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A NEW SPECIES OF *BOLBELASMUS* BOUCOMONT, 1911
(*Insecta Coleoptera Geotrupidae*) FROM SICILY (ITALY)

SUMMARY

Authors have examined scrupulously all available sicilian specimens belonging to the genus *Bolbelasmus*, collected between 1893 and 2010, previously identified as *B. gallicus* and *B. unicornis*. They conclude that both species have to be excluded from the sicilian fauna and describe the new species *B. romanorum*, which is characterized by peculiar punctures on the clypeus, the head and the pronotum, and by the shape of the clypeus, the head and the aedeagus sclerites. They compare the new species with all the taxa currently known in the Mediterranean. Further, they show oscillograms of both sexes of the new species, which, as other *Bolbelasmus*, stridulates vigorously; they also detect for the first time the *pars stridens*, consisting in a series of small bristles on the lower outer border of wings; the insect emits its sound moving actively the abdomen, the friction of the wing on the first abdominal tergite, particularly swollen, produces the stridulation.

RIASSUNTO

Una nuova specie di Bolbelasmus Boucomont, 1911 (Insecta Coleoptera Geotrupidae) della Sicilia (Italia). Attraverso un accurato studio degli esemplari siciliani del genere *Bolbelasmus* raccolti in Sicilia nell'arco di poco più di un secolo, in precedenza ritenuti *B. gallicus* e *B. unicornis*, vengono escluse entrambe le specie dalla fauna siciliana ed è istituita la nuova specie *B. romanorum*, caratterizzata da una peculiare punteggiatura del clipeo, del capo e del pronoto, dalla forma del clipeo e del capo e dalla forma dei parameri dell'edeago. La nuova specie è messa a confronto con gli altri taxa attualmente conosciuti nel Mediterraneo. Inoltre viene presentato l'oscillogramma dei due sessi della nuova specie, che come gli altri *Bolbelasmus*, stridula attivamente ed è individuata per la prima volta la *pars stridens* in una serie di piccole setole nella parte inferiore del bordo esterno dell'ala, che sfregando sul primo tergite, particolarmente rigonfio, tramite il movimento attivo dell'addome produce la stridulazione.

INTRODUCTION

Even if SCHOLTZ & BROWN (1996) and KRÁL *et al.* (2006) have proposed for Bolboceratinae (Geotrupidae) the rank of family, not all authors agree with this taxonomical proposal (e.g., VERDÚ *et al.*, 1998). Bolboceratinae have a worldwide distribution, and the genus *Bolbelasmus* Boucomont, 1911 covers Palearctic and Nearctic regions. Species of this genus have been found borrowing to different species of hypogeous fungi, are mainly crepuscular and nocturnal and are attracted to light. Further, they stridulate vigorously (FABRA, 2003).

In accordance with KRIKKEN (1977), up to day five species have been recorded in Europe, W-Asia and N-Africa, namely *B. bocchus* (Erichson, 1841), *B. gallicus* (Mulsant, 1842), *B. nireus* (Reitter, 1895), *B. tauricus* Petrovitz, 1973 and *B. unicornis* (Schrank, 1789). We had the chance to put together a series of specimens collected in Sicily (Italy), belonging to a species which resulted different from those already known in the Mediterranean area. In the present paper we describe it as a new species.

MATERIAL AND METHODS

Specimens examined are listed below. Series of images of specimens with different focal planes were taken by M. Romano using a Canon Eos 450D digital camera mounting a Sigma 70 mm 1:2.8 DG macro, and were integrated using the freeware Helicon Focus (http://d-studio.com.ua/products/helicon_focus/download/index.html). Measurements on mounted specimens were taken using a digital calliper (preciseness 0.01 mm) and a stereomicroscope. Aedeagi were drawn by M.A., after re-hydration in physiological solution.

Two males and two females were recorded separately in the laboratory to restrict interactions by a digital recorder (Edirol R09HR) and sampled fragments from the recordings were analysed with the Cool Edit software. Three specimens were reared in laboratory to observe their behaviour and when they were producing sounds.

Abbreviations of Museums. MHNG = Museum d'Histoire Naturelle, Genève; MRSNT = Museo Regionale di Scienze Naturali, Turin; MSNG = Museo Civico di Storia Naturale 'G.Doria', Genoa; MZUCT = Museo di Zoologia dell'Università, Catania; MZUF = Museo di Zoologia La Specola dell'Università, Florence; MZUPA = Museo di Zoologia dell'Università 'P.Doderlein', Palermo.

