LIE et *al.* 2001), SZEL et *al.* (2007),

-Munticelu 1000 m. (LIE et *al.* 2001),

+ Harghita Mountains (Harghita County) :

-Vlahita-Varghis-Selters 720-820 m., LIE et *al.* (2000), MATHE et *al.* (2002),

-Odorheiu Secuiesc, CSIKI 1906,

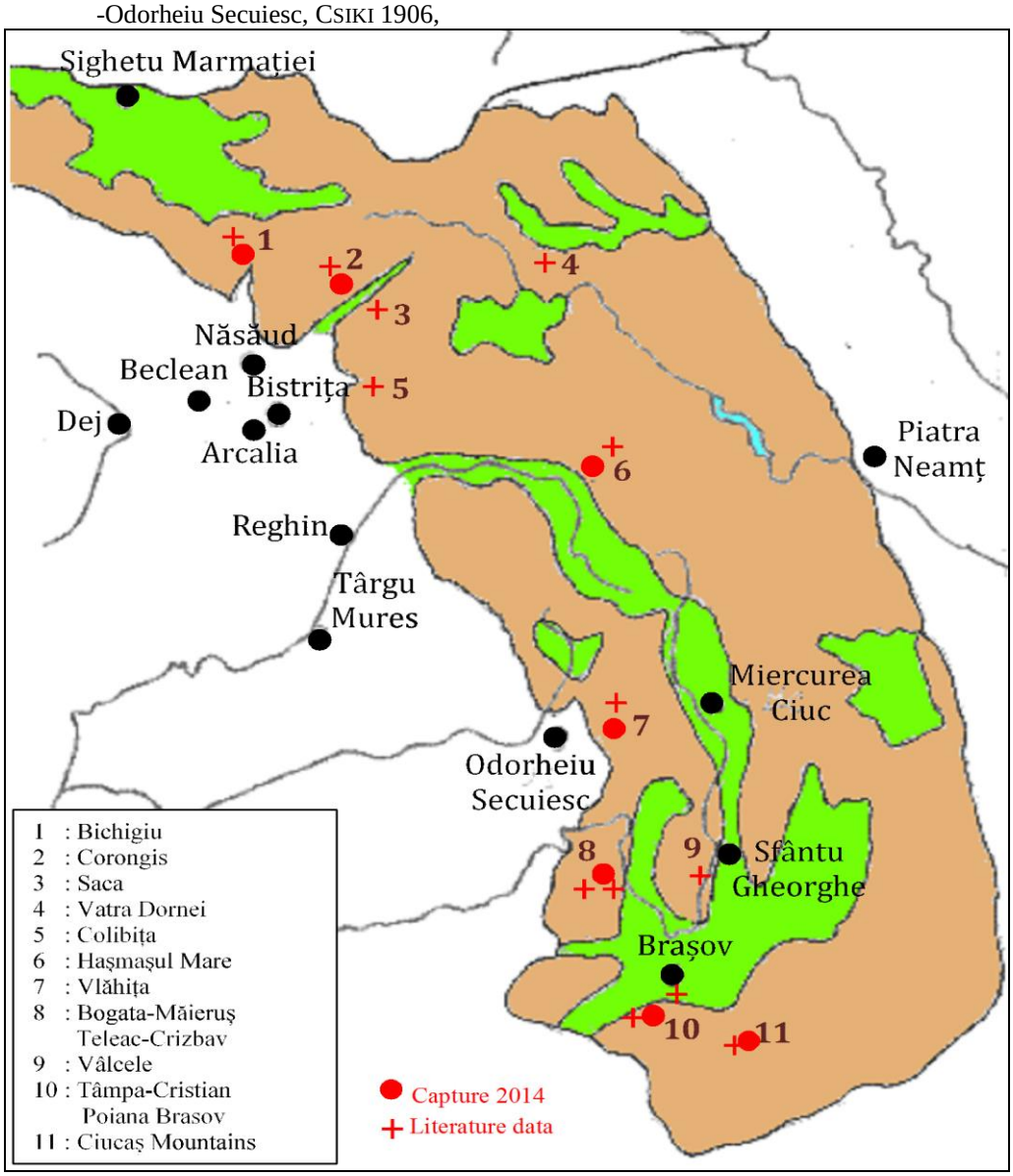


Figure 1. Geographical distribution of *C. (Morphocarabus) incompsus* Kr. 1880

+ Persani Mountains (Brașov County) :
-Maieruș-Teleac : PETRI (1912) ; Crizbav: BIELZ (1912),
+ Baraolt Mountains (Covasna County):
-Valcele: PETRI (1912), BREUNING (1932),
+ Brașov Mountains (Brașov and Prahova Counties):
-around of Brasov: KRAATZ (1880), in PETRI: BIRTHLER-DEUBEL (1895),
-Postăvarul Massif (near Poiana Brașov) 1789 m. in Petri: KIMAKAVEZ (1895), Timiș-Tâmpa: LIE et *al.* (2001),
-Cristian village (Brașov County) 380 m.,
+ Brașov Mountains (Brașov County):
-Râșnov in PETRI: ALBRECHT (1895),
- Azuga-Sinaia-Bușteni FLECK (1904), MONTANDON (1906),
+Ciucaș Mountains (Brașov and Prahova Counties:
-Muntele Roșu 1397m., Pasul Bratocea 1263 m., MEHELY (1890), PETRI (1912), KUTASI et al. (2011).

Except the fact that the true discoverers are the first to be quoted, the most recent authors have taken these references, without always having conducted an audit "in situ".

Most of the references are old and the assignation of populations to *C. (Morphocarabus) incompsus* Kr. 1880 is based on morphological criteria, available only at those times.

STUDIES OF SOME ORIGINS OF *C. (MORPHOCARABUS)* SPECIES

Material and methods

