20

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Physeter macrocephalus Linnaeus, 1758 - S. Nicola Arcella (Calabria, S-Tyrrhenian Sea)

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The Cetacean biodiversity in the Italian Seas (Mammalia Cetacea). The Cetaceans are the marine Mammals more specialized for life in the aquatic environment, having achieved during their evolution profound morphological, anatomical and physiological adaptations. The Cetaceans are considered up to now a monophyletic taxon (Order Cetacea Brisson, 1762), but recent studies at the molecular level have shown that they are closely related to the Order Artiodactyla, considered probably a paraphyletic group. This means that some groups (especially the hippos) are more closely related to Whales than with the other animals of this order. Modern phylogenetic analysis take Artiodactyls and Cetaceans for monophyletic clade of Cetartiodactyla Montgelard, Catzeflis et Douzery, 1997. The Order Cetartiodactyla was adopted by the International Whaling Commission in 2003, by I.U.C.N. (Red List of Threatened Species, Version 2015.3) and by the Committee on Taxonomy of the Society for Marine Mammalogy (List of October 2014). Most zoologists, however, still consider the living Cetaceans as a separate order, with 90 described species divided into two suborders, Odontoceti Flower, 1867 (Toothed Whales), and Mysticeti Flower, 1864 (Baleen Whales): the first one with 10 families and 76 species (with one species, *Lipotes vexillifer*, "possibly extinct", and one Sousa un-named species, Australian Humpback Dolphin); the second one is divided into four families with 14 species. The Cetofauna of the Mediterranean basin can be considered as a subset of the North Atlantic one with 23 regular species, as they live, breed and feed in this sea: no species is endemic, they are abundantly widespread species in all the oceans of the globe. Eight of them are sighted on a regular basis in Italian seas: one species of Mysticeti, the Fin Whale *Balaenoptera physalus* (Linnaeus, 1758) (Balaenopteridae) and seven species of Odontoceti: the Sperm Whale *Physeter macrocephalus* Linnaeus, 1758 (= *P. catodon*) (Physeteridae); the Cuvier's Beaked Whale *Ziphius cavirostris* Gray, 1865 (Ziphiidae); and five species of the family Delphinidae (the Short-Beacked Common Dolphin *Delphinus delphis* Linnaeus, 1758, the Common Bottlenose Dolphin *Tursiops truncatus* (Montagu, 1821), the Striped Dolphin *Stenella coeruleoalba* (Meyen, 1833), the Risso's Dolphin *Grampus griseus* (G. Cuvier, 1812), and the Long-Finned Pilot Whale *Globicephala melas* (Traill, 1809)). In Italian waters there are also other species considered as "irregular" since there is no certainty that they reproduce, but there may allocate for some periods: the Common Minke Whale *Balaenoptera acutorostrata* Lacépède, 1804, and three dolphin species (the Killer Whale *Orcinus orca* (Linnaeus, 1758), the False Killer Whale *Pseudorca crassidens* (Owen, 1846) and the Rough-Toothed Dolphin *Steno bredanensis* (Lesson, 1828)). Concerning other species there are very few records: North Atlantic Right Whale *Eubalaena glacialis* (Müller, 1776) (Mysticeti Balaenidae), the Humpback Whale *Megaptera novaeangliae* (Borowski, 1781) (Balaenopteridae), the Dwarf Sperm Whale *Kogia sima* (Owen, 1866) (Kogiidae), and two species of Ziphiidae, the Sowerby's Beaked Whale *Mesoplodon bidens* (Sowerby, 1804) and the Gervais' Beaked Whale *Mesoplodon europaeus* (Gervais, 1855). Cetaceans are protected at international level by CITES (Appendices I and II), by the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992) on the conservation of natural habitats and of wild fauna and flora (annex II and IV), and a lot of species are mentioned on the IUCN Red List of Threatened Species. At European level some species are protected by the "Barcelona Convention" on the Protection of the Marine Environment and the Mediterranean Coast (and its new Application Protocol relative to Special Protection Zones and the Biological Diversity in the Mediterranean adopted on 1995), the "Bonn Convention" on the Conservation of Migratory Species of Wild Animals, the "Bern Convention" relative to the Conservation of European Wildlife and Natural Habitats, and by the Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS). For these reasons the Cetaceans are protected by special laws in many countries.

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cover photo by **Giuseppe Gruosso**

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The effects of afforestation and vegetation conversion on plant diversity: a case study in S-W Syrian Mountains

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ABSTRACT

The effect of afforestation and conversion of natural vegetation on plant diversity was investigated in 4 sites in the South-Western Syrian Mountains. Plot and plotless sampling tech-niques were used to assess vegetation parameters within and outside afforested sites. The results of the survey indicated the presence of 80 species belonging to 70 genera and 24 families in the study area. Seventy five percent of the species were of medicinal and forage values where the remaining were of wild relatives of fruit trees. Therophytes and hemicryptophytes dominated plant communities in the all sites. Average species richness was 12.6 in open areas compared to 6.7 in forest tracts. Nine species were limited to forest plantations only. Shannon-Weiner diversity index was 63% greater in open than in afforested areas. Species similarity between open and afforested areas was 47%. Significant differences existed between afforested and open area sites with regard to the number of species and diversity index, however, no significant differences were observed among afforested sites nor among open area sites for measured parameters. It is concluded that afforestation and land conversion effect on the composition and structure of natural vegetation is obvious, however this effect is highly variable. It is recommended that afforestation and land conversion operations be integrated into national strategies for biodiversity conservation in the country to maintain habitats and minimize loss of native species.

KEY WORDS

Pinus; afforestation; conversion; coniferous; Syria; Mediterranean.

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INTRODUCTION

The Syrian vegetation is heterogeneous due to bio-geographical, historical, climatic, physiognomic, and geomorphological factors (Zohary, 1973; Nahal, 1981; Khouzami & Nahal, 1983; Quezel, 1985; Nahal, 1995; Quézel et al., 1999). These factors contributed to emerging distinctive ecosystems that harbor a number of plant species exceeding 3100 (Mouterde, 1966). Furthermore, vegetation cover is characterized by instability and vulnerability due to anthropogenic activities (Nahal, 1995; Abido, 1999; Ghazal, 2008). Afforestation and conversion of natural forest into forest plantations contribute to this instability and vulnerability. These operations are believed to harm ecosystem biodiversity and interfere with biodiversity conservation goals (Fleming & Freedman, 1998; Maestre & Cortina, 2004; Carnus et al., 2006, Brockerhoff et al., 2008). However, this issue is still under

debate due to site locations, modalities of afforestations, ecological context and the definition of biodiversity itself (Allen et al., 1995; Bremer & Farley, 2010). Changes in the composition, decrease of richness and abundance of understory species have been reported after afforestation due to microclimate changes at site level (Elmarsdottir & Magnusson, 2007). The impact also differs according to afforested species, where light penetration through the canopy of trees plays an important role in recruitment of lower vegetation. Broadleaf species allow more light penetration compared to conifers creating better conditions for recruitment of understory species (Pourbabaei et al., 2012; Yang et al., 2014). It has been reported that habitat dependent species are the most affected by afforestation operations (Amici et al., 2012; Calviño-Cancela et al., 2012).

A number of researchers consider conversion of natural forest to plantation yields limited habitats and niches (Bernhard-Reversat, 2001); thus negatively affecting richness of native species (Meers et al., 2010; Pourbabaei et al., 2012). On the other hand, it is well known that original land cover, replaced species, age and density of stands contribute to habitat formations leading to controversial effects of conversion on biodiversity (Brockerhoff et al., 2001; Hartley, 2002; Carnus et al., 2006; Gil-Tena et al., 2007; Brockerhoff et al., 2008; González-Moreno et al., 2011). For instance, decreasing stand density or stand basal area, makes favorable conditions for light demanding species, thus in-creasing understory plant diversity and richness (Bone et al., 1997; Parker et al., 2001; Carnevale & Montagnini, 2002).

Mediterranean natural forests and woodlands are habitats for a wide spectrum of native species (Naveh, 1975; Proença et al., 2010; Bergner et al., 2015). Meanwhile, they provide humans with many products as well as environmental and cultural services (Croitoru, 2007). To this end, the South-Western Syrian Mountains form an ecotone where the Mediterranean, Irano-Turanian biogeographic regions meet (Zohary, 1973; Cohen et al., 1981, Abido, 2000). With its unique climate and topography the area supports Eu-Mediterranean vegetation type of rich plant diversity; making its conservation a priority (Abido, 1999; Chikhali, 2000; Ghazal, 2008). However, large tracts of these mountains have been subjected to extensive afforestation and land conversion operations. The current study explores vegetation structure and composition of the area and the effect of afforestation and the conversion of natural forests into plantations on plant diversity.

MATERIAL AND METHODS

Study site

The study area is composed of three adjacent sites where, afforestation and conversion of natural forests have taken place since the 1980s (Table 1, Fig. 1). In these sites, pine plantations replaced degraded natural vegetation that composed mainly of evergreen and non-deciduous trees and shrubs of less than 20% coverage. Native cover species include *Amygdalus communis* L., *Crataegus azarolus*, *C. monogyna* Jacq., *Quercus calliprinos*, *Q. infectoria*, *Prunus cerasus* L., *P. mahaleb* L., *P. microcarpa*, *P. ursina* Kotschy, *Pyrus syriaca* and *Poterium spinosum* L. Soil is terra rosa of 20-30 cm deep on limestone. The climate is sub humid Mediterranean type of meso-thermo variant (Nahal, 1981; Quezel, 1985) with monthly averages precipitation and temper-ature of 500 mm and 14 ºC respectively. Drought period extends to 6 months a year (Fig. 2).

Methods

Three 10x10 m quadrates were taken randomly in and outside each of the three plantations.

Figure 1. Location of the study area: S-W Syrian Mountains.

Site	Latitudes	Altitude (m)	Physiography	Anthropogenic activities	Stand
Wadi Barada (Nabi Habeel)	33° 36" N, 36° 22" E	1310	Gentle to steep slopes (30-35%) North, South, West	Afforestation - grazing	*Cedrus libani, Cupressus arizonica, C. sempervirens.*
Dimas (Dier Ashaer)	33° 35" N, 36° 24" E	1250	Steep slopes (45%) North, East, South	Afforestation - land clearing	*P. brutia, Cupressus sempervirens.*
Zabadani (Jebel Saeeda)	33° 36" N, 36° 31" E	1246	Moderate slope (20-30%); North, East, West	Afforestation - Reforestation - grazing – tourism - collection of medicinal and aromatic plants	*Pinus brutia, Cupressus arizonica, C. sempervirens.*
Rawda (Zarzar)	33° 37" N, 36° 01" E	1210	Gentle slopes (15-20%); North, East, South	Grazing- wood cutting, - collection of medicinal and aromatic plants	Natural landscape (Maquis)

Table 1. Study site attributes: S-W Syrian Mountains.

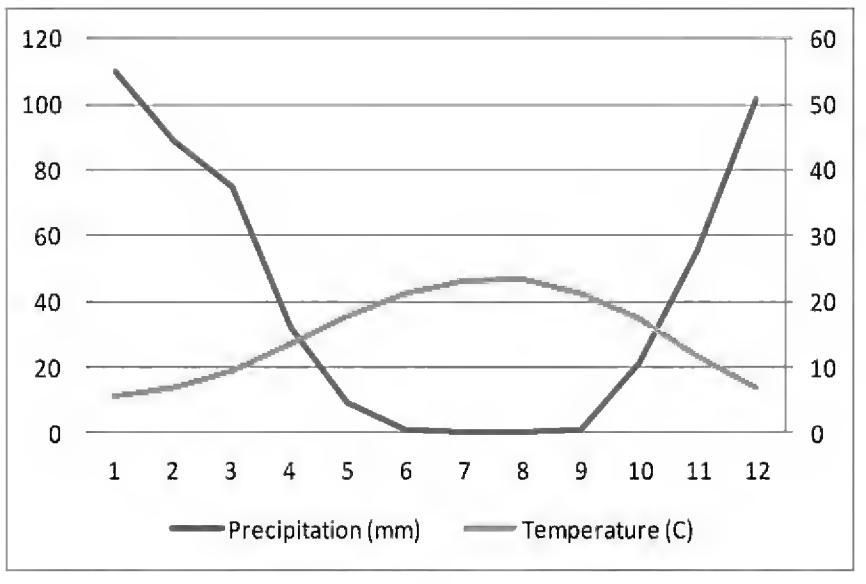

Figure 2. Average annual rainfall, temperature and dry period.