RESULTS AND DISCUSSION

Previous records of Bolbelasmus in Sicily

RAGUSA (1893) was the first entomologist who collected a species of *Bolbelasmus* in Sicily. He sent the specimen, a female, to E. Reitter, who tentatively identified it as *Bolbelasmus gallicus*, and wrote on a label that the study of the male was needed to confirm his identification (ARNONE, 2010). When Ragusa obtained the male, was convinced that it belonged to *B. gallicus* and without consulting again Reitter, decided to publish the record. Thus, this species was reported within the catalogues of LUIGIONI (1929), PORTA (1932) and AGOGLITTA *et al.* (2006), without checking the specimens preserved in the Ragusa collection. In 1974 B.M. collected on the sandy coast of Balestrate (Palermo) (by daylight, not attracted to the light, as reported by AGOGLITTA *et al.*, 2006) another male, finding that characters of the scutellum and the head pattern did not overlap with characteristics of *B. gallicus*. That specimen was examined and identified by Jacques Baraud as *B. unicornis* (BARAUD, 1977). Since 1974 few specimens of *Bolbelasmus* were found (cf. ALIQUÒ, 1988, who recorded it as *B. gallicus*; AGOGLITTA *et al.*, 2006, who identified two specimens as *B. unicornis*¹). By chance, in the last years a series of specimens was collected, attracted by the light in the night or found during the day on sand soils. Thus, it was possible to dispose of some males and females to compare them with the two species previously reported from Sicily and the others known in the Mediterranean area, and we were able to confirm that Sicilian specimens belong to an undescribed species.

***Bolbelasmus romanorum* new species**

Specimens examined (10 ♂♂, 10 ♀♀): Italy, Sicily, Piazza Armerina (Enna) (1 ♂); Sicily, Termini Imerese (Palermo) (1 ♀); Sicily, Palermo (1 ♀); Sicily (1 ♂ and 1 ♀ tentatively identified as *B. gallicus* by Reitter) (paratypes, Coll. Ragusa, MZUCT); Sicily, Balestrate, foce Calatubo (Palermo) 17.III.74, B. Massa (1 ♂) (holotypus, MSNG); Sicily, Pedalino (Ragusa) 1.V.72, A.Monastra (1 ♀) (allotypus, MSNG); Sicily, Marausa (Trapani) 18.XII.83, V.Aliquò (1 ♂) (paratypus, coll. Aliquò, Palermo); Sicily, Vendicari Nature Reserve (Siracusa)

¹ AGOGLITTA *et al.* (2006) report that these specimens, collected on Isle of Capo Passero (Siracusa) 29.XI.1997, are in coll. Zunino, now preserved at MRSNT, but we were not able to find them in the Turin Museum; however, M.A. could see them on 1998 and did not find differences with the other Sicilian specimens, then considered *B. unicornis*.

18.IV.09, B.Massa (1 ♂) (paratypus, coll. Arnone, Palermo); Sicily, Niscemi (Caltanissetta) IV.06 and XI.09, M.Zafarana (1 ♂, 1 ♀); Sicily, Bosco Santo Pietro Nature Reserve (Catania) X.98, M.Zafarana (1 ♂) (paratypi, coll. Zafarana, Niscemi); Sicily, Menfi 6.XI.09, 14.XI.09, 20.III.10, 28.III.10, 4.IV.10, 13.XI.10, A.Carapezza (1 ♂, 5 ♀♀) (paratypi, coll. Arnone, Palermo).

Description of the male (Figs. 1-2)

Shiny black, some specimens show brownish highlights, possibly because teguments are not completely sclerified. Labrum very slightly concave, sides rounded, surface rugulate-punctate.

Cephalic contours. Clypeus widely rounded, surface much punctate, with deep punctures merging together and looking as oval depressions, as in the labrum. Margin is raised. Genal angles are nearly tuberculate. Clypeo-frontal suture distinct, slightly undulated, frons immediately behind the suture has a high coniform tubercle. The frons is abundantly punctate, punctures are well deep and defined. Vertex is sparsely punctate, punctures are less deep than on frons.

Eye-canthus arcuate, with reflexed anterior margin, surface of canthus roughly punctate, separated from frons by frontolateral ridge extending to hind border of eye.