Biological material: *C. (Morphocarabus) incompsus* Kr. 1880 (c. localization, distribution map).

-Bichigiu-Valea Bichigiului (Bistrița Năsăud County) 47°41' N, 24°35'E ; 435 m., ♂♂ 36.0/13.5 mm, ♀♀ 37.8/13.7 mm.
-Călinești Oaș forest, 47°52' N, 23°14'E ; 170 m., 47°53' N, 23°16'E ; 180 m., ♂♂ 30.0/11.5 mm, ♀♀ 31.5/11.5 mm., blue, green, deep enough punctuations.
-Corongiș (Bistrița Năsăud County) 48°76' N, 21°81'E ; forest 1087 m, and alpine meadow 1312 m, ♂♂ 30.6/11.8 mm, ♀♀ 31.0/12.0 mm. supposed *spectabilis* Csiki 1906. Sometimes the brightly colored blue or purple. In the open area unto the top of Corongisu Mare it was not found a population which to provide specimens.
-Hășmașu Mare 1783 m, 46°68' N, 25°82'E ; ♂♂ 22.0/8.5 mm, ♀♀ 25.0/9.4 mm. supposed *mehelyanus* (Csiki 1906). Margins often blue darkened.
-Vârghiș-Selters 789-806 m. 46°31' N, 26°54'E ; ♂♂ 28.7/11.5 mm, ♀♀ 29.7/11.6 mm.
-Bogata Forest 700 m. 45°54' N, 25°26'E ♂♂ 28.2/10.8 mm, ♀♀ 29.2/11.3 mm.
-Poiana Brașov Forest 987 m. 45°36' N, 25°33'E ♂♂ 27.9/10.0 mm, ♀♀ 28.8/10.7 mm.
-Tâmpa Brașov Forest 800 m. 45°38' N, 25°35'E;
-Ciucaș (forest from vicinity of Bratocea Pass at 1174 m.) 45°28' N, 25°54'E ♂28.0/11.0 mm., no visible punctuations

Other Morphocarabus biological material

a. Romania: 2 *kollari*, 19 *rothi*, 3 *comptus*, 6 *alutensis*, 15 *hampe*i, 6 *seriatissimus*, 2 *excellens*
b. France: 5 *monilis*,
c. Moldova: 2 *excellens*
For a, b, c, detailed references in Barloy et *al.* 2014.
d. Romania: *C. (Morphocarabus) hampei* Kust 1846. The closest morphologically form from *incompsus* Kr.