The basal area of the stands was estimated by measuring diameter at breast height (DBH) of all trees in the forested plots using diameter tape (Husch et al., 2003). Height of 6 trees representing dominant, co-dominant and medium height were measured using clinometers. Basal area and overall density of trees were calculated and expressed in hectares. Relative coverage, density, frequency and importance value of species for outside plots were calculated using a 60 meter- line transect laid along the edge of each quadrate (Mueller-Dombois & Ellenberg, 1974; Magurran, 1988). Shannon-Weiner diversity index (H') was calculated (Mueller-Dombois & Ellenberg, 1974) as:

$$H' = -\sum_{i=1}^{s} P_i \, In \, Pi$$

where S is Number of unique species, Pi is the proportional abundance of species i and In Pi = the natural logarithm of the proportional abundance of species i.

Søerensons similarity index (ISs) was calculated according to Mueller-Dombois & Ellenberg (1974); Boyce & Ellison (2001).

$$IS_s = \frac{2C}{A+B} \times 100$$

where, C is the common species between paired plots, A and B are a number of encountered species in each plot. Species' life form was classified according to Raunikiaer (1934).

Analysis of variance between sites was conducted at 5% level using CoHort Statistical Package. Furthermore, cluster analysis for sites was implemented using Multi-Variable Statistical Package (MVSP). Uses of species were acquired from Louhaichi et al. (2009), Al-Oudat & Qadir (2011). Species were identified according to Mouterde (1966) and Tohmé & Tohmé (2007).

RESULTS AND DISCUSSION

The outcomes of the study showed the presence of 80 species belonging to 70 genera and 24 families in the study region (Table 2). This reflects a species genera ratio of 1.14 and the genera, families ratio of 2.92. Forty percent of the surveyed species

Scientific name	Family name	Life form class	Open areas	Forest land	Wild relatives	Medi-cinal	Forage
Acer hermoneum (Bornm.) Schwer.	Aceraceae	Ph	+	-	*	*	
Achillea falcata L.	Asteraceae	Ch	+	-		*	
Achillea membranacea (Labill.) DC.	Asteraceae	Ch	+	-		*	
Achillea santolina L.	Asteraceae	He	+	-		*	
Aegilops sp.	Gramineae	Th	+	+			*
Allium paniculatum L.	Liliaceae	Ch	+	-		*	
Amygdalus orientalis Miller	Rosaceae	Ph	+	-	*	*	*
Anagallis arvensis phoenicea Vollm.	Asteraceae	Th	-	+			
Anchusa strigosa Retz.	Boraginaceae	Th	+	-		*	
Anthemis cotula L.	Asteraceae	Th	+	+			
Artemisia herba-alba Asso	Asteraceae	Ch	+	-		*	
Asphodeline lutea (L.) Reichenb	Asteraceae	Cr	+	+			*
Asphodelus microcarpus Salzm. et Viv.	Asteraceae	Ch	+	-			
Bromus tectorum L.	Gramineae	Th	+	+			*
Capparis spinosa L.	Capparaceae	Ch	+	-			*
Capsella bursa-pastoris (L.) Medik.	Brassicaceae	Th	+	-			*
Carduus pycnocephalus L.	Asteraceae	He	+	-		*	
Caucalis tenella Delile	Caryophyllaceae	Th	+	-			*
Centaurea iberica Trevir. et Spreng.	Asteraceae	Th	+	-			
Cichorium pumilum Jacq.	Asteraceae	Th	-	+		*	
Cirsium libanoticum DC.	Asteraceae	He	-	+		*	
Cirsium phyllocephalum Boiss. et Blanche	Asteraceae	He	+	+			
Colchicum brachyphyllum Boiss. et Hausskn.	Liliaceae	Cr	+	+		*	
Coronilla scorpioides (L.) Koch	Fabaceae	Th	+	-			
Crataegus azarolus L.	Rosaceae	Ph	+	+	*	*	*
Descurainia sophia (L.) Webb ex Prantl.	Brassicaceae	Th	+	-			*
Ecballium elaterium (L.) A. Rich.	Cucurbiaceae	He	-	+		*	
Echinops viscosus Rchb.	Asteraceae	He	+	+			
Erodium hirtum (Forssk.) Willd.	Geraniaceae	He	+	-			*
Eryngium creticum Lam.	Umbellifera	He	+	+		*	*
Euphorbia macroclada Boiss.	Euphorbiaceae	He	+	-		*	
Fibigia clypeata (L.) Medik.	Brassicaceae	He	+	-		*	
Fritillaria libanotica (Boiss.)	Liliaceae	He	+	-			
Gundelia tournefortii L.	Asteraceae	He	+	-			
Haplophyllum fruticulosum G.Don	Rutaceae	He	+	-			
Hordeum bulbosum L.	Gramineae	He	+	+			*
Koeleria cristata (L.) Roem. et Schult.	Gramineae	Th	-	+			*
Lactuca orientalis (Boiss.) Boiss	Asteraceae	Ch	+	-		*	
Linum strictum L.	Linaceae	Th	+	-			
Malva sylvestris L.	Malviaceae	He	+	-		*	

Table 2/1. Life forms and uses of species found in open and afforested areas. Ph: Phanerophyte, Ch: Chamaephyte, Th: Therophyte, Cr: Cryptophyte, He: Hemicryptophyte, +: presence, -: absence (continued).

Scientific name	Family name	Life form class	Open areas	Forest land	Wild relatives	Medi-cinal	Forage
Marrubium vulgare L.	Lamiaceae	He	+	-		*	
Notobasis syriaca (L.) Cass.	Asteraceae	Th	+	+		*	
Ononis natrix L.	Fabaceae	Ch	+	-		*	
Papaver syriacum Boiss. et Bl.	Papaveraceae	Th	+	+		*	
Salvia triloba L. fil.	Lamiaceae	Ch	+	+		*	
Pistacia atlantica Desf.	Anacardiaceae	Ph	+	-	*		
Pisum sativum L.	Fabaceae	Th	+	-		*	
Poa bulbosa L.	Gramineae	Ch	+	+			*
Poa sinaica Steud.	Gramineae	Ch	+	+			*
Prunus microcarpa C.A.Mey	Rosaceae	Ph	+	-	*	*	*
Pterocephalus plumosus (L.) Coulter	Dipsacaceae	Th	+	-		*	
Pyrus syriaca Boiss.	Rosaceae	Ph	+	-	*	*	
Quercus calliprinos Webb.	Fagaceae	Ph	+	-	*		
Quercus infectoria Olivier	Fagaceae	Ph	+	-	*		
Ranunculus arvenis L.	Ranunculaceae	Th	+	-		*	
Salvia pinardi Boiss.	Lamiaceae	He	+	+		*	
Sarcopoterium spinosum (L.) Spach	Rosaceae	Ch	+	-		*	
Scabiosa prolifera L.	Dipsacaceae	Th	+	-			
Scolymus hispanicus L.	Asteraceae	Th	-	+		*	
Scolymus maculatus L.	Asteraceae	Th	+	+		*	
Scorzonera parviflora Jacq.	Asteraceae	He	+	+		*	
Scrophularia libanotica Boiss.	Scrophulariaceae	He	+	+			*
Senecio sp.	Asteraceae	Th	+	+			*
Serratula kurdica Post	Asteraceae	He	+	+		*	
Silene latifolia Poir.	Caryophyllaceae	He	+	-		*	
Sinapis alba L.	Brassicaceae	Th	+	+			*
Sinapis arvensis L.	Brassicaceae	Th	+	-			*
Stachys nivea Labill.	Lamiaceae	Ch	+	-			*
Stipa barbata Desf.	Gramineae	He	+	+			*
Taraxacum syriacum Boiss.	Asteraceae	He	+	-		*	*
Teucrium polium L.	Lamiaceae	Ch	+	+		*	
Thymus syriacus Boiss.	Lamiaceae	Ch	+	-		*	
Tragopogon latifolius Boiss.	Asteraceae	He	+	-		*	
Trifolium campestre Schreb.	Fabaceae	Th	+	+			*
Trifolium purpureim Loisel.	Fabaceae	Th	+	+			*
Trifolium stellatum L.	Fabaceae	Th	+	+			*
Trigonella spinosa L.	Fabaceae	Th	+	+			*
Turgenia latifolia (L.) Hoffm.	Umbellifera	Th	+	-			
Vaccaria segetalis (Neck.) Garcke ex Asch.	Caryophyllaceae	Th	+	-		*	
Vicia sp.	Fabaceae	Th	-	+		*	*

Table 2/2. Life forms and uses of species found in open and afforested areas. Ph: Phanerophyte, Ch: Chamaephyte, Th: Therophyte, Cr: Cryptophyte, He: Hemicryptophyte, +: presence, -: absence.

were of medicinal value, 35% forage species and 9 wild relatives of fruit trees. The area was dominated by Therophytes (38%), Hemicryptophytes (30%), followed by Chamaephytes (20%) which reflects the dryness of the area and the prevailing of low temperature in winter months. Figure 3 presents the percentage of plants in each category of life forms in open and forested areas.

The plant community in open areas varied in structure and composition among sites due to physiographic and anthropogenic pressures. The community was dominated by a mixture of evergreen and deciduous species, of which *Amygdalus* spp., *Crataegus* ssp., *Poterium spinosum*, *Quercus calliprinos* and *Prunus* spp. were the prominent species. The community was stratified into two strata as dwarf trees (up to 4m) with average density of 500 tree ha^{-1} are dispersed among herbaceous and shrubby vegetation.

The following species with their importance values (IV) were observed outside plantation plots: *Coronila scorpioides* (29%), *Crataegus azarolus* (26%), *C. monogyna* (15%), *Poterium spinosum* (29%), *Sinapis arvensis* (19%), *Euphorbia macrocloda* (18%), *Stachys nivea* (17%) and *Prunus microcarpa* (6%). Other species of lesser IVs like *Asphodehine aestivus*, *Centaurea iberica* and *Salvia pinardi* were registered. The slopes of the study area were dominated by different woody species according to their water requirement. *Quercus calliprinos* dominated eastern slopes with 39% importance value, whereas northern slopes were occupied by *Crataegus azarolus* (25%) and *Prunus microcarpa* (8%). Meanwhile, southern slopes were occupied by *Asphodelus microcarpus*

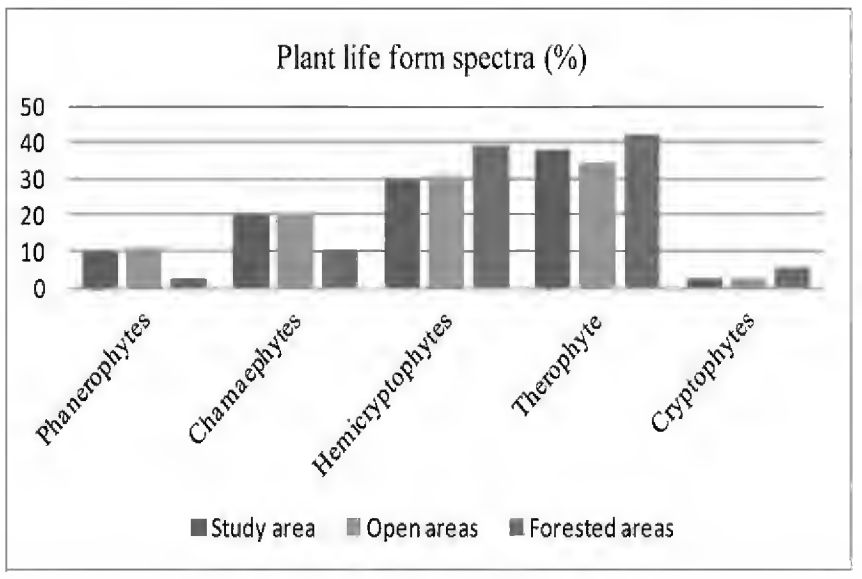

Figure 3. Plant life forms in open and afforested areas.