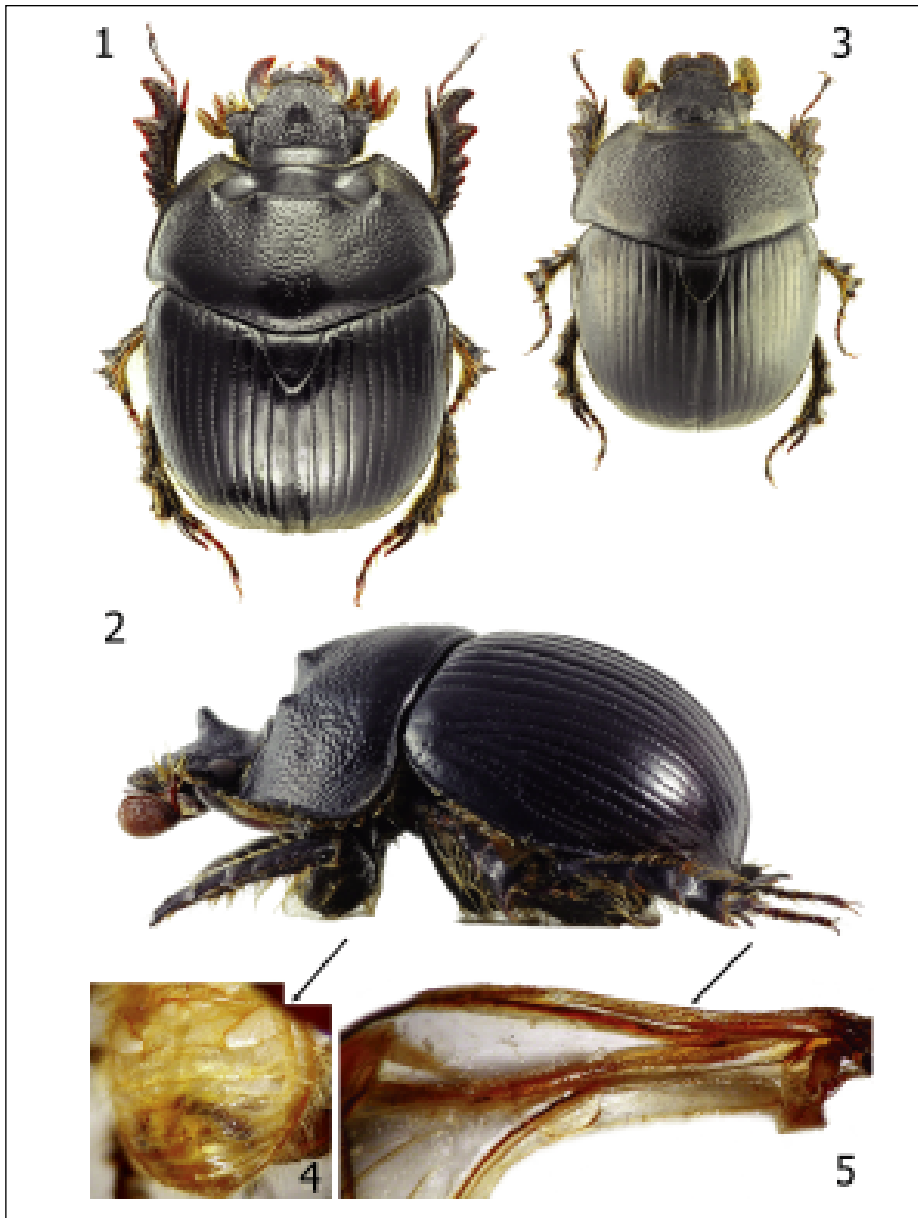
Pronotum medially bituberculate, tubercles are connected by concave arcuate ridge, anterior declivity is steep, base is marginate. Lateral tubercles are separated from median protrusion by a concavity. Pronotal punctation is double, on disc large and deep punctures are sparse with some concentrations, well defined, on the centre; small fine and less deep punctures are mixed with previous ones. On lateral sides punctures are very abundant and merge together, single punctures are no more clearly defined.

General surface of elytra are strongly convex. Juxtasutural striae are fine and punctate, discal striae have some deep punctures. Interstriae are moderately convex, with some very fine punctures.

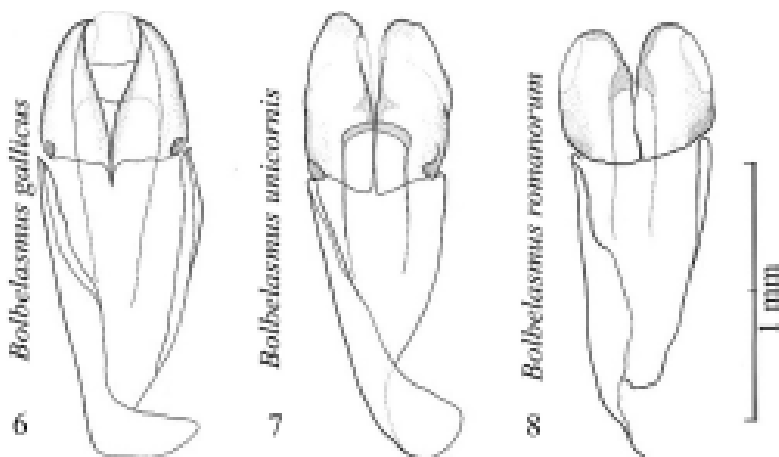
Scutellum. Very characteristic, with a few indistinct small punctures.