-Beclenut : 47°42' N, 26°19'E ; 275 m. ♂♂ 31.5/11.8 mm, ♀♀ 34.3/12.9 mm.
-Arcalia : 47°05' N, 24°20'E ; 296 m. ♂♂ 31.3/12.0 mm, ♀♀ 33.4/12.2 mm.
-Micula 47°53' N, 22°56'E 100 m. ♂ 30.0/11.7 mm
e. Hungary:
C. Morphocarabus) scheidleri styriacus Kraatz, 1887
-Bakonybél 47°15' N, 17°43'E; 344 m., ♂♂ 27.1/11.5 mm, ♀♀ 29.5/11.2 mm.

C. (Morphocarabus) zawadzkii dissimilis Csiki, 1906

Village Óhuta (Háromhuta Borsod-Abaúj-Zemplén) 48°30' N, 21°30'E; 375 m., ♀♀ 31.5/12.0 mm,

Methods

a. Morphometric studies: external morphology, aedeagus, endophallus

b. Molecular biology studies

Attachment at subgroups and specific identification. Use of nuclear marker 28S $rRNA_5$

Primers:

28SO1 and 28 SRO1 (Kergoat et *al.* 2005) ;
28S D45F (Belshaw and Quicke 2002)

Methods cf Dreano et *al.* (2015).

Comparison with *C. (Morphocarabus) hampei dacicus* Csiki, 1906 and infraspecific variability. The use of cytoplasmic markers COI I and cyt b.
COI I : CO 1490-HCO 2198 (Hébert et *al.* 2003)
cyt b CP1 (Harry et *al.* 1998) CB1-CB2 Jermin and Crozier (1994)
Methods cf. Barloy et *al.* 2014.

Sequences analysis

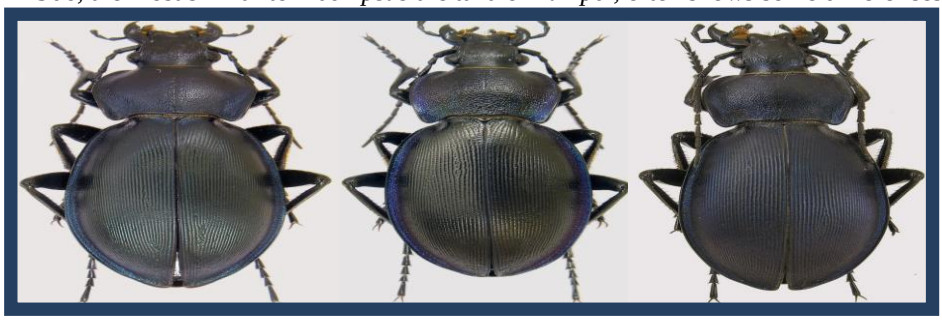
Sequences analyzed manually on using the software Geneions version 7,
Multiple alignment performed with the algorithm MAFT (Kaloh 2013)
Phylogenetic trees made with the algorithm PHYM1 (Guindon 2003), the substitution model JC 69 and boostrap of 10 replicata.

RESULTS AND DISCUSSIONS

Morphological studies

External morphology

The external morphology comparison between the populations individuals of Poiana Brasov-Bogata, of substantially similar size and those of *C. (Morphocarabus) hampei dacicus* Csiki 1906, the most similar to *incompsus* the taxa of *hampei*, often shows some differences.



Bichigiu Poiana Braşov Beclean

Figure 2. Populations appearance *incompsus* (Bichigiu, Poiana Braşov); populations apperance *hampei* (Beclean)

The distinguishing criteria, very few ones, vary within populations, morphologically heterogeneous, involving the observation of a number of insects.

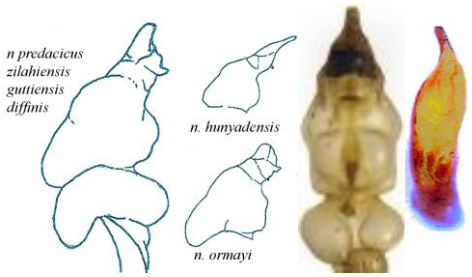
a. Elytra - wider on the coasts, in the rear third, apex elytra more strongly rounded (pointed at in *dacicus*); feature especially valuable for ♂♂.

b. Foveae of primary intervals, in small number, sometimes absent, shallower than *dacicus*.