	Plot	Zabadani (BA: 24 m^2)			Wadi Barada (BA: 18 m^2)			Dimas (BA: 10 m^2)			Rawda (Natural landscape)		
Plot		1	2	3	1	2	3	1	2	3	1	2	3
Zabadani (BA: 24 m^2)	1	100.00											
	2	76.35	100.00										
	3	94.73	71.43	100.00									
Wadi Barada (BA: 18 m^2)	1	94.68	71.39	99.95	100.00								
	2	82.54	66.67	87.28	87.24	100.00							
	3	91.49	84.55	86.23	86.55	79.00	100.00						
Dimas (BA: 10 m^2)	1	86.28	64.04	91.52	91.48	96.40	78.29	100.00					
	2	90.27	67.37	95.52	95.57	91.85	81.91	95.75	100.00				
	3	94.14	70.89	99.41	99.46	86.79	85.70	91.02	95.24	100.00			
Rawda (Natural landscape)	1	56.51	39.12	60.88	60.92	64.89	49.85	68.09	64.74	61.38	100.00		
	2	70.67	50.46	75.57	75.61	79.99	63.08	83.47	79.83	75.92	83.76	100.00	
	3	43.00	28.93	46.67	46.71	50.08	37.52	52.84	49.96	47.10	81.98	66.78	10

Table 3. Similarity index among plots based on number of species and diversity index .

Source	df	Number of species				Shannon-Weiner **diversity index**			
		Type III SS	MS	F	P	Type III SS	MS	F	P
Blocks	2	32	16	0.71	0.53 ns	1.27	0.64	3.76	0.09 ns
Trt.	3	509.67	169.89	7.53	0.02 *	4.02	1.34	7.91	0.02 *
Error	6	135.33	22.56<-			1.02	0.17<-		
Total	11	677				6.31			

Table 4. ANOVA for number of species and Shannon-Weiner diversity index among the study sites.
*Significant at 5% (LSD 0.05 = 9.49 for number of species and 0.82 for diversity index).

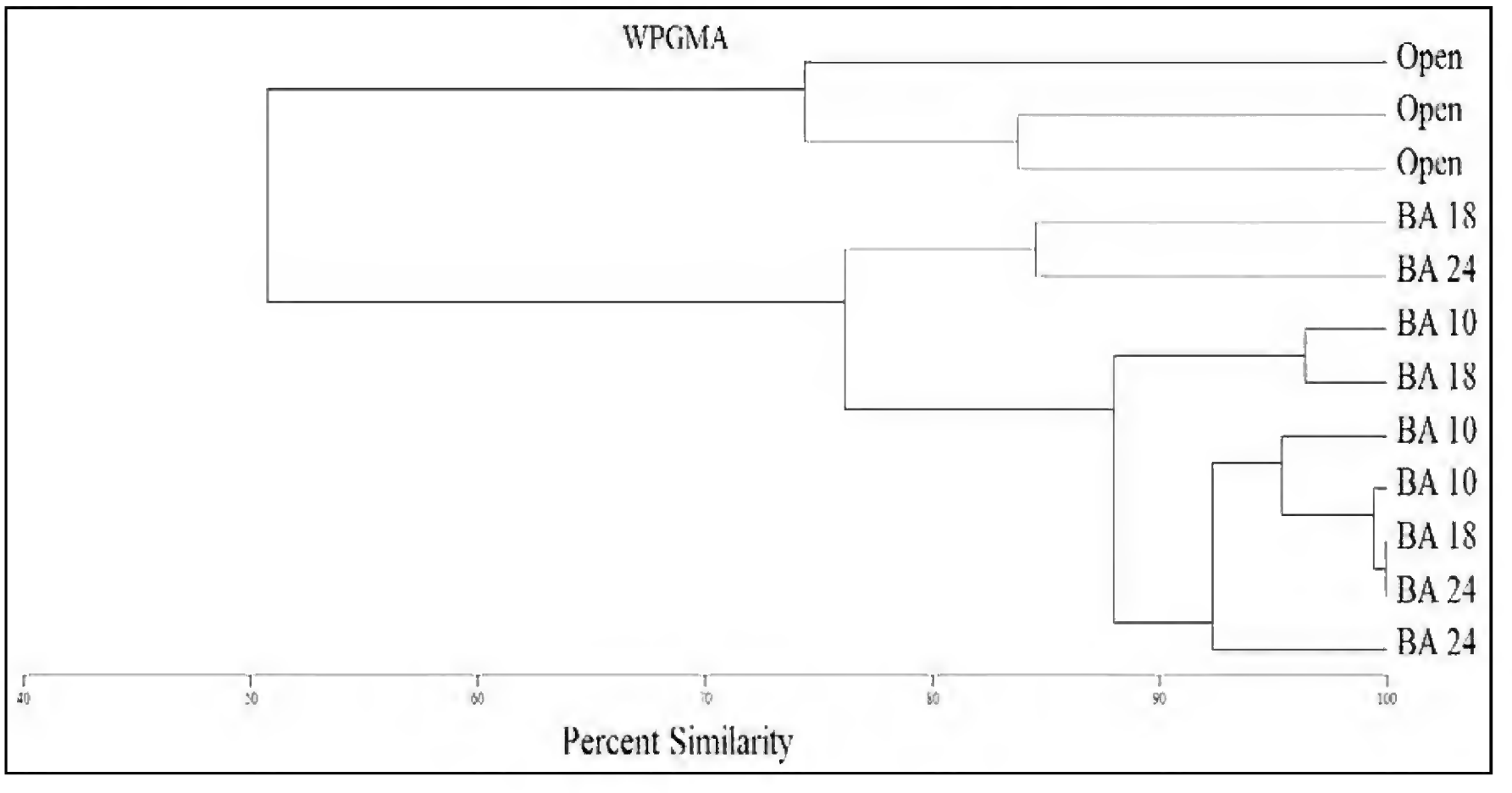

Figure 4. Cluster analysis among plots based on number of species and diversity index .

(72%) and *Poterium spinosum* (35%). Other herbaceous species existed on the slopes with lesser IVs. The dominance of *Poterium spinosum* and *Asphodelus microcarpus* indicates degradation of plant community as free ranging animals are roaming the site (Naveh, 1975; Thirgood, 1981; Giourga et al., 1998; Abido, 2000).

There were 73 species outside forested areas belonging to 24 families compared to 35 species related to 11 families in closed forest tracts. Forty five species were only found outside forest area, which represent 52% of the total species. Species richness was higher in open areas than in afforested areas, where average species richness was 12.6 in open areas compared to 6.7 in forest areas. Nine species were limited to forest plantations as height of trees were in the range of 10-15 meters. In the meantime, density and BA of trees ranged from 500 to 816 ha -1 and 10 to 24 m^2/ha consecutively. Shannon-Weiner diversity index was 63% greater in open than in afforested areas as a diversity index registered 3.92 and 1.46 for the open and afforested areas consecutively. This result is line with Sattout & Caligari (2011) where they related forest diversity with stand age, density and site history. Species similarity between open and afforested areas was 47%. Figure 4 and Table 3 illustrate the results of cluster analysis among plots with regard to the number of species and diversity index.

Significant differences existed between afforested sites and open area sites with regard to the number of species and diversity index, however, no

differences were observed among afforested nor among open area sites for measured parameters (Table 4). This result is in line with the findings of a number of researchers where highlighted the negative effects of afforestation on species diversity (Andrés & Ojeda, 2002; Cao et al., 2009; Pourbabaei et al., 2012).

CONCLUSIONS

The Natural vegetation of the study area represents a relic of natural forest with various degradation states as indicated by the presence of remnant of old natural forests as well as pioneer species in all sites of the study area forming a steppe vegetation. Afforestation and land conversion effect on the composition and structure of natural vegetation is obvious as the number and diversity of species were lower in afforested sites. However, this effect is highly variable as physiographic, anthropogenic activities and the structure and composition of afforested sites themselves contributed to this variability.

It is very important to incorporate afforestation and land conversion into national strategies for the conservation of biodiversity in the country in order to maintain habitats and native species.

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Occurrence of a nine-armed sea star larvae, *Luidia senegalensis* (Lamark, 1816) (Asteroidea Luidiidae), further north along Florida's east coast

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ABSTRACT The nine-armed sea star, *Luidia senegalensis* (Lamark, 1816) (Asteroidea Luidiidae), typically ranges from South American marine waters into Florida. Previous reports have documented this species collected as far north as latitude 28°N. This observation at 29.89°N represents the farthest north this species has been collected.

KEY WORDS *Luidia senegalensis*; Matanzas River Estuary; marine; sea star.

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INTRODUCTION

One of the major consequences of climate change is a shift in the latitudinal distributions of species (Parmesan, 2006). This shift is occurring in Northeast Florida, as the coastal marine ecosystem is changing from one dominated by salt marsh to one dominated by mangroves (Cavanaugh et al., 2015). Animal species also have been migrating northward, i.e. the mangrove tree crab, *Aratus pisonii* Milne-Edwards, 1853 (Decapoda Sesarmidae) (Riley et al., 2014) and gray snapper, *Lutjanus griseus* (Linnaeus, 1758) (Perciformes Lutjanidae), (Hare et al., 2012). The increase in air and water temperatures has the potential to open areas previously unavailable to non-native species (Kolbe et al., 2012). In aquatic systems, non-native species tend to have a decided advantage over native species in aquatic systems (Sorte et al., 2013).

The nine-armed sea star (*Luidia senegalensis*) (Lamark, 1816) (Asteroidea Luidiidae), has been documented in Florida, but the exact extent of its range is unknown (Tiffany, 1978; Lawrence et al., 1993). Observations indicate that this species is known from latitude 28°N and south in Florida (Tiffany, 1978).

Due to the continued increase in water and air temperatures, it is imperative to monitor for non-native species that can disrupt an ecosystem. The aim of the over-arching study in which this nine-armed sea star was discovered is to relate patterns of fish biodiversity, phytoplankton diversity and total chlorophyll-a, and major nutrient concentrations in the Matanzas River Estuary (MRE) region of northeast Florida. The study area is located from 26.6°-26.9°N latitude and is generally characterized by oceanic salinities > 30 ‰, low water residence times, and relatively low chlorophyll-a concentrations as compared to similar systems such as the Indian River Lagoon estuary system further south.

MATERIAL AND METHODS

As part of a monthly fish and phytoplankton sampling, two plankton tows were conducted

simultaneously on March 10th, 2015 in the Intracoastal Waterway in downtown St. Augustine, FL, USA (29.89°N, -81.31°W). The net consisted of 153 µm mesh with a 12.7 cm opening attached to a 1.16 m pole. Each phytoplankton tow was done for 3 minutes in duration. As the nets were pulled through the water, the sample was collected in a 125 ml plastic bottle with a screw cap and transported to the lab for identification.

Plankton identification from the duplicate tow samples was performed on March 11th, 2015 at Flagler College (St. Augustine, FL). 200 µl aliquots of sample were placed on a Lovin Field Finder Gridded Micro-slide (Cat #72266-01) and species were identified using a Nikon Eclipse E100 microscope under 100X magnification. When the organism was located, a picture was taken using an iPhone 4 camera (Fig. 1). Based on the grid size of the micro-slide, the species is approximately 100 µm in diameter. The picture was sent to the Florida Fish and Wildlife Conservation Commission (FWC) for verification on the identification of the species.

DISCUSSION

The positive identification received from FWC indicated that the species in Fig. 1 was indeed the nine-armed sea star. As stated previously, this species is commonly found in Florida, but has typically been documented to reside south of latitude 28°N (Tiffany, 1978). The observation of this species at 28.89°N likely represents the farthest north this species has ever been documented.

Figure 1. Picture of the nine-armed sea star (*Luidia senegalensis*) obtained from a plankton tow in the Matanzas River Estuary (MR in downtown St. Augustine).

The diet of the nine-armed sea star tends to consist primarily of gastropods and bivalves (Halpern, 1970; Gibran, 2002), most notably the common Atlantic abra, *Abra aequalis* (Say, 1822) (Veneroida Semelidae) (Halpern, 1970). Previous studies indicate that the MRE is home to the Atlantic abra and several other species preferred by the nine-armed sea star (Frazel, 2009; Hymel, 2009). Temperature and food are often cited as the some of the most important factors that determine sea star growth rates, and it appears that there is a food resource that can be exploited by the nine-armed sea star in the MRE.

The MRE currently is home to three documented sea star species: the Forbes sea star, *Asterias forbesi* (Desor, 1848) (Asteroidea Asteriidae), the royal sea star, *Astropecten articulatus* (Say, 1825) (Asteroidea Astropectinidae), and the lined sea star, *Luidia clathrata* (Say, 1825) (Asteroidea Luidiidae) (Frazel, 2009). Diet studies indicate that both the Forbes sea star (Menge, 1986) and the royal sea star (Wells at al., 1961) are generalists and consume gastropods as well as bivalves encountered, although the majority of the diet for the royal sea star tends to be gastropods rather than bivalves. McClintock & Lawrence (1985) found that the last species, the lined sea star, preferably feeds on the dwarf surf clam, *Mulinia lateralis* Say, 1822 (Veneroida Mactridae) when available, but will also feed on gastropods and other bivalves as well. The similar diet patterns of the various sea stars indicate the possibility of trophic overlap if the nine-armed sea star were to become established. Halpern (1970) notes that the growth rate of this sea star is much greater than many other temperate sea stars. This could become a decided advantage for limited food resources if competition did arise.