Fore tibiae have 7 external denticles, distally increasing, just rounded; terminal spur is acuminate and exceeds the second tarsal segment. Middle and hind tibiae have spinose fossorial elevations, distally developed. Terminal spurs of hind tibiae are subequal in length, upper is longer and reaches the third tarsal segment, lower is shorter and hardly exceeds the second tarsal segment.

Aedeagus (Fig. 8).



Figs. 1-5 — *Bolbelasmus romanorum* new species. 1) paratypus male collected at Marausa (Trapani) 18.XII.1983; 2) holotypus male collected at Balestrate (Palermo) 17.III.1974; 3) paratypus female collected at Menfi (Agrigento) 14.XI.2009; 4) abdominal segments of the paratypus female collected at Vendicari (Siracusa) 18.IV.2009, photographed in vivo; 5) wing of the paratypus female collected at Menfi 6.XI.2009 (1-3: photo by M. Romano; 4-5: photo by B. Massa).



Figs. 6-8 — Aedeagus of *B. gallicus* (Spain, Madrid, Villaviciosa de Odón 3.III.1987, J. Plaza, MSNG) (6), *B. unicornis* (Italy, Piedmont, coll. Ghiliani, MSNG) (7), *B. romanorum* holotypus (Sicily, Balestrate, foce Calatubo (Palermo) 17.III.74, B.Massa, MSNG) (8) (drawings by M. Arnone).

Description of the female (Fig. 3)

The female has the same characteristics of the male, with the exception of the following ones. Frontal horn is smaller and is reduced to a ridge, just raised on the centre. Pronotum in the anterior third has a ridge of the same length of the head. All the pronotum is much punctate, more than in the male, with very deep punctures.

Measurements (in mm)

Males. Body length: 11.28 ± 1.57 (min-max: 9.4-13.1); body width: 7.22 ± 0.85 (min-max: 6.0-8.0); scutellum length: 1.21 ± 0.15 (min-max: 0.95-1.34); scutellum width: 1.27 ± 0.20 (min-max: 0.95-1.45); scutellum length/width: 0.94 ± 0.04 (min-max: 0.92-1.0).

Females. Body length: 11.73 ± 0.67 (min-max: 10.9-12.7); body width: 7.48 ± 0.51 (min-max: 6.6-8.4); scutellum length: 1.28 ± 0.04 (min-max: 1.23-1.34); scutellum width: 1.33 ± 0.07 (min-max: 1.23-1.4); scutellum length/width: 0.96 ± 0.06 (min-max: 0.88-1.04).

Derivatio nominis. This species is named after our sincere friends, the late Francesco Paolo Romano and his son Marcello Romano; the latter assisted us during the preparation of the manuscript and carried out many photographs.

Sound production. *B. romanorum* emits a sound, which may be perceived also by human ears. It is produced by the friction of the outer lower borders of wings, which are provided by a row of microscopic bristles (*pars stridens*), with two wide swollen areas on the sides of the first abdominal segment (Figs. 4-5). When the insect moves actively the abdomen, produces its stridulation. We obtained two different oscillograms, one from males and the other from females. The song consists of monosyllabic echemes separated by intervals of about 20 msec. Each echeme has an average length of 15 msec. Oscillograms of males and females resulted to be different, females show a frequency impulse more marked, while males have a larger sound range than the female; the syllable structure is different in the two sexes. Also spectrograms show these differences, females emit songs at a higher frequency than males (Figs. 9-10).

According to FABRA (2003), *B. gallicus* produces the stridulation by the friction between the abdomen and elytra², and also its larvae produce a sound, as well as those of *B. bocchus*. It is well known that beetles produce sounds (cf. KASPER & HIRSCHBERGER, 2006; WESSEL, 2006), and in particular different stridulatory organs producing sounds have been found within Scarabaeoidea (cf. SCHOLZ, 1906; PALESTRINI *et al.*, 1988, 1990). It is less known the reason why they produce sounds. Additionally, ZUNINO & FERRERO (1988) have recorded sexual dimorphism in a Mexican genus of Geotrupidae, which eventually produces different stridulations. Different sounds of male and female may depend on possible relationships between sexes; in accordance with PALESTRINI & ZUNINO (1987), we should exclude the existence of distinctive acoustic contact between larvae and adults. Because we observed that sounds were emitted when the beetles were molested, we consider that they may be also produced as natural reaction to an inconvenience or as territorial signals.