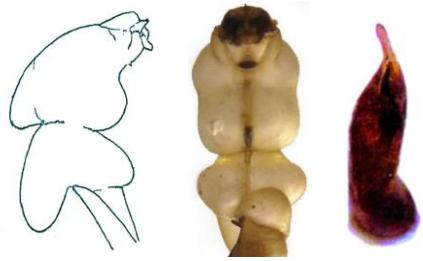
As indicated, these criteria are sometimes insufficient because they are fickle to provide certain identification with the shape of *C. (Morphocarabus) hampei* Küster 1846 to equal width and slightly interrupted intervals. (fig. 2)

Aedeagus and endophallus

The comparison between aedeagus and endophallus *C. (Morphocarabus) incompsus* Kraatz, 1880 (population Poiana Brasov) and *C. (Morphocarabus) hampei dacicus* Csiki, 1906 shows (fig. 3))



C. (Morphocarabus) rothi hampei Kuster 1846



C. (Morphocarabus) incompsus Kraatz 1880

Figure 3. Length of the aedeagus apex and endophalus shape (endophalus after Panin)

-a similar shape of aedeagus, except the apex, longer in *incompsus*,
-a more curve endophallus with a very short to nonexistent aggonoporus.

Molecular biology studies. Results

Attachment to subgroupe and specific identification (nuclear marker 28r RNA5)

The marker 28S rRNA5 apportions the studies species belonging to *C. (Morphocarabus)* in 4 groups (fig. 4)*:*

-group I: *rothi, kollari, comptus, hampei, alutensis,*
-group II: *scheidleri, seriatissimus, zawadskii, incompsus,*
-group III: *excellens,*
-group IV: *monilis,*

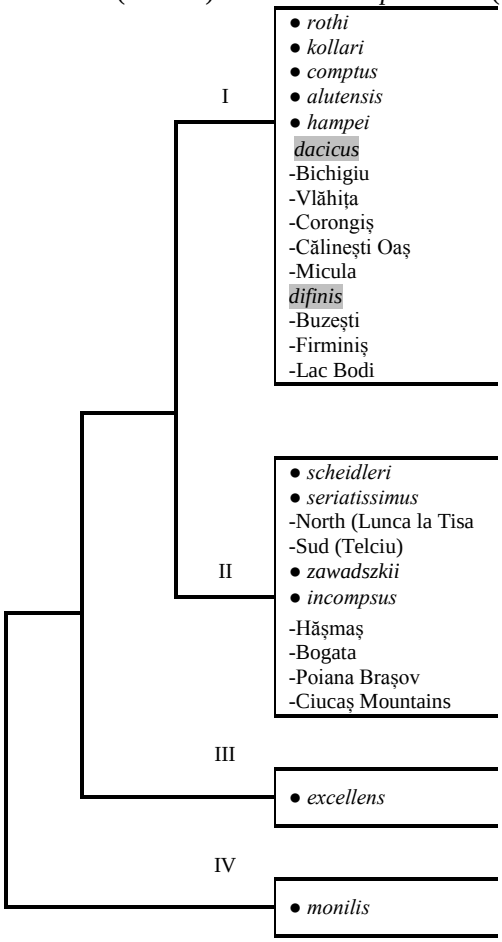
a. Insofar as this marker groups the species by Subgenus (Sg)

-*comptus-hampei-alutensis* can be grouped under the Sg *rothi*, classification accepted by many authors,
-*kollari* should be placed under the Sg *rothi* and not under Sg *scheidleri,*
-*seriatissimus- zawadzkii dissimilis* is attachment to Sg *scheidleri,*
-*incompsus* did not belong to *rothi*, or to *hampei* but to *scheidleri,*
-*excellens* and *monilis* form different Sg.

These nomenclature changes are proposed on the basis of genetic criteria and not only morphological.

b. The marker 28S r RNA5 divided the populations apparently „*incompsus*" in two groups:

b.1. Those related to the group *rothi-hampei*, having a elytral mimetic sculpture of *incompsus* and which are *hampei* (Bichigiu, Vlăhița, Corongiș). At Bichigiu, basing on the shape of aedeagus Panin (2014) had identified as belonging to hampei a population considered *incompsus*, that il named *hampei* transitus *incompsus*. Without being certain that our capture come from the same location, the analysis in molecular biology of insects apparently „*incompsus*" led to the same report. A Vlahița in his doctoral thesis Mathé (2007) quotes hampei, becoming *incompsus* in the publication of 2008 (Mathé et *al.*). For Corongis, the catches were performed at half height (1087-1312 m) and belong to *hampei*. One should study the populations in the summit area (1950 m) mentioned as *spectabilis* (Csiki 1906).