The second factor that is necessary for sea star survival is temperature (Halpern, 1970), however, very little information exists on the temperature tolerances of the nine-armed sea star. The Encyclopedia of Life has limited information based on collections made, and state the temperature range at which this organism is found is between 22.67 – 27.58 °C (*Luidia senegalensis,* 2015). Temperature

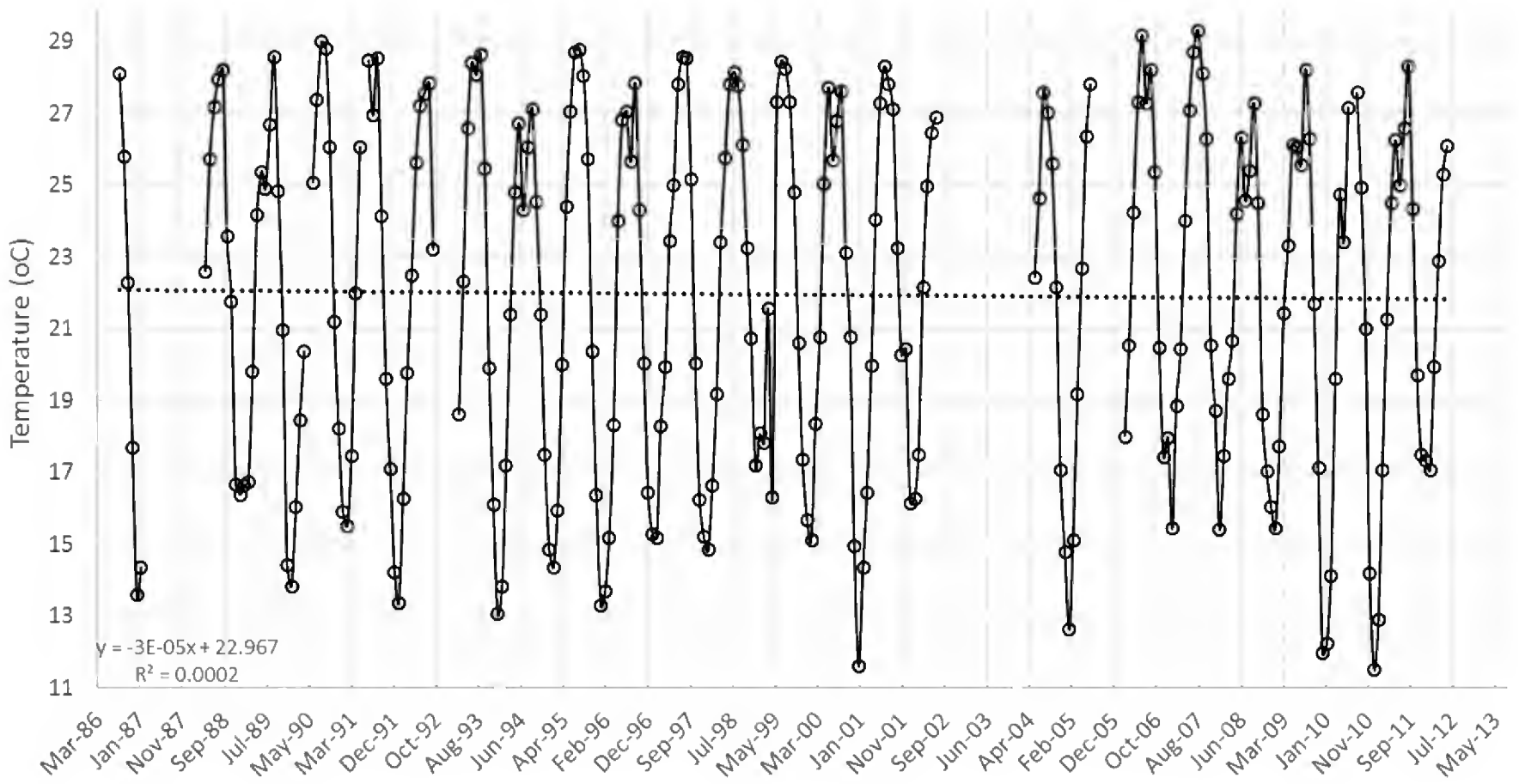

Figure 2. Temperature profile for St. Augustine pier from September 1986 to June 2012. These values were obtained from the National Oceanic and Atmospheric Administration's National Data Buoy Center; coordinates: 29.857°N, 81.265°W. Missing values indicate no data from that time point.

profiles from the St. Augustine pier (Fig. 2) indicate that ocean waters flowing into the MRE fall between these temperatures at times of the year. There are many instances in which the temperature does fall below 22.67 °C, which could be a limiting factor for this species. Assessment of temperatures from 1986–2012 also indicate that temperatures have not been increasing in this area. With so little information on temperature tolerances of this species, more intensive sampling will be necessary to determine if this species is indeed moving northward and capable of establishing a stable population.

Sampling efforts in the southeast US Intracoastal Waterway and MRE system are being conducted monthly. Along with plankton samples, fishes are sampled in this waterbody to monitor for changes in the community structure, and the possible presence of invasive species. A genetic barcoding effort has been started to positively identify each fish species and determine if non-native species are present or if hybridization is occurring in this ecotone. Documenting the current status of the estuary will be invaluable to determining the climatic and species changes that we have already begun to record.

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Catalogue of inland fishes of Chanthaburi Province, Eastern Gulf of Thailand Drainages

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ABSTRACT The present paper reports on a catalogue of inland fishes in Chanthaburi Province, Eastern Gulf of Thailand Drainages. All the species encountered in this region, belonging to 18 orders, 73 families and 229 species, are listed. In particular, *Crossocheilus reticulatus* (Fowler, 1934) (Cypriniformes Cyprinidae), *Pangio anguillaris* (Vaillant, 1902) and *P. oblonga* (Valenciennes, 1846) (Cypriniformes Cobitidae) are new records for Chanthaburi Province, entered in December 2007 and February 2012; description and distribution data of the three new records are provided here.

KEY WORDS *Crossocheilus reticulatus*; *Pangio anguillaris*; *Pangio oblonga*; Chanthaburi; Thailand.

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INTRODUCTION

The Asian Chanthaburi Basin originates at Kitchakut-Soidao mountain range. This river system runs through Chanthaburi Province, East Thailand, and flows into the Upper Gulf of Thailand at Laem Sing estuary, with a total length of about 123 kilometers. Chanthaburi Basin is a very important river basin but in some areas of it, such as Pongnum Ron District and South Soidao mountain range, very little is known about inland fishes population. At the present moment available data are scarce and fragmented making it difficult to use them.

A survey project aimed at studying freshwater fishes in Chanthaburi Province (see Fig. 1) was carried out in December 2007 and February 2012. We separated this area into two: a pool and a small stream in the mountain; te pool showed transparent slowly waters with an average width of about 20 m, average depth less than 1 m, and a combination of clay and sand on the botton; the stream had transparent and running fast waters with an average width of about 15 m, average depth ranging from 0.3–1.0 m, and a combination of rock and sand on the bottom.

We found specimens of *Crossocheilus reticulatus* (Fowler, 1934) (Cypriniformes Cyprinidae), *Pangio anguillaris* (Vaillant, 1902) and *P. oblonga* (Valenciennes, 1846) (Cypriniformes Cobitidae) in Chanthaburi Province. Three species are new r ecords in this area and are reported for the first time in this paper; for previous reviews, see Fowler, 1934; Smith, 1945; Sontirat, 1976; Suvatti, 1981; Karnasuta, 1993; Kottelat & Lim, 1993; Monkolprasit et al., 1997; Robert, 1997; Robert, 1998; Ng & Kottelat, 2000; Soonthornkit, 2001; Sontirat et al., 2006).

ABBREVATIONS. Standard length = SL; head length = HL.

RESULTS

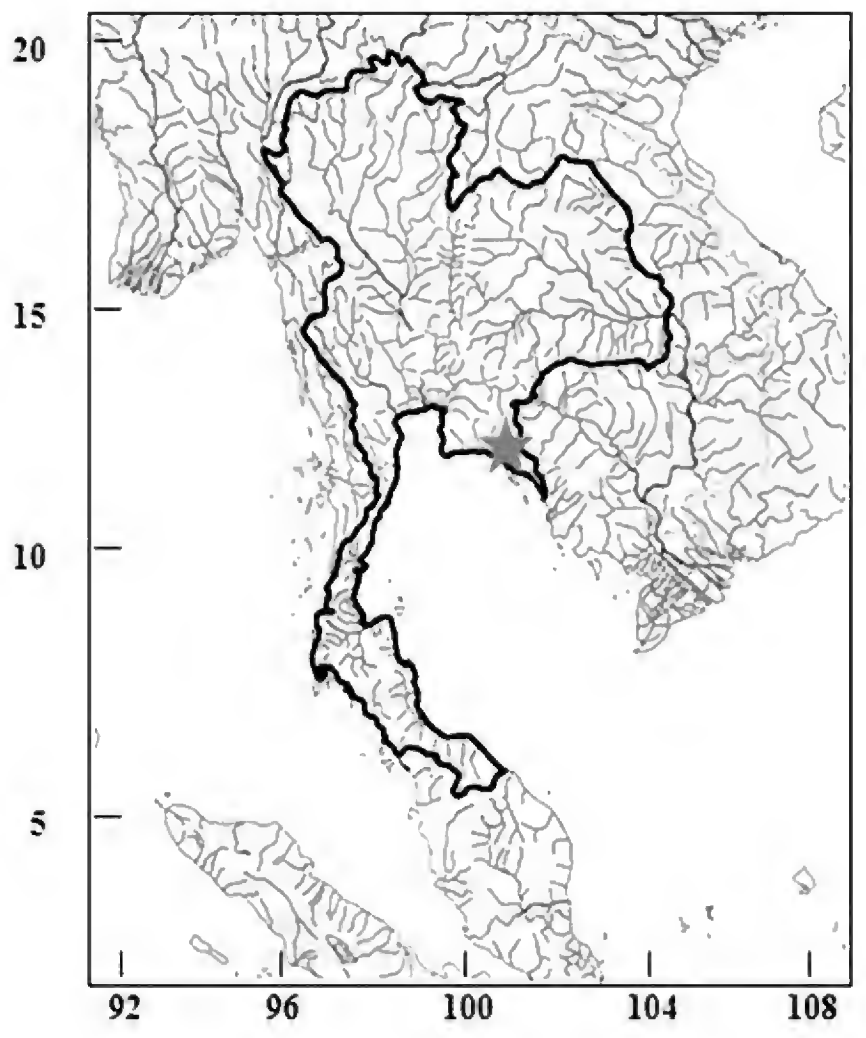

Figure 1. Study area: Chanthaburi Province, East Thailand.

CATALOGUE OF INLAND FISHES IN CHANTHABURI PROVINCE, EAST THAILAND

According to known literature (see above) and present study, inland fishes in Chanthaburi Province belong to 18 orders, 73 families and 229 species.