Affinities

As above recorded, *Bolbelasmus* collected in Sicily were previously identified as *B. unicornis* or *B. gallicus*, but they differ very much from these species. We compared our species with the other five Mediterranean ones.

Bolbelasmus bocchus (Erichson, 1841) (Figs. 11-12)

Specimens examined (5 ♂♂, 1 ♀ of subsp. *bocchus*, photographs of 1 ♂ and 1 ♀ of subsp. *vaulogeri*): Spain, Madrid 3.III.87, J.Plaza (1 ♂); Madrid,

² Eventually in this species the sound should be also produced by the same type of *pars stridens* found by us on *B. romanorum*.

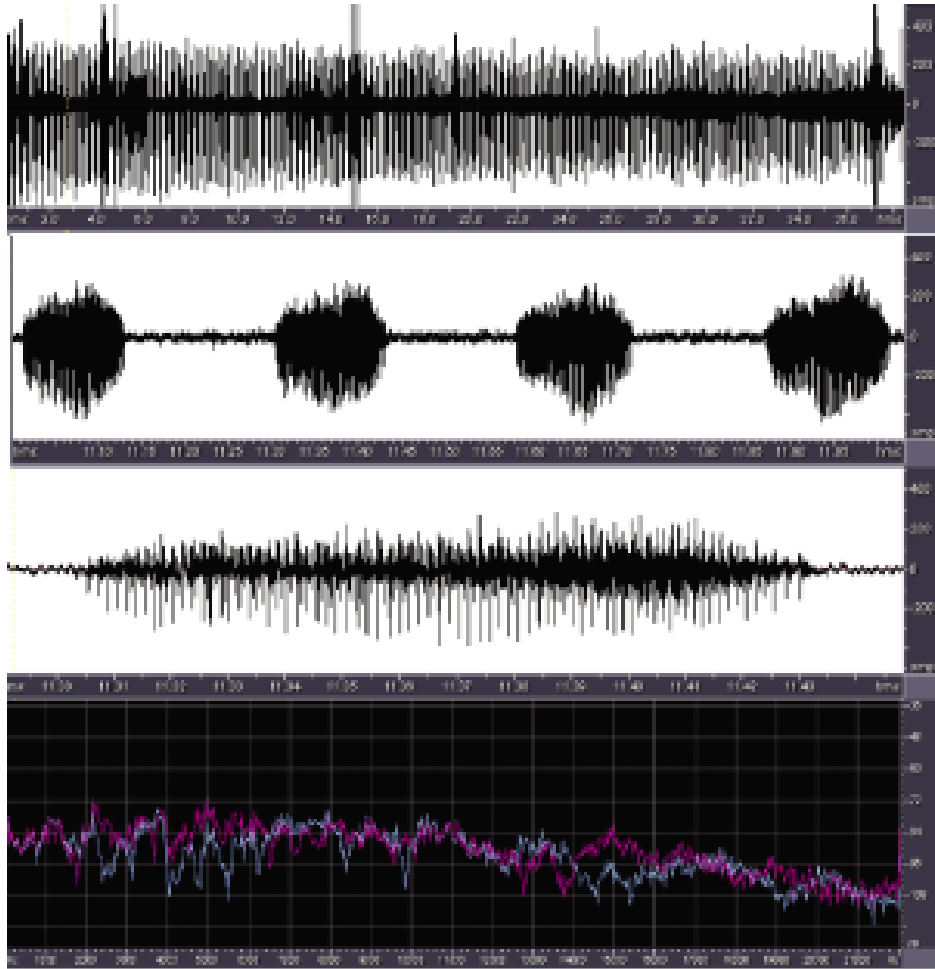


Fig. 9 — Oscillogram and spectrogram of the male of *Bolbelasmus romanorum* new species (specimen collected at Vèndicari 18.IV.2009, recorded on 19.IV.2009) (photo by F.M. Buzzetti).

G.Schramm (1 ♂); Murcia 10.V.80 (1 ♂); Morocco, Melilla, Pardo Alcaide (1 ♂); Algeria, Aflou 4.V.81, H.Pierotti (1 ♂) (MSNG); Morocco, Melilla, Pardo Alcaide (1 ♀) (MRSNT); Tunisia, Hammamet, Kuijten (1 ♂, 1 ♀, examined only photos) (coll. J.Krikken, Leiden).