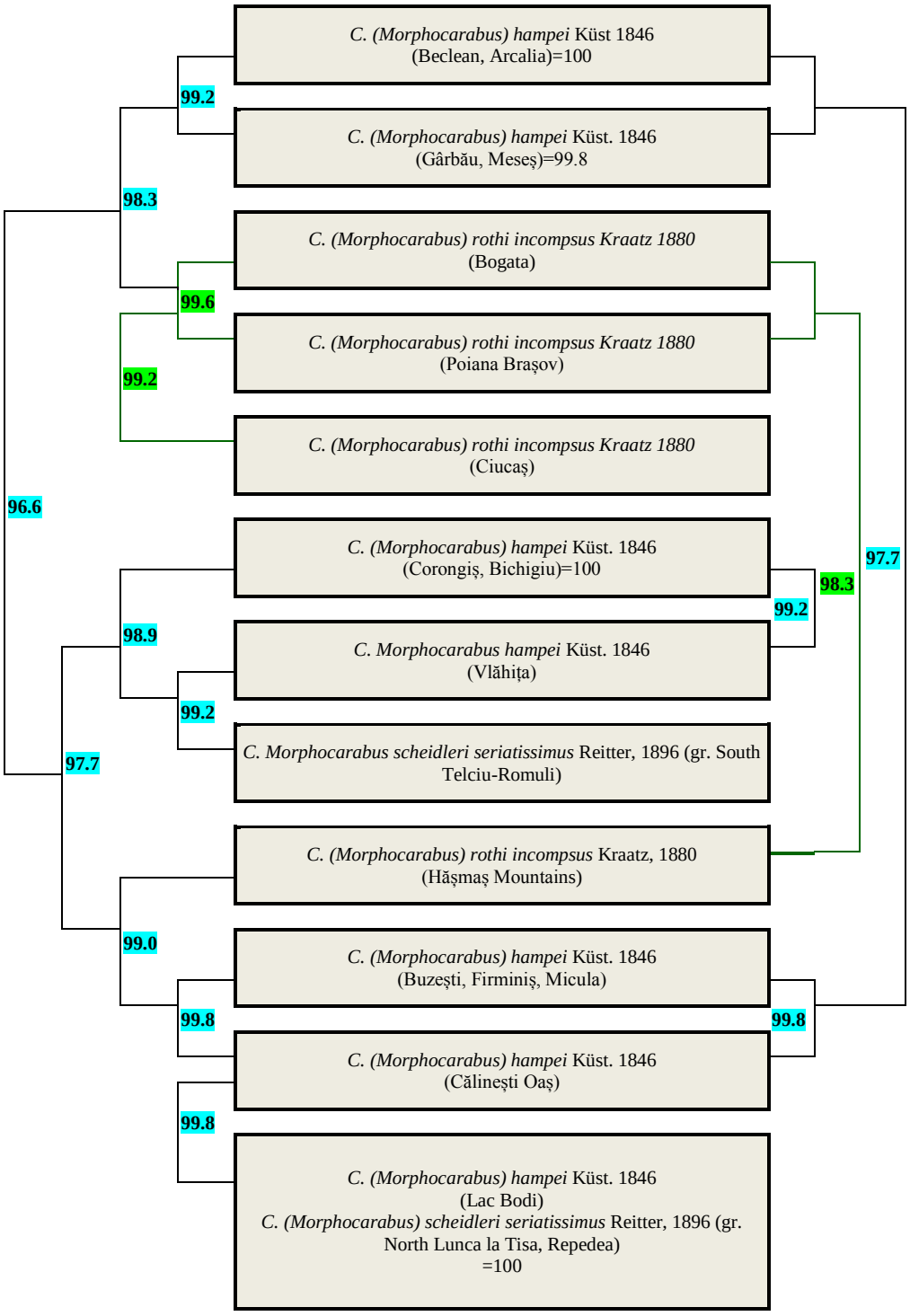


Nucleotide	38	106	243
Group I	A	G	A
Group II	T	G	A
Group III	T	G	G
Group IV	T	A	A