Order ORECTOLOBIFORMES Applegate, 1972
Family HEMISCYLLIIDAE Gill, 1862

Chiloscyllium indicum (Gmelin, 1789)
Chiloscyllium plagiosum (Anonymous [Bennett], 1830)

Order RAJIFORMES Berg, 1940
Family GYMNURIDAE Fowler, 1934

Gymnura micrura (Bloch et Schneider, 1801)

Order OSTEOGLOSSIFORMES Berg, 1940
Family OSTEOGLOSSIDAE Bonaparte, 1832

Scleropages formosus (Müller et Schlegel, 1844)

Family NOTOPTERIDAE Bleeker, 1859

Notopterus notopterus (Pallas, 1780)

Order CLUPEIFORMES Bleeker, 1959
Family CLUPEIDAE Cuvier, 1817

Anodontostoma chacunda (Hamilton, 1822)
Clupeichthys goniognathus Bleeker, 1855
Sardinella gibbosa (Bleeker, 1849)

Family ENGRAULIDAE Gill, 1861

Stolephorus indicus (van Hasselt, 1823)
Stolephorus insularis Hardenberg, 1933
Stolephorus tri (Bleeker, 1852)
Stolephorus waitei Jordan et Seale, 1926
Thryssa hamiltonii Gray, 1835
Thryssa mystax (Bloch et Schneider, 1801)
Thryssa setirostris (Broussonet, 1782)

Order CYPRINIFORMES Bleeker, 1859
Family CYPRINIDAE Swainson, 1839

Barbodes rhombeus Kottelat, 2000
Barbodes aurotaeniatus (Tirant, 1885)
Barbonymus gonionotus (Bleeker, 1850)
Barbonymus schwanenfeldii (Bleeker, 1853)
Barilius koratensis (Smith, 1931)
Cirrhinus microlepis Sauvage, 1878
Crossocheilus reticulatus (Fowler, 1934)
Cyclocheilichthys apogon (Valenciennes, 1842)
Danio albolineatus (Blyth, 1860)
Esomus metallicus Ahl, 1923
Garra fasciacauda Fowler, 1937
Garra cambodgiensis (Tirant, 1883)
Hampala macrolepidota Kuhl et Van Hasselt, 1823
Hypsibarbus vernayi (Norman, 1925)
Labiobarbus leptocheila (Valenciennes, 1842)
Labiobarbus lineatus (Sauvage, 1878)
Laubuca siamensis Fowler, 1939
Mystacoleucus marginatus (Valenciennes, 1842)
Neolissochilus sumatranus (Weber et de Beaufort, 1916)
Neolissochilus stracheyi (Day, 1871)

Oreichthys parvus Smith, 1933
Osteochilus microcephalus (Valenciennes, 1842)
Osteochilus schlegelii (Bleeker, 1851)
Osteochilus waandersii (Bleeker, 1852)
Osteochilus vittatus (Valenciennes, 1842)
Osteochilus lini Fowler, 1935
Oxygaster anomalura Van Hasselt, 1823
Parachela maculicauda (Smith, 1934)
Parachela siamensis (Günther, 1868)
Poropuntius bantamensis (Rendahl, 1920)
Poropuntius deauratus (Valenciennes, 1842)
Poropuntius normani Smith, 1931
Puntius leiacanthus (Bleeker, 1860)
Puntius masyai Smith, 1945
Puntigrus partipentazona (Fowler, 1934)
Puntius brevis (Bleeker, 1850)
Rasbora dusonensis (Bleeker, 1851)
Rasbora trilineata Steindachner, 1870
Rasbora borapetensis Smith, 1934
Rasbora myersi Brittan, 1954
Rasbora paviana Tirant, 1885
Systomus orphoides (Valenciennes, 1842)
Trigonostigma heteromorpha (Duncker, 1904)

Family GYRINOCHEILIDAE T.N. Gill, 1905

Gyrinocheilus aymonieri (Tirant, 1883)

Family COBITIDAE Swainson, 1838

Acanthopsoides gracilentus (Smith, 1945)
Acantopsis choirorhynchos (Bleeker, 1854)
Barbucca diabolica Roberts, 1989
Lepidocephalichthys hasselti (Valenciennes, 1846)
Lepidocephalichthys berdmorei (Blyth, 18609
Pangio anguillaris (Vaillant, 1902)
Pangio kuhlii (Valenciennes, 1846)
Pangio oblonga (Valenciennes, 1846)
Serpenticobitis zonata Kottelat, 1998
Yasuhikotakia sidthimunki (Klausewitz, 1959)

Family BALITORIDAE Swainson, 1839

Balitora annamitica Kottelat, 1988
Homaloptera modesta (Vinciguerra, 1890)
Homaloptera sexmaculata Fowler, 1934
Homaloptera orthogoniata Vaillant, 1902
Homaloptera smithi Hora, 1932
Homaloptera zollingeri Bleeker, 1853
Nemacheilus binotatus Smith, 1933
Nemacheilus masyai Smith, 1933
Nemacheilus pallidus Kottelat, 1990
Nemacheilus platiceps Kottelat, 1990
Schistura deignani (Smith, 1945)
Schistura kohchangensis (Smith, 1933)
Schistura nicholsi (Smith, 1933)
Schistura schultzi (Smith, 1945)
Schistura sexcauda (Fowler, 1937)

Order SILURIFORMES Cuvier, 1816
Family AMBLYCIPITIDAE Day, 1873

Amblyceps foratum Ng et Kottelat, 2000

Family AKYSIDAE Gill, 1861

Akysis maculipinnis Fowler, 1934
Pseudobagarius macronemus (Bleeker, 1860)

Family SISORIDAE Bleeker, 1858

Glyptothorax fuscus Fowler, 1934
Glyptothorax major (Boulenger, 1894)
Glyptothorax trilineatus Blyth, 1860

Family SILURIDAE Rafinesque, 1815

Ompok siluroides Lacepède, 1803
Pterocryptis torrentis (Kobayakawa, 1989)
Silurichthys phaiosoma (Bleeker, 1851)
Silurichthys hasseltii Bleeker, 1858
Silurichthys schneideri Volz, 1904

Family PLOTOSIDAE Bleeker, 1858

Plotosus canius Hamilton, 1822

Family CLARIIDAE Bonaparte, 1845

Clarias batrachus (Linnaeus, 1758)

Family BAGRIDAE Bleeker, 1858

Hemibagrus nemurus (Valenciennes, 1840)
Leiocassis micropogon (Bleeker, 1852)
Mystus cavasius (Hamilton, 1822)
Mystus castaneus Ng, 2002
Pseudomystus stenomus (Valenciennes, 1840)
Pseudomystus siamensis (Regan, 1913)

Family ARIIDAE Bleeker, 1858

Arius maculatus (Thunberg, 1792)
Arius venosus Valenciennes, 1840
Batrachocephalus mino (Hamilton, 1822)
Hexanematichthys sagor (Hamilton, 1822)
Osteogeneiosus militaris (Linnaeus, 1758)
Plicofollis argyropleuron (Valenciennes, 1840)

Order AULOPIFORMES D.E. Rosen, 1973
Family SYNODONTIDAE Gill, 1861

Saurida tumbil (Bloch, 1795)

Order GADIFORMES Goodrich, 1909
Family BREGMACEROTIDAE Gill, 1872

Bregmaceros mcclellandi Thompson, 1840

Order BATRACHOIDIFORMES Goodrich, 1909
Family BATRACHOIDIDAE Jordan, 1896
Allenbatrachus grunniens (Linnaeus, 1758)

Order ATHERINIFORMES D.E. Rosen, 1966
Family PHALLOSTETHIDAE Regan, 1916

Neostethus bicornis Regan, 1916
Neostethus lankesteri Regan, 1916
Phenacostethus smithi Myers, 1928

Order BELONIFORMES L.S. Berg, 1937
Family BELONIDAE Bonaparte, 1835

Xenentodon cancila (Hamilton, 1822)

Family EXOCOETIDAE Risso, 1827

Cheilopogon arcticeps (Günther, 1866)

Family HEMIRAMPHIDAE Gill, 1859

Dermogenys siamensis Fowler, 1934
Zenarchopterus ectuntio (Hamilton, 1822)

Order SYNGNATHIFORMES Berg, 1940

Family CENTRISCIDAE Bonaparte, 1831

Centriscus scutatus Linnaeus, 1758

Family SYNGNATHIDAE Bonaparte, 1831

Doryichthys boaja (Bleeker, 1851)
Doryichthys martensii (Peters, 1868)
Hippocampus kuda Bleeker, 1852

Order CYPRINODONTIFORMES L.S. Berg, 1940
Family APLOCHEILIDAE Bleeker, 1859

Aplocheilus panchax (Hamilton, 1822)

Order SYNBRANCHIFORMES Nelson, 1994
Family SYNBRANCHIDAE Bonaparte, 1835

Monopterus albus (Zuiew, 1793)

Family MASTACEMBELIDAE Swainson, 1839

Macrognathus circumcinctus (Hora, 1924)
Macrognathus siamensis (Günther, 1861)
Mastacembelus armatus (Lacepède, 1800)
Mastacembelus favus Hora, 1924

Order SCORPAENIFORMES Greenwood et al., 1966
Family APISTIDAE Gill, 1859

Apistus carinatus (Bloch et Schneider, 1801)

Family PLATYCEPHALIDAE Swainson, 1839

Grammoplites scaber (Linnaeus, 1758)
Platycephalus indicus (Linnaeus, 1758)

Family SYNANCEIIDAE Swainson, 1839

Inimicus didactylus (Pallas, 1769)
Trachicephalus uranoscopus (Bloch et Schneider, 1801)

Family TETRAROGIDAE Smith, 1949

Paracentropogon longispinis (Cuvier, 1829)
Pterois russelii Bennett, 1831

Order PERCIFORMES Bleeker, 1859
Family AMBASSIDAE Klunzinger, 1870

Parambassis siamensis (Fowler, 1937)

Family LATIDAE Jordan, 1888

Lates calcarifer (Bloch, 1790)

Family APOGONIDAE Günther, 1859

Apogon hyalosoma Bleeker, 1852
Apogon multitaeniatus Cuvier, 1828

Family SILLAGINIDAE Richardson, 1846

Sillago sihama (Forsskål, 1775)

Family CARANGIDAE Rafinesque, 1815

Alectis ciliaris (Bloch, 1787)
Carangoides praeustus (Anonymous [Bennett], 1830)
Caranx sexfasciatus Quoy et Gaimard, 1825
Parastromateus niger (Bloch, 1795)
Scomberoides lysan (Forsskål, 1775)

Family LEIOGNATHIDAE Gill, 1893

Gazza minuta (Bloch, 1795)
Leiognathus daura (Cuvier, 1829)
Secutor ruconius (Hamilton, 1822)

Family LUTJANIDAE Gill, 1861

Lutjanus sanguineus (Cuvier, 1828)
Lutjanus vitta (Quoy et Gaimard, 1824)

Family LOBOTIDAE Gill, 1861

Lobotes surinamensis (Bloch, 1790)

Family GERREIDAE Bleeker, 1859

Gerres erythrourus (Bloch, 1791)
Gerres setifer (Hamilton, 1822)

Family HAEMULIDAE Gill, 1885

Plectorhinchus nigrus (Cuvier, 1830)
Pomadasys hasta (Bloch, 1790)
Pomadasys maculatus (Bloch, 1793)

Family SPARIDAE Rafinesque, 1818

Acanthopagrus berda (Forsskål, 1775)

Family POLYNEMIDAE Rafinesque, 1815

Eleutheronema tetradactylum (Shaw, 1804)
Eleutheronema tridactylum (Bleeker, 1849)

Family SCIAENIDAE Cuvier, 1829

Nibea soldado (Lacepède, 1802)
Pennahia argentata (Houttuyn, 1782)

Family MULLIDAE Rafinesque, 1815

Upeneus sulphureus Cuvier, 1829
Upeneus tragula Richardson, 1846
Upeneus vittatus (Forsskål, 1775)

Family MONODACTYLIDAE Jordan et Evermann, 1898

Monodactylus argenteus (Linnaeus, 1758)

Family TAXOTIDAE Bleeker, 1859

Toxotes jaculatrix (Pallas, 1767)

Family POMACENTRIDAE Bonaparte, 1831

Abudefduf bengalensis (Bloch, 1787)
Neopomacentrus taeniurus (Bleeker, 1856)
Pristotis obtusirostris (Günther, 1862)

Family NANDIDAE Bleeker, 1852

Nandus nebulosus (Gray, 1835)
Pristolepis fasciata (Bleeker, 1851)

Family TERAPONTIDAE Richardson, 1842

Pelates sexlineatus (Quoy et Gaimard, 1825)
Terapon theraps Cuvier, 1829

Family CEPOLIDAE Rafinesque, 1815

Acanthocepola limbata (Valenciennes, 1835)

Family LABRIDAE Cuvier, 1816

Halichoeres argus (Bloch et Schneider, 1801)
Halichoeres nigrescens (Bloch et Schneider, 1801)
Thalassoma lunare (Linnaeus, 1758)

Family BLENNIIDAE Rafinesque, 1810

Istiblennius dussumieri (Valenciennes, 1836)
Petroscirtes mitratus Rüppell, 1830

Family CALLIONYMIDAE Bonaparte, 1831

Dactylopus dactylopus (Valenciennes, 1837)

Family ELEOTRIDAE Bonaparte, 1835

Butis butis (Hamilton, 1822)
Butis gymnopomus (Bleeker, 1853)
Ophiocara porocephala (Valenciennes, 1837)