The type locality of *bocchus* is in Algeria, it covers Spain (not Portugal: BRANCO, 2005), Tunisia, Algeria, Morocco, Libya (Cyrenaica) and Egypt (Mariut) (SCHATZMAYR, 1946; BARAUD, 1977, 1985, 1992); CHIKATUNOV & PAVLICEK (1997) also report it from Israel, but evidences are lacking. KRIKKEN (1977) recognizes two subspecies, *bocchus* in Spain, Morocco and

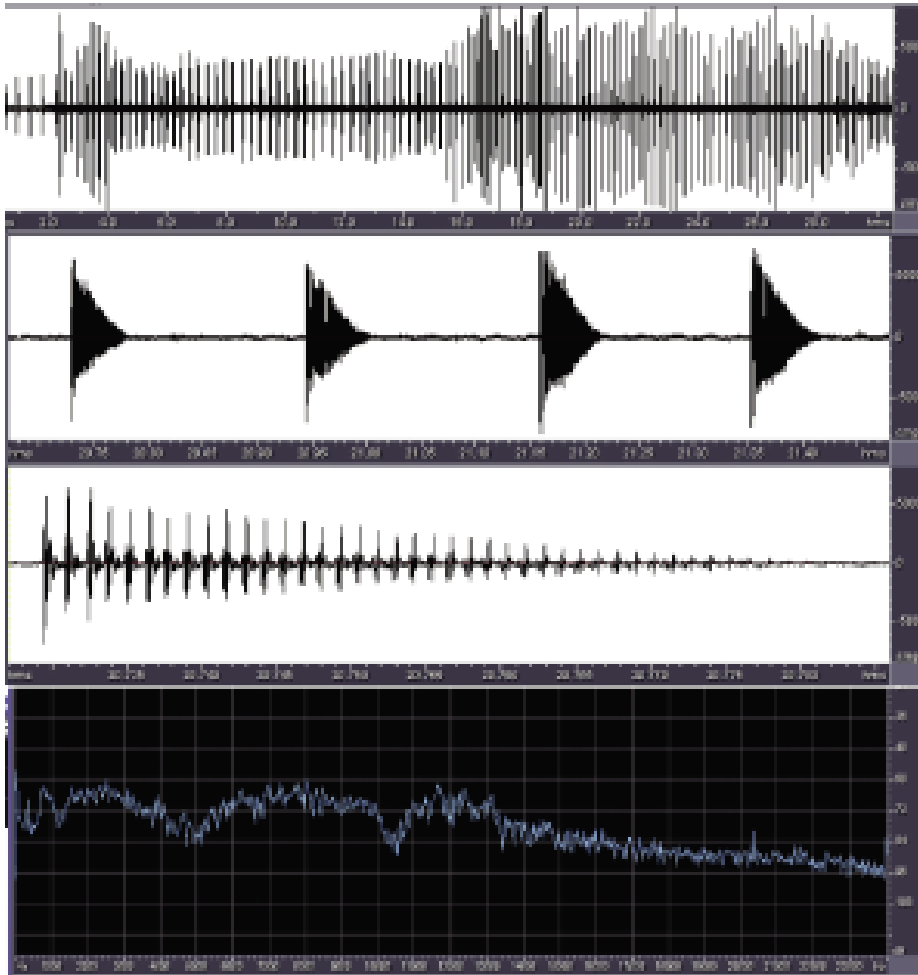


Fig. 10 — Oscillogram and spectrogram of the female of *Bolbelasmus romanorum* new species (specimen collected at Menfi 20.III.2010, recorded on 21.III.2010) (photo by F.M. Buzzetti).

Algeria, and *vaulgeri*³ Abeille, 1898 in Tunisia, which differs from the former for the profile of anterior declivity of pronotum interrupted by obliquely placed paramedian tubercle, the base of declivity more depressed, the paramedian tubercle basally not angulate, and the frontal horn with tip short, usually feebly bifid, in frontal view giving a strongly dilated impression.

These taxa differ from *B. romanorum* for the shape of the eye-canths, the presence of a bifid horn on the head, the profile of fore margin of the prono-

³ However, BRANCO (2005) considers unavailable the name *vaulgeri* for Tunisian *Bolbelasmus*.

tum, the position and the length of pronotal horns, the scarce punctuation on the pronotum (smooth in the hind portion). GONZÁLEZ PEÑA (1979) has depicted the aedeagus of *B. bocchus bocchus*, which has different parameres of that of *B. romanorum* (Fig. 8).

Bolbelasmus gallicus (Mulsant, 1842) (Fig. 13)

Specimens examined (12 ♂♂, 4 ♀♀): Spain, Madrid (3 ♂♂); Spain, Sierra de Grados, Avila (1 ♂); France (1 ♂); France, Toulon (1 ♂); France, Provence (1 ♂); France, Le Beausset (1 ♂, 2 ♀♀); France, Marseille (1 ♂); France, Var (1 ♂) (MSNG); France, Hyères (1 ♂, 1 ♀) (MZUPA); France (1 ♂, 1 ♀) (MRSNT).