558 nucleotides

Group I: sg. *rothi*
Group II: sg. *incompsus*

Figure 4. Attachment and identification using nuclear marker 28r RNA5


C. (Morphocarabus) hampei Küst 1846 (Beclean, Arcalia)=100
99.2
C. (Morphocarabus) hampei Küst. 1846 (Gârbău, Meseş)=99.8
98.3
C. (Morphocarabus) rothi incompsus Kraatz 1880 (Bogata)
99.6
C. (Morphocarabus) rothi incompsus Kraatz 1880 (Poiana Braşov)
99.2
C. (Morphocarabus) rothi incompsus Kraatz 1880 (Ciucaş)
96.6
C. (Morphocarabus) hampei Küst. 1846 (Corongiş, Bichigiu)=100
97.7
98.3
99.2
98.9
C. Morphocarabus hampei Küst. 1846 (Vlăhiţa)
99.2
C. Morphocarabus scheidleri seriatissimus Reitter, 1896 (gr. South Telciu-Romuli)
97.7
C. (Morphocarabus) rothi incompsus Kraatz, 1880 (Hăşmaş Mountains)
99.0
C. (Morphocarabus) hampei Küst. 1846 (Buzeşti, Firminiş, Micula)
99.8
99.8
C. (Morphocarabus) hampei Küst. 1846 (Călineşti Oaş)
99.8
C. (Morphocarabus) hampei Küst. 1846 (Lac Bodi)
C. (Morphocarabus) scheidleri seriatissimus Reitter, 1896 (gr. North Lunca la Tisa, Repedea) =100

-- Relations between populations *incompsus*
-- Relations between populations *hampei*

Figure 5. Results using cytoplasmic marker COI I

Lie et *al.* 2001 signals the ambiguous status of this shape compared to *mendax*. Furthermore *C. (Morphocarabus) hampei* Küster, 1846 is mentioned in Rodnei Mountains -Telciu towards Telcisoara (pers. com. Nitu) and Natura 2000 (PM PN Rodna Mountains 2008).

b.2. Those related to the *scheidleri* group show the *incompsus* based on elytra sculpture by difference with that of *seriatissimus* attached to the same sg. (scheidleri do not exist in in Romania). The case of: Hășmaș, Bogata, Poiana Brașov.

Conclusion - Discussion on the use of the 28S rRNA5 nuclear marker

This marker, operational, regardless of sex:

- it is added to the shape of the endophallus as a criterion for distinguishing between C. (*Morphocarabus*) *incompsus* Kraatz, 1880 and shapes of C. (*Morphocarabus*) *hampei* Küster, 1846 has similar elytra costulation.
-suggest among the species of subgenus *Morphocarabus*, changes to the taxonomic connection for *kollari* and *incompsus*.
-shows that various populations considered as *incompsus* belong to *hampei* and encourages the study of all those mentioned by the discoverers which often are experienced entomologists (Csiki, Deubel, Petri and the members of Sibiu School).

Intraspecific variability of C. (Morphocarabus) incompsus

Results with the cytoplasmic marker COI I

These results also cover *C. (Morphocarabus) scheidleri seriatissimus* Reitter, 1896 studied previously (Barloy et *al.* 2014) and *C. (Morphocarabus) hampei* Küst 1846. (fig 5)

CONCLUSIONS

Cause of the lack of relevant criteria in external morphology the distinction between *C. (Morphocarabus) hampei Küst.* 1846 and *C. (Morphocarabus) incompsus* Kraatz 1880 it turns out random and risks of confusion is high. The safety of identification is obtained by recourse to the shape of the aedeagus for the male insects and has the molecular biology for both sexes (28S rRNA5).