Family GOBIIDAE Cuvier, 1816

Acentrogobius bontii (Bleeker, 1849)
Acentrogobius caninus (Valenciennes, 1837)
Acentrogobius chlorostigmatoides (Bleeker, 1849)
Acentrogobius viridipunctatus (Valenciennes, 1837)
Callogobius hasseltii (Bleeker, 1851)
Cryptocentrus callopterus Smith, 1945
Cryptocentrus diproctotaenia Bleeker, 1876
Eugnathogobius oligactis (Bleeker, 1875)
Glossogobius giuris (Hamilton, 1822)
Mahidolia mystacina (Valenciennes, 1837)
Oxyurichthys microlepis (Bleeker, 1849)
Parapocryptes serperaster (Richardson, 1846)
Periophthalmus barbarus (Linnaeus, 1766)
Priolepis semidoliata (Valenciennes, 1837)
Scartelaos histophorus (Valenciennes, 1837)
Valenciennea muralis (Valenciennes, 1837)
Yongeichthys nebulosus (Forsskål, 1775)

Family SCATOPHAGIDAE Gill, 1883

Scatophagus argus (Linnaeus, 1766)

Family SPHYRAENIDAE Rafinesque, 1815

Sphyraena barracuda (Edwards, 1771)
Sphyraena flavicauda Rüppell, 1838
Sphyraena obtusata Cuvier, 1829

Family SCOMBRIDAE Rafinesque, 1815

Scomberomorus commerson (Lacepède, 1800)
Scomberomorus guttatus (Bloch et Schneider, 1801)

Family DREPANEIDAE Gill, 1872

Drepane punctata (Linnaeus, 1758)

Family ANABANTIDAE Bonaparte, 1831

Anabas testudineus (Bloch, 1792)

Family OSPHRONEMIDAE van der Hoeven, 1832

Betta taeniata Regan, 1910
Betta prima Kottelat, 1994
Trichogaster trichopterus (Pallas, 1770)
Trichopsis pumila (Arnold, 1936)
Trichopsis vittata (Cuvier, 1831)

Family CHANNIDAE Fowler, 1934

Channa gachua (Hamilton, 1822)
Channa lucius (Cuvier, 1831)
Channa striata (Bloch, 1793)

Family CYNOGLOSSIDAE Jordan, 1888

Cynoglossus lingua Hamilton, 1822

Order PLEURONECTIFORMES Linnaeus, 1758
Family SOLEIDAE Bonaparte, 1833

Brachirus orientalis (Bloch et Schneider, 1801)

Family PARALICHTHYIDAE Regan, 1910

Pseudorhombus arsius (Hamilton, 1822)
Pseudorhombus oligodon (Bleeker, 1854)

Order TETRAODONTIFORMES L.S. Berg, 1940
Family BALISTIDAE Rafinesque, 1810

Abalistes stellatus (Anonymous, 1798)

Family DIODONTIDAE Bonaparte, 1835

Diodon holocanthus Linnaeus, 1758

Family TETRAODONTIDAE Bonaparte, 1831

Arothron leopardus (Day, 1878)
Arothron stellatus (Bloch et Schneider, 1801)
Tetraodon cambodgiensis Chabanaud, 1923
Tetraodon fluviatilis Hamilton, 1822
Tetraodon leiurus Bleeker, 1851

Family TRIACANTHIDAE Bleeker, 1859

Triacanthus biaculeatus (Bloch, 1786)

NEW RECORDS FOR CHANTHABURI PROVINCE

Crossocheilus reticulatus (Fowler, 1934)

EXAMINED MATERIAL. 3 specimens, 48.3–61.1 mm SL, Pongnum Ron District, Chanthaburi Province, East Thailand, XII.2007 and II.2012, legit S. Kulabtong (Fig. 2).

DESCRIPTION. *Crossocheilus reticulatus* is compress, body depth is 26.23–27.1 %SL. Body width is 12.28–12.35 %SL. Scales in lateral series are medium to large, lateral series scales are 31–33. Head length is 23.52–23.75 %SL. The eyes is large, eye diameter is 36.7–37.1 %HL. Snout length is long, with 37.41–38.2 %HL and interorbital width is 40.29–40.46 % HL. Dorsal fin origin is anterior pelvic fin origin, predorsal fin length is 48.22–49.31 %SL, prepectoral fin length is 22.87–23.69 %SL, prepelvic fin length is 51.8–53.47 %SL and preanal fin length is 75.63–78.24 %SL. Caudal peduncle depth is 11.2–12.52 %SL. Pectoral fin is short not reaching beyond anus, the pectoral fin is 18.2–20.98 %SL long with 13–14 branched fin rays. Pelvic fin is short not reaching beyond anus, the pelvic fin is 18.95–20.33 %SL long with 7–8 branched fin rays. Anal fin base is shorter than dorsal fin base, the anal fin base length is 8.8–10.6 %SL, dorsal fin with 2 unbranched rays and 10–11 branched rays and dorsal fin base length is 16.07–17.4 %SL.

DISTRIBUTION. This species is known from peninsular Thailand, Mekong Basin in Indochina, Chao Phraya Basin and Maeklong Basin, Thailand. New record for Chanthaburi Province.

Pangio anguillaris (Vaillant, 1902)

EXAMINED MATERIAL. 1 specimen, 60 mm SL, from Pongnum Ron District, Chanthaburi Province, East Thailand, XII.2007, legit S. Kulabtong (Fig. 3).

DESCRIPTION. *Pangio anguillaris* is compress, body depth is 6.05 %SL. Body width is 1.96 %SL. Head length is 10.46 %SL. The eyes are small, eye diameter is 1.56 %HL. Snout length is long, with 34.38 %HL and interorbital width is 32.6 % HL. Dorsal fin origin is posterior pelvic fin origin, predorsal fin length is 67.97 %SL, prepectoral fin length is 9.48 %SL, prepelvic fin length is 50.33 %SL and preanal fin length is 69.12 %SL. Caudal peduncle depth is 3.76 %SL. Pectoral fin is short not reaching beyond anus, the pectoral fin is 6.86 %SL long with 5 branched fin rays. Pelvic fin is short not reaching beyond anus, the pelvic fin is 6.54 %SL long with 6 branched fin rays. Anal fin base is shorter than dorsal fin base, the anal fin base

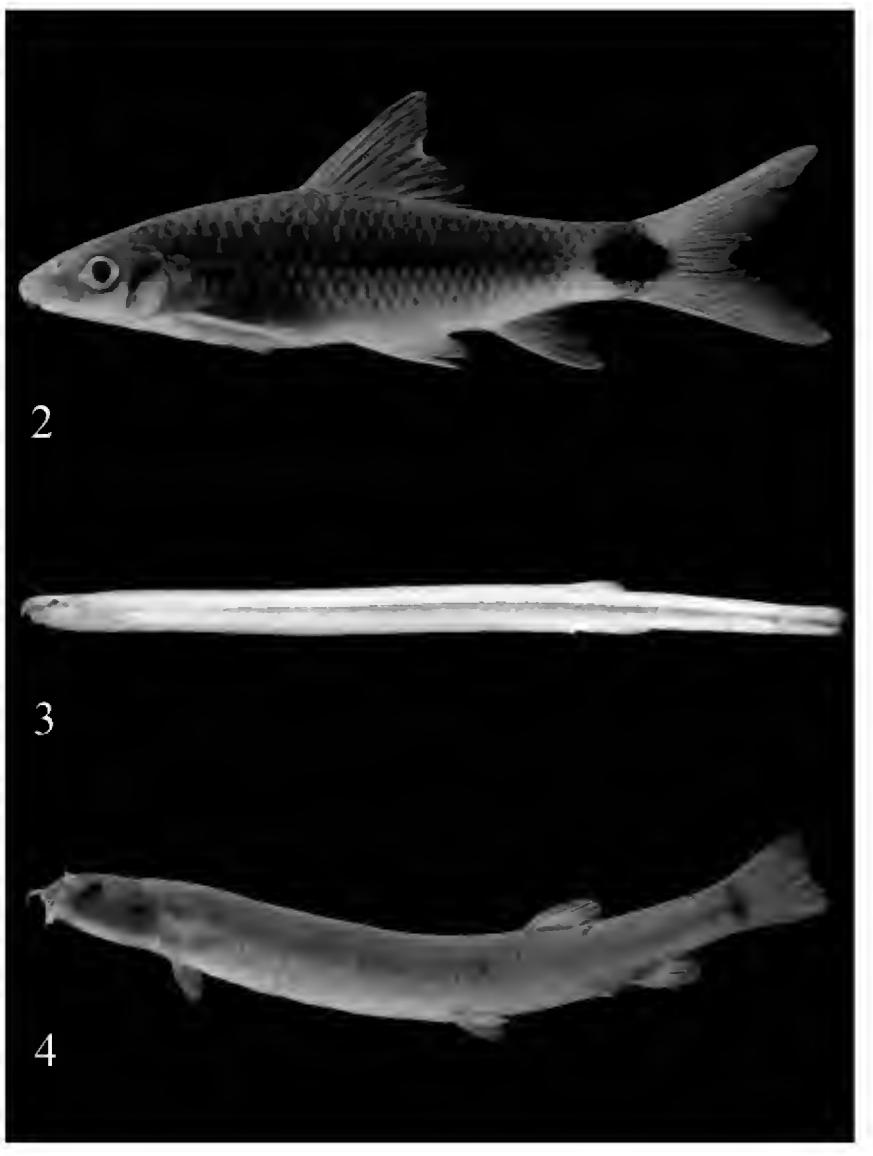

Figure 2. *Crossocheilus reticulatus*, 57.6 mm SL. Figure 3. *Pangio anguillaris*, 60.8 mm SL. Figure 4. *Pangio oblonga*, 45.6 mm SL.

length is 0.16 %SL, dorsal fin shows 1 unbranched and 7 branched rays; dorsal fin base length is 0.16 %SL.

DISTRIBUTION.This species is known from Malaysia, Indonesia, peninsular Thailand, Mekong Basin in Indochina, Chao Phraya Basin and Rayong River, Thailand. New record for Chanthaburi Province.

Pangio oblonga (Valenciennes, 1846)

EXAMINED MATERIAL. One specimen, 43.1 mm SL, from Pongnum Ron District, Chanthaburi Province, East Thailand, XII.2007, legit S. Kulabtong (Fig. 4).

DESCRIPTION. *Pangio oblonga* is compress, body depth is 11.03 %SL. Body width is 5.75 %SL. Head length is 19.08 %SL. The eyes are small, eye diameter is 15.66 %HL. Snout length is long, with 40.96 %HL and interorbital width is 30.12 % HL. Dorsal fin origin is posterior pelvic fin origin, predorsal fin length is 63.68 %SL, prepectoral fin length is 20.0 %SL, prepelvic fin length is 59.31 %SL and preanal fin length is 82.53 %SL. Caudal peduncle depth is 6.44 %SL. Pectoral fin is short not reaching beyond anus, the pectoral fin is 10.11 %SL long with 5 branched fin rays. Pelvic fin is short not reaching beyond anus, the pelvic fin is 6.21 %SL long with 6 branched fin rays. Anal fin base is short than dorsal fin base, the anal fin base length is 0.23 %SL, dorsal fin with 1 unbranched and 7 branched rays; dorsal fin base length is 0.23 %SL.

DISTRIBUTION.This species is known from Malaysia, Indonesia, peninsular Thailand, Mekong Basin in Indochina, Chao Phraya Basin and Rayong River, Thailand. New record for Chanthaburi Province.

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Observation on food items of Asian water monitor, *Varanus salvator* (Laurenti, 1768) (Squamata Varanidae), in urban ecosystem, Central Thailand

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ABSTRACT Feeding habit of Asian water monitor, *Varanus salvator* (Laurenti, 1768) (Squamata Varanidae) in urban areas of Central Thailand indicated that this species is carnivorous and scavenger according to the observations data.

KEY WORDS food items; Asian water monitor; *Varanus salvator*; urban ecosystem; Thailand.

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INTRODUCTION

Asian water monitor, *Varanus salvator* (Laurenti, 1768) (Squamata Varanidae) is the largest monitor in Thailand and the second largest lizard in the world (Shine et al., 1996). Asian water monitor is the most widespread species of all monitor lizards. Distribution range of this species is extending from India Subcontinental to South East Asia, Sunda Islands, and Moluccas (Böhme, 2003; Gaulke & Horn 2004; and Koch et al., 2007, 2010).