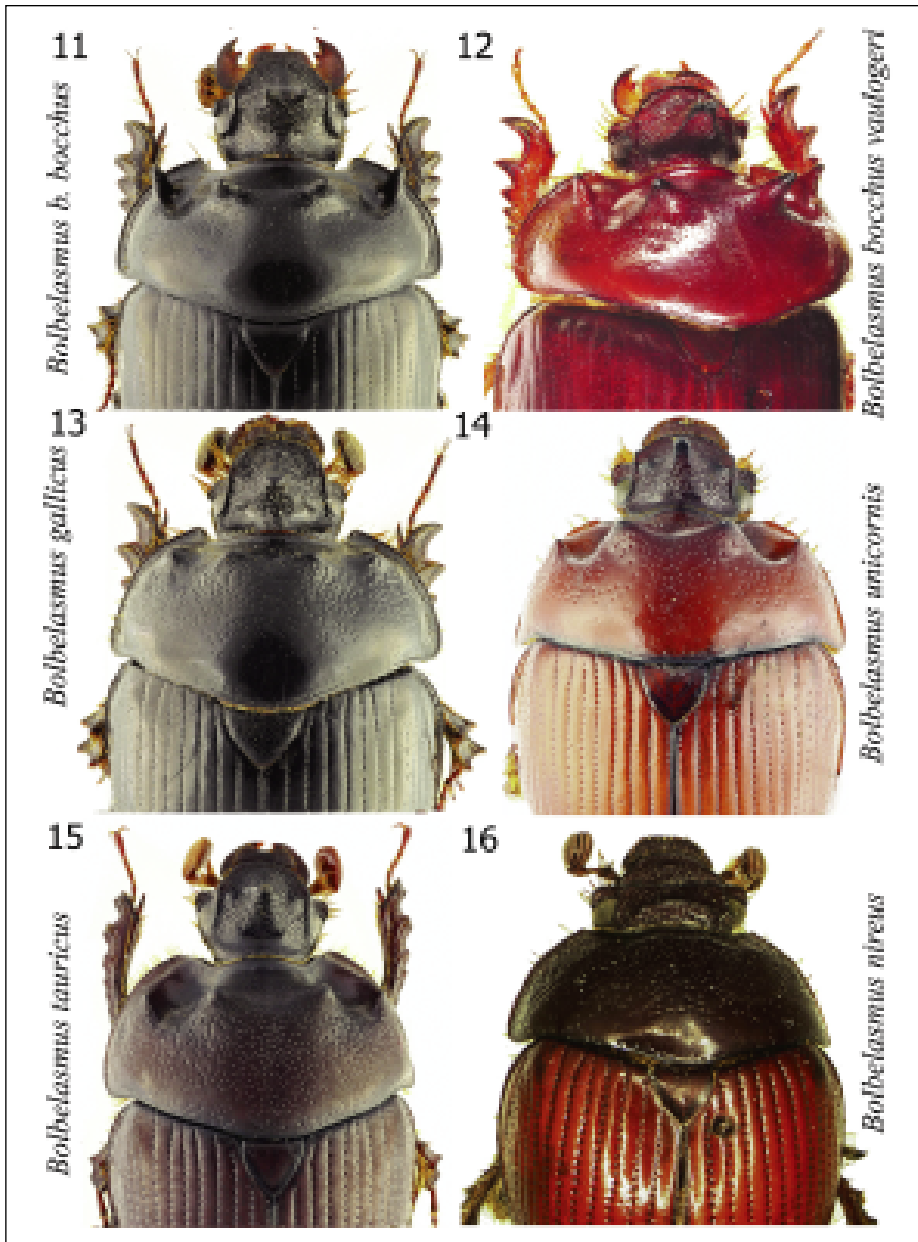
The type locality is in France. It covers Mediterranean France, Pyrenees, Iberian peninsula and N-W Italy (PORTA, 1932; BARAUD, 1977, 1992). Because the presence in Sicily was assumed on the basis of the records of RAGUSA (1893) and ALIQUÒ (1988), which actually resulted to be *B. romanorum*, now it has to be omitted from the Sicilian fauna. It differs from *B. romanorum* for the shape of the clypeus, eye-canthi, the type of punctures (both in the head and in the pronotum, particularly on the sides), the fine and close punctures on the scutellum, and bigger punctures on the discal striae of the elytra.

GONZÁLEZ PEÑA (1979) has depicted its aedeagus parameres, which are similar to those drawn by M.A. and differ from those of *B. romanorum* (compare Fig. 6 with 8).