In the current state of the prospecting, four geographical zones hold *C (Morphocarabus) incompsus* Kr.: Hășmaș Mountain and Tarcăului Mountain / Perșani Mountains / Postăvarul Mountain and Brașov / Ciucaș Mountains. The presence in other places (Rodnei Mountains; Călimani Mountains, Suhard Mountains) require confirmation. In the southern part of Rodnei Mountains in Saca Mountain (1600 m) and Corongisu Mic, in the forest area is only *C. (Morphocarabus) hampei* Küst., 1846.

These results:

Confirm the ancestral origin proximity between *C.* (*Morphocarabus*) *seriatissimus* Reitter, 1896 (northern group) and *C. (Morphocarabus*) *incompsus* Kraatz, 1880 (Hășmaș) already found in previous work.

Show that the populations of Bichigiu, Corongis, Vlahita are very close, do not belong to *C.* (*Morphocarabus*) *incompsus* Kraatz, 1880 but to *C. (Morphocarabus) hampei* Küst., 1846 (cf. results 28S rRNA5). The populations from Oasului Mountains also belong to *C (Morphocarabus) hampei* Kraatz, 1880.

Show two homes for *C.* (*Morphocarabus*) *incompsus* Kraatz, 1880 with genetically distinct populations.

-a northern center of Hasmas Mountains (and maybe close to Tarcaului Munticelului)

-a fairly large southern area, including Persani Mountains (Bogata), Postavarul Brasov and Ciucaş.

Among other potential sites one should study the Suhardului Mountains (Vatra Dornei mentioned by LIE *et al* (2001) and the Calimani Mountains evoked by Panin (Molbiol. Ru. 2008).

Thanking

We thank to Cl. Besnard for the supply of *Morphocarabus* species from Hungary. For the consultation of the national collections our thanks are address:

-to Ph.D. Melanya STAN ("Grigore Antipa" NMNH Bucharest Romania)

-to Prof. Sabin Adrian LUCA Ph.D. (Brukenthal National Museum, Sibiu)

-to Ph.D. Szél Gyõzõ (HNHM Budapest)

BIBLIOGRAPHY

1. BARLOY J, PRUNAR F, BARLOY-HUBLER F, DREANO S. 2014- Preliminary study of *C. (Morphocarabus) zawadzkii seriatissimus* Reitter 1896 from Northern Romania. Research Journal of Agricultural Science, 2014, 46(1):47-59.
2. BREUNING, ST., 1932 - Monographie der Gattung *Carabus* L. Bestimmungs-Tabellen der europäischen Coleopteren, 104 Heft. Troppau: 1-496.
3. CSIKI, E. 1906- Adatok a magyarországi *Morphocarabusok* ismeretéhez. (Beiträge zur Kenntniss der Ungarischen Morphocaraben.) – Annales Musei Nationalis Hungarici 259 pp.
4. CSIKI, E. 1906- Új Carabus a Csík-vármegyéből (Carabus hampei Küst. var. méhelyanus) [Eine neue Carabus-Art aus dem Ciuc-Komitat]. Rov. Lapok, 13 (8): 175
5. CSIKI, E. 1942- A Balánbányai hegység bogárfaunája. (Die Käferfauna des Balánbányaer Gebirges) Mat. Természettud. Értesítő, 61(LXI) : 706-735.
6. CSIKI, E. 1946- Die Käferfauna des Karpaten-Beckens. – In: Tasnádi-Kubacska, A. (ed.): Naturwissenschaftliche Monographien, IV. Budapest. 798 pp.
7. DEUVE, TH., 2004 - Illustrated Catalogue of the Genus *Carabus* of the World (*Coleoptera Carabidae*). Edit. Pensoft. Sofia-Moscow, 461 pp.
8. FLECK, ED., 1904 - Die Coleopteren Rümaniens. Bulletin de la Société des Sciences de Bucarest - Roumanie. Imprimerie de l'État, Bucharest. XIII-XV (1906) separatabdruck 336pp.
9. HOLDHAUS K., DEUBEL F. 1910-Untersuchungen über die Zoogeographie der Karpathen (unter besonderer Berucksichtigung der Coleopteren). *Abh. zool.-bot. Ges. Wien*, 6, 1: 1-202 pp.
10. HORMUZAKI C.F. 1905-Zur Definition des Artbegriffesmit besonderer Anwendung auf die Untergattung *Morphocarabus* Gehin. Zeitsch. Wissenchat. Insektenbiol. Sep.-Abdr., Husum, 10 (1) 155-169 pp.
11. KRAATZ, G.,1880- Ueber *Carabus comptus* Dej. und dessen Varietäten. Ent Monatssbl-14; 49-53.
12. KUTASI CS., TALLÓSI B. 2011- A Csukás futóbogarai (*Coleoptera: Carabidae*) Acta Siculica, 105-110.
13. LIE, P., MÁTHÉ, I. 2000- *Carabus (Callistocarabus) marginalis decorus* Seidlitz 1891 wurde in Transsilvania (Siebenbürgen) - Rumänien -nach fast hundert Jahren wieder aufgefunden. Galathea, 16(1):18 -30.
14. LIE, P., KLEINFELD, F. 2001- Betrachtungen über *Carabus (Morphocarabus)* hampei Küster, 1846 und seine Rassen in Transsylvanien, Rumänien (*Coleoptera: Carabidae*). – Galathea 17 (2): 75-94
15. LÖBL, I., SMETANA, A. (eds) 2003- Catalogue of Palaearctic *Coleoptera*. Volume 1. *Archostemata - Myxophaga - Adephaga*. – Apollo Books, Stenstrup, 819 pp.
16. MONTANDON, A.L., 1906- Notes sur le faune entomologique de la Roumanie. Bull. Soc. Sc. Bucarest, 15(1-2): 30-80.
17. MÁTHÉ, I., 2007-Studiul faunistic şi ecologic al carabidelor (Coleoptera Carabidae) din sctorul Superior al Bazinului Olt. Teza de doctorat. Univ. Babeş-Bolyai Cluj Napoca 232 p.
18. MÁTHÉ, I., RUDNER, J., 2002- The ground beetle fauna (*Coleoptera: Carabidae*) of Vlăhiţa and its surroundings (Harghita: Romania). – Entom. Rom. 7: 37-44.