Current status of the species can be separated into following subspecies according to Koch et al. (2010) namely *V. salvator salvator* from Sri Lanka; *V. salvator bivittatus* (Kuhl, 1820) from Indonesia, type locality Java; *V. salvator andamanensis* Deraniyagala, 1944 from Andaman Islands; *V. salvator macromaculatus* Deraniyagala, 1944 from Thailand, Peninsula Malaysia, Vietnam, southern China, Hainan, Sumatra, and Borneo and smaller off-shore islands.

In Thailand, Asian water monitor can be found in many ecosystems from hill stream ecosystem, mangrove ecosystem, national park ecosystem to urban ecosystem. Habitat of this species is semi-aquatic ecosystem. The microhabitat of the species was thermally stable and the species also used burrows for the body temperature control (Shine et al., 1996). Feeding habit and reproductive biology of Asian water monitor were reported in many countries, especially in Sumatra, Indonesia, Shine et al. (1998) reported that, the monitor lizard can eat a wide variety of prey, including vertebrates (e.g. rats, chickens) and invertebrates (e.g. insects, crabs). Reproduction of the monitor lizard is all year-round spawned, with lower intensity in drier months and the monitor lizard can produce multiple clutches of 6–17 eggs each year. In Thailand, the biological data of Asian water monitor, *V. salvator* are poorly known, especially in urban ecosystem.

MATERIAL AND METHODS

The surveys were carried out by direct observation of Asian water monitor, *V. salvator* in many urban areas of Central Thailand during the period January–December, 2014.

The determination of the ingested material was carried directly on the site as observation or transporting food waste is difficult to identify in the laboratory. The observation areas include: green space of Kasetsart University Bangkhen Campus and many parks in Bangkok; green space of Silpakorn University Sanamchandra palace Campus, Meuang District, Nakhon Patthom Province; green space of Kasetsart University Kamphaeng Saen Campus, Nakhon Pathom Province; Mueang District, Ayuttaya Province; Meuang District, Chachoengsao Province; Bang Kruai District, Nonthaburi Province and Bang Kachao green zone, Prapadaeng District, Samut Prakan Province (Figs. 1–4).

RESULTS

In the observation zone and in laboratory we surveyed many food products which constitute the basic diet of the Asian water monitor in urban ecosystem of Central Thailand.

Food items can be separated into 17 groups which were Cyprinid fishes, Common suckers, Nile tilapia, Climbing perch, Striped snakehead, Marsh crab, Snail-eating turtle, Chinese edible frog, Chicken, Duck, Waterhen, Myna, Rat, Cat, Dog, food scraps and carcass.

Below is the list of foods classified in detail.

1. CYPRINIFORMES CYPRINIDAE
   Carps or Cyprinid fish

   Cyprinus carpio (Linnaeus, 1758)
   Labeo rohita (Hamilton, 1822)

2. SILURIFORMES LORICARIIDAE
   Common suckers

   Pterygoplichthys disjunctivus (C. Weber, 1991)
   Pterygoplichthys pardalis (Castelnau, 1855)

3. PERCIFORMES CICHLIDAE
   Nile tilapia

   Oreochromis niloticus (Linnaeus, 1758)

4. PERCIFORMES ANABANTIDAE
   Climbing perch

   Anabas testudineus (Bloch, 1792)

5. PERCIFORMES CHANNIDAE
   Striped snakehead

   Channa striata (Bloch, 1793)

6. DECAPODA GRAPSIDAE
   Marsh crab

   Episesarma spp.

7. TESTUDINES BATAGURIDAE
   Snail-eating turtle

   Malayemys macrocephala (Gray, 1859)

8. ANURA RANIDAE
   Chinese edible frog

   Hoplobatrachus rugulosus (Wiegmann, 1834)

9. GALLIFORMES PHASIANIDAE
   Chicken

   Gallus gallus domesticus (Linnaeus, 1758)

10. ANSERIFORMES ANATIDAE
    Duck

    Anas spp.

11. GRUIFORMES RALLIDAE
    White-breasted waterhen

    Amaurornis phoenicurus Pennant, 1769

12. PASSERFORMES STURNIDAE
    White vent Myna

    Acridotheres grandis Moore, 1858

13. RODENTIA MURIDAE
    Common rat

    Rattus norvegicus (Berkenhout, 1769)

14. CARNIVORA FELIDAE
    Cat

    Felis catus Linnaeus, 1758

Figures 1–4. Asian water monitor, *Varanus salvator* (Laurenti, 1768) in urban ecosystem of Bang Kachao green zone, Prapadang District, Samut Prakan Province, Central Thailand

15. CARNIVORA CANIDAE
Dog

Canis familiaris Linnaeus, 1758

16. Food scraps from households and restaurants, rubbish bin

17. Carcass

CONCLUSIONS

The Asian water monitor, *V. salvator*, are carnivores, and have a wide range of foods. They are known to eat fish, frogs, rodents, birds, crabs, snakes, turtles, young crocodiles and crocodile eggs (Sprackland, 1992; Whitaker, 1981) and garbage (Uyeda, 2009).

According also to these our observations which include a wide range of foods (see above), at present, feeding habit of Asian water monitor, in urban areas of Central Thailand indicated that this species is carnivorous and scavenger.

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A new species of *Luisia* Gaud. (Orchidaceae) from northwestern Bihar, India

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ABSTRACT In this paper, a new species of genus *Luisia* Gaud. (Orchidaceae) is described and illustrated. *L. indica* n. sp. is morphologically similar to *L. trichorhiza* (Hook.) Bl., but it is distinguished from *L. trichorhiza* by its smaller flowers and smooth surfaced greenish lip with purple spots together with five veined sepals and petals.

KEY WORDS *Luisia*; endangered; orchid; Bihar; India.

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INTRODUCTION

Luisia Gaud. is a small genus in the family Orchidaceae with ca 40 epiphytic species distributed in Indian subcontinent, Southeast Asia, Micronesia, Melanesia and Australia. India is the centre of diversity of this genus. In India, 18 species of *Luisia* have been reported and they are mainly found in Northeastern states, Peninsular India, Andaman and Nicobar Islands (Haines, 1924; Gamble, 1935; Bose & Bhattacharjee, 1980; Abraham & Vatsala, 1981; Kataki et al. 1984; Deva & Naithani, 1986; Srivastava, 1996; Chowdhery, 1998; Rath & Priyadarshini, 2005; Kumar et al., 2007; Gogoi et al., 2012; Karthigeyan et al., 2014). Taxonomically, *Luisia* is a difficult genus with relatively low morphological variations among the species (Seidenfaden, 1971; Misra, 2010).

During plant collection tour in March 2015 to Valmiki Tiger Reserve at West Champaran district of Bihar state, an attractive species of *Luisia* was found growing on a tree trunk on the top of the Bodrewa Hill in Manguraha Range of the Tiger Reserve. The species was found growing in clump with long green stem with terete leaves. The specimens were collected, acclimatized and grown in the Botanic Garden, CSIR-NBRI and have started bearing flowers in early April 2015.

ACRONYMS. LWG = Herbarium, National Botanical Research Institute, Lucknow, India.

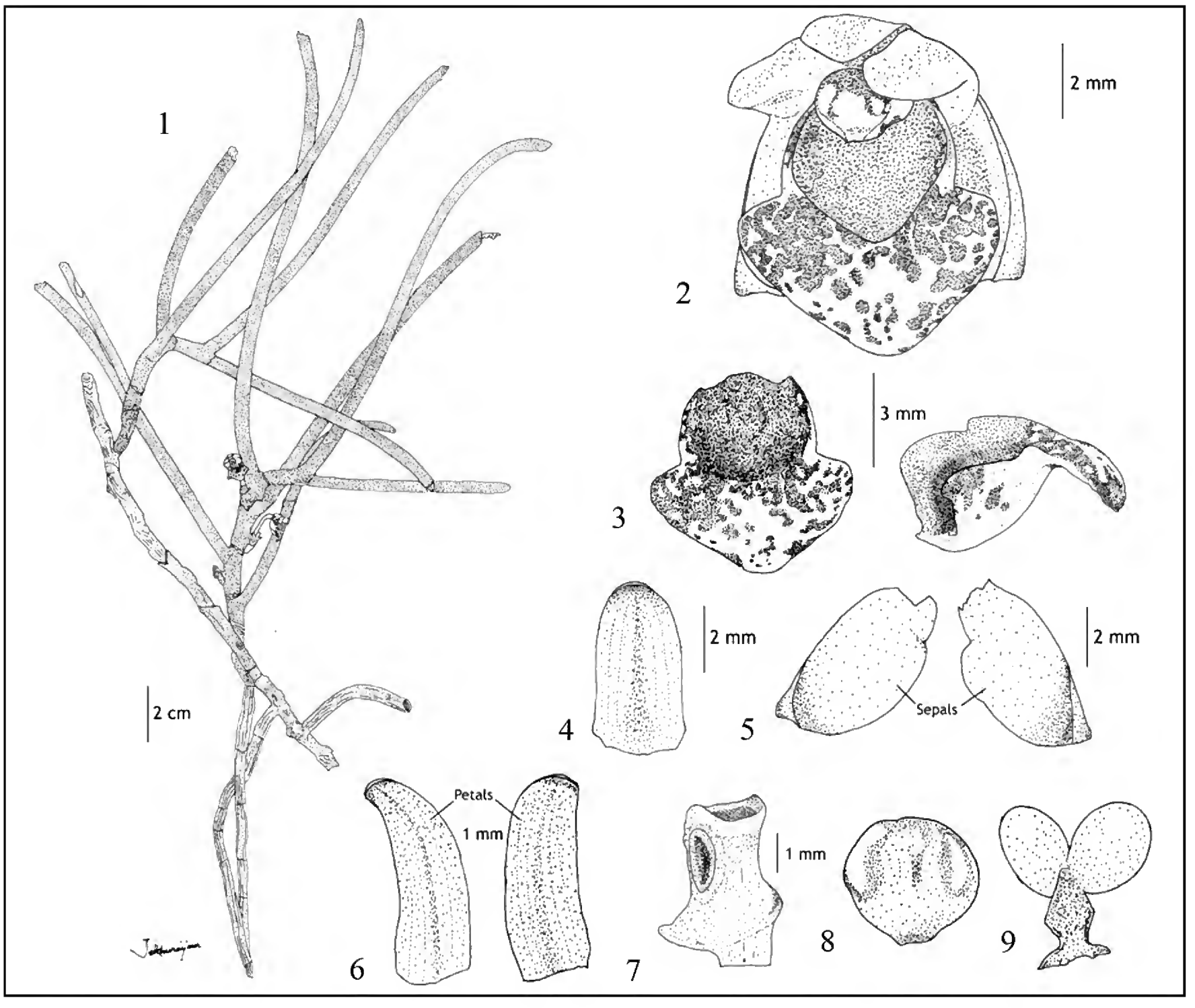
Luisia indica n. sp.
(Figures 1–12)

DIAGNOSIS. Herba caule erecto sive ascendendo; relinquit tenuibus, denique inflorescen axillares, 2-5 erecti, floribus, labium, triangularibus trilo, lamina labii pallore purpura coloratum; sepalis pallide quinque pauílo oblongo- petalis obovatis porrect carnosus, pallide viridia, five pauílo columna crassa, purpureus; duo flavo; pollinia.