Bolbelasmus unicornis (Schrank, 1789) (Fig. 14)

Specimens examined (10 ♂♂, 4 ♀♀): Italy, Piedmont (4 ♂♂, 2 ♀♀); Italy, Lombardy, Milan (1 ♂, 1 ♀); Austria (2 ♂♂, 1 ♀); Serbia, Ruma (1 ♂) (MSNG); Italy, Piedmont, Baudi (1 ♂), L. Carrara (1 ♂) (MZUF).

Its type locality is in Austria. It also covers Switzerland, France, Germany, Great Britain, Hungary, N Italy, Greece, Balkan peninsula, Poland, Romania, Check and Slovak Republics, Ukraine, Crete and Rhodes (SCHATZAMAYR, 1936; BARAUD, 1977; LUMARET, 1990; NÁDAI, 2006). Italian records of *B. unicornis* actually cover Piedmont, Lombardy, Trentino, Veneto and Friuli (BENASSO, 1971), but its actual distribution should be defined checking carefully specimens preserved in museums and private collections. Its presence in Sicily, as reported above, has to be omitted. Concerning differences between *B. romanorum* and *B. unicornis*, they interest the shape of the scutellum, the punctuation of pronotum and head, the shape of eye-canthi and clypeus, the position of lateral pronotal horns, and the size of punctures along the discal striae of elytra. Further, general colour of *B. unicornis* is reddish and aedeagus parameres differ from those of *B. romanorum* (compare Fig. 7 with 8).



Figs. 11-16 — Species and subspecies of the genus *Bolbelasmus* known in the Mediterranean area: 11) *B. b. bocchus* (male from Algeria); 12) *B. bocchus vaulogeri* (male from Tunisia); 13) *B. gallicus* (male from France); 14) *B. unicornis* (male from Italy, Piedmont); 15) *B. tauricus* (male from Turkey); 16) *B. nireus* (female from Iraq) (11, 13, 14, 15: photo by M. Romano; 12: photo by J. Krikken; 16: photo by G. Cuccodoro).

Bolbelasmus tauricus Petrovitz, 1973 (Fig. 15)

Specimens examined: Turkey, Bereketli (Denizli) 5.VII.65, H.Pierotti & A.Perissinotto (1 ♂) (MSNG).

It is probably an endemic species of Turkey (type locality: Namrun). It differs from *B. romanorum* for the shape of eye-canthi, the presence of smaller punctures on clypeus, head and pronotum, the position of lateral pronotal horns, and bigger punctures on the discal striae of the elytra.

Bolbelasmus nireus (Reitter, 1895) (Fig. 16)

Specimen (examined only photos): Iraq, Assur (1 ♀) (MHNG).

Its distribution covers Iraq, Iran and Turkey (type locality: Akbes, which currently is in Turkey, not in Syria, KEITH, 2005). It differs from *B. romanorum* for the shape of eye-canthi, the position of lateral pronotum horns, the presence of bigger punctures on the central area of the pronotum, and bigger punctures on the discal striae of the elytra. Further, general colour is brownish, mainly on the elytrae.

Acknowledgements. We are indebted with Marcello Romano, who carried out many photographs included in this paper, Attilio Carapezza, who presented us the series of specimens of *Bolbelasmus romanorum*, collected near Menfi (Sicily), Carlo Monastra, who consented to present to the Museo Civico di Storia Naturale 'G.Doria' of Genoa the specimen designated as allotypus, collected by his father, the late Armando Monastra. We also thank very much Vittorio Aliquò and Manuel Zafarana, who loaned specimens preserved in their collections, Roberto Poggi, who loaned us some specimens preserved in the Museo Civico di Storia Naturale 'G.Doria' of Genoa, Luca Picciau, who loaned us some specimens of Museo Regionale di Scienze Naturali di Turin, Giorgio Sabella, who consented us to study the material of the collection Enrico Ragusa, preserved in the Dipartimento di Biologia Animale dell'Università di Catania, Maurizio Sarà and Mathia Coco, who consented us to study specimens preserved in the Museo di Zoologia dell'Università of Palermo, Luca Bartolozzi, who loaned specimens of Museo di Zoologia 'La Specola' dell'Università of Florence, Giulio Cucodoro, who sent us some photographs of *Bolbelasmus nireus* preserved in the Muséum d'Histoire Naturelle of Geneva, Jan Krikken who carried out some photographs of *Bolbelasmus bocchus vaulogeri* preserved in his collection. Alberto Ballerio and Stefano Ziani kindly sent some suggestions and bibliographic references, Filippo M. Buzzetti and Paolo Fontana provided us with some useful interpretations of bioacoustics. Finally, we express our gratitude to Daniel Juřena from Check Republic, who shared within the forum 'Entomologi Italiani' his knowledge on *Bolbelasmus unicornis*.

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