19.MÁTHÉ, I., 2012-Studii asupra faunei de carabidae (*Coleoptera*) din Bazinul Oltului Superior. Ed. Scientia Cluj-Napoca. 230 p.
20.MERKL, O., 2008 - Data to the knowledge on the beetle fauna of Maramureş, Romania (*Coleoptera*). Studia Universitas "Vasile Goldiş" Ştiinţele vieţii (Life Sciences Series), 18 (suppl.): 243-311.
21.NAKLÁDAL O., HEJDA R., 2012-Soubor map: historické a sou asné rozsiření střevlíkovitých brouki (*Coleoptera: Carabidae*) tribu *Carabini* Vceské Republici
22.NIŢU E., 2008-Species diversity of beetle fauna, a sensitive parameter for ecological monitoring. Maramureş Mountains Nature Park (Romania). Transylv. Rev. Syst. Ecol. Res., 5: 143-154.
23.PANIN R. 2011 - Communication *C. (Morphocarabus) rothi hampei* Küst. 1846 *mendax. Carabidae* of the World.
24.PETRI K. 1912- Siebenbürgens Käferfauna auf grund ihrer Erforschung bis zum Schlusse des Jahre 1886. Hermannstadt, Jos. Drotleff . Ver. Naturw. XXXVII; 27-114.
25.RETEZÁR I. 1997- A *magyarországi nagy futóbogarak atlasza* és ikonográfiája (Coleoptera: Carabidae) Kéziat. 27 pp.
26.REITTER E. 1896- Bestimmungs-Tabellen der europäischen Coleopteren. 34. Carabidae. 1. Abtheilung: Carabini, gleichzeitig mit einer systematischen Darstellung sämtlicher Subgenera der Gattung *Carabus* L. – *Verhandlungen des Naturforschenden Vereines in Brünn* 34[1895]: 36–198.
27.SZÉL GY., A. TAKÁCS, A. LIE P., RETEZÁR I. 2007 -Subspecies of *Carabus (Morphocarabus) hampei* Küster, 1846 in the Carpathian Basin (*Coleoptera : Carabidae*). Folia Ent. Hung. 68: 71–80 pp
28.TURIN H., PENEV L., CASALE A., 2003 - The Genus *Carabus* in Europe. A Synthesis. Pensoft-Sofia-Moscow. 511 pp.