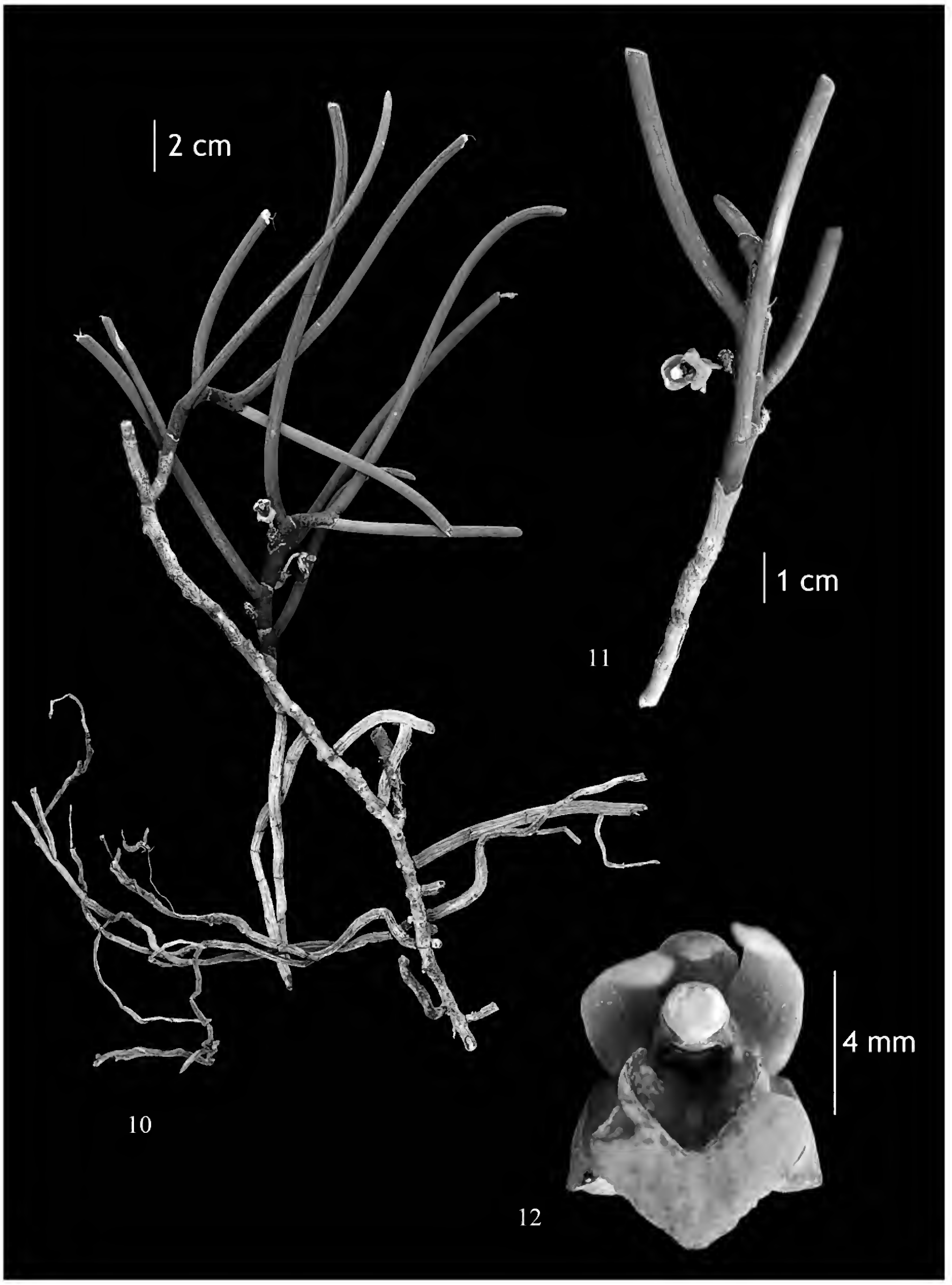
EXAMINED MATERIAL. Type. India. Bihar: West Champaran, Valmiki Tiger Reserve, 13 March 2015. J.S. Khuraijam 101206 (holotype LWG), here designated. Paratypes 101208, 101209 (LWG), same data of holotype.

DESCRIPTION OF HOLOTYPUS. Epiphytic herb, stem erect or ascending, 12 cm long, ca 0.5 cm diameter, covered with leaf bases. Roots 3 mm thick, vermiform. Leaves terete, slender, apex narrowed 17 cm long. Inflorescence short, axillary, 0.9 cm long, peduncle minute, 2 flowered, opening 1–3 flowers at a time. Flowers ca 8×7 mm, purplish green, lamina of lip greenish with purple coloured dots, green beneath, hypochile dark purple. Pedicel with ovary 9 mm long, pale green. Sepals and petals spreading. Sepals unequal, dorsal sepal 5 mm long, elliptic, acute, slightly hooded, pale green, five veined, central vein larger pale purple/pink. Lateral sepals 6 mm long, concave, boat shaped, dorsally keeled beyond the middle, pale green, five veined. Petals 7 mm long, oblong-obovate, pale green, five veined, central vein larger dim pink. Lip triangular, trilobed, fixed at the base of the column, porrect, fleshy, surface smooth, 5×7 mm, margin recurved. Column 4 mm long, stout, purple, anther cap greenish white with purple colour dots, pollinia two, yellow.

VARIABILITY. The paratypes do not show substantial morphological differences compared to the holotype. Lenght 10–15 cm, diameter 0.3–0.7 cm; Roots 2–3 mm thick, vermiform. Leaves terete, slender, apex narrowed 10–20 cm long. Inflorescence 0.5–1 cm long, 2–5 flowered, opening 1–3 flowers at a time. Flowers ca 8–9×7–8 mm; dorsal sepal 5–6 mm long; lateral sepals 6–7 mm long; petals 7–8 mm long; lip 5–6×6–7 mm; column 3–5 mm long.



Figures 1–9. *Luisia indica* n. sp. Fig. 1: habit. Fig. 2: flower. Fig. 3: Lip. Fig. 4: dorsal sepal. Fig. 5: lateral sepals. Fig. 6: petals. Fig. 7: column. Fig. 8: anther cap. Fig. 9: pollinia.



Figures 10–12. *Luisia indica* n. sp. Figs. 10, 11: habit. Fig. 12: flower.
Photos by A.C. Little.

ETYMOLOGY. The specific epithet is in reference to the species occurrence in India.

HABITAT, ECOLOGY AND DISTRIBUTION. Grow on tree trunks at tops of low lying hills in evergreen forest. The species is now known only from Valmiki Tiger Reserve in West Champaran district of Bihar, India.

FLOWERING. Late March–April

CONSERVATION STATUS. Since the species is known only from a small area in Valmiki Tiger Reserve along the Indo-Nepal border, the species may be designated as Endangered (IUCN SPS, 2010).

REMARKS. *Luisia indica* n. sp. resemble *L. trichorhiza* (Hook.) Bl. in having trilobed triangular lip but differ in having rather smooth surfaced greenish lip with purple spots and five veined sepals and petals. On the basis of these morphological variations, *L. indica* is different from *L. trichorhiza*. Moreover, *L. trichorhiza* have deep purple lip with ridged surface or deeply grooved and three veined sepals and petals (Hooker, 1823; Blume, 1849; Bose & Bhattacharjee, 1980; Yonzone & Rai, 2012). *Luisia indica* n. sp. is the first report of the genus *Luisia* from Bihar.

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Additions and corrections to the Scissurellidae and Anatomidae (Gastropoda Vetigastropoda) of the Mediterranean Sea, with first record of *Sinezona semicostata* Burnay et Rolán, 1990

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ABSTRACT New information on the scissurellids fauna, Scissurellidae and Anatomidae (Gastropoda Vetigastropoda), in the Mediterranean Sea is presented. *Scissurella azorensis* Nolt, 2008, is confirmed from several localities in the Tyrrhenian Sea. *Sinezona semicostata* Burnay et Rolán, 1990, a species until now known from Cape Verde and Canary Islands, is reported for the first time in the Mediterranean, based on the record of 12 specimens at Linosa island (Sicily Channel), 35 m. *Anatoma crispata* (Fleming, 1828) does not occur in the Mediterranean; earlier misidentified records are corrected. *Anatoma eximia* Seguenza, 1880, appears to be a cold water guest species at the type locality Gallina, Reggio Calabria.

KEY WORDS *Anatoma; Scissurella*; *Sinezona*; Mediterranean.

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INTRODUCTION

Scissurellidae and Anatomidae are two families of microscopic marine gastropods of world-wide distribution. They are amongst the smallest gastropods (0.5–11 mm, modal size ~1–3 mm), and are distributed in all fully marine oceans from the intertidal to the abyssal plain. They are members of the basal Vetigastropoda as evidenced by paired gills, a rhipidoglossate radula, and usually with a slit or hole in the shell above the mantle cavity. Unlike other Vetigastropoda such as abalone (Haliotidae), top snails (Trochidae Turbinidae), and slit shells (Pleurotomariidae), scissurellids lack a nacreous inner shell layer (see Geiger et al., 2008 for review).

The groups have been recently revised and monographed by Geiger (2012) on a global scale. As was anticipated, some errors need to be corrected, and some additional data have come to light in the meantime (see also Pimenta & Geiger, in press). Here are addressed some novel data for the Mediterranean Sea.

MATERIAL AND METHODS

Standard procedures for scanning electron microscopy (SEM) were employed (see Geiger et al., 2007; Geiger, 2012).

Some specialized terms are defined following Geiger (2012).

• Selenizone: the closed portion of the slit. Has lateral keel and growth markings (= lunules). The onset of the selenizone with growth defines the boundary between teleoconch I and II.

• Shoulder: on the teleoconch II, the portion of the shell between the apical suture and selenizone.

• Slit: the anteriormost portion of the selenizone, which is open at the apertural margin.

• Teleoconch I: postembryonic shell to the start of the selenizone.

• Teleoconch II: postembryonic shell from the start of the selenizone to the apertural margin.

ABBREVIATIONS AND ACRONYMS. DLG: Daniel L. Geiger collection, Los Angeles, California, U.S.A. DSC: Danilo Scuderi collection, Catania, Italy. M: Monotypy. OD: original designation. PMF: Pasquale Micali collection, Fano, Italy. SBMNH: Santa Barbara Museum of Natural History, Santa Barbara, California, U.S.A. SD: subsequent designation. USNM: United States National Museum, Smithsonian Institution, Washington (DC), U.S.A.

SYSTEMATICS

VETIGASTROPODA Salvini-Plawen, 1980

Vetigastropoda are typically divided into a number of superfamilies. Geiger (2012) discussed in detail the fundamental disagreement amongst various phylogenetic studies with respect to family-level relationships, further hampered by highly incomplete and incongruent taxonomic sampling of major lineages. With respect to the scissurellids, it seems clear that Scissurellidae and Anatomidae are not sister taxa, and Larocheidae and Depressizonidae have not been included in any formal phylogenetic assessment. Accordingly, the superfamily Scissurelloidea is untenable, unless it is restricted to Scissurellidae s.s. only. Using Scissurelloidea (or any other vetigastropod superfamily) in the narrow sense does not contain any classification information, therefore, is superfluous. Because superfamilies are not mandatory ranks as per ICZN 1999, the best and most honest representation of our understanding is to omit all superfamilies under Vetigastropoda at this time.

Family SCISSURELLIDAE Gray, 1847

Scissurella d'Orbigny, 1824.
Type species: *Scissurella laevigata* d'Orbigny, 1824 (SD: Gray, 1847) (= *Scissurella costata* d'Orbigny, 1824)

Scissurella azorensis Nolt, 2008

EXAMINED MATERIAL. France, Corsica SW, between Pisciucani and Paragan beaches, beach, 41.442°N, 9.115°E (DSC 2). Italy, Reggio di Calabria, Scilla, 50 m, 38.261°N, 15.715°E (DLG 2370, 4; DSC 4). Italy, Reggio di Calabria, Scilla, 50 m, 38.255°N, 15.714°E (DLG 2670, 1). Italy, Sicily, Trapani, Egadi Islands, Marettimo Island, Secca del Cammello, 30 m, 37.989°N, 12.065°E (DLG 1812, 3). Italy, Sicily, Trapani, 30 m, 38.024°N, 12.504°E (DLG 2386, 1). Italy, Sicily, Trapani, San Vito Lo Capo, Cape San Vito, 2.5 m, 38.185°N, 12.733°E (DLG 2542, 2). Italy, Sicily, Acitrezza, Lachea island, 5-30 m, 37.561°N, 15.163°E (DSC 11). Italy, Sicily, Brucoli, 3 m, 37.282°N, 15.188°E (DLG 2547, 5). Italy, Sardinia, Sant'Antioco, 39.066°N, 8.459°E (DLG 2607, 1). Italy, Pelagian Islands, Linosa (SBMNH 456685, 7; DSC 6). Italy, Linosa, Punta Calcarella, 35 m, 35.853°N, 12.880 °E (PMF 8). Italy, Pelagian Islands, Lampedusa, Cala Croce, 6 m, 35.499°N, 12.590 °E (DSC 3).

REMARKS. The species was described from the Azores, but was reported by Geiger (2012) also from a single lot from the Mediterranean sea. Since then, several additional lots have been found from Mediterranean sediment samples. Most (8 of 12) of those samples are from Sicily or the eastern tip of mainland Italy, while one is from Corsica and Sardinia to the north and Linosa and Lampedusa Islands to the south. The species have not been recovered from any other samples (e.g., Croatia, Spain, France).

Scissurella azorensis (Figs. 9–12) differs from *S. costata* by the more rounded whorls, lacking of flat shoulder, the lack of spiral threads on shoulder and base, teleoconch II of about 0.75 whorls, compared to 1–1.125 whorls.

Sinezona Finlay, 1926.
Type species: *Schismope brevis* Hedley, 1904 (OD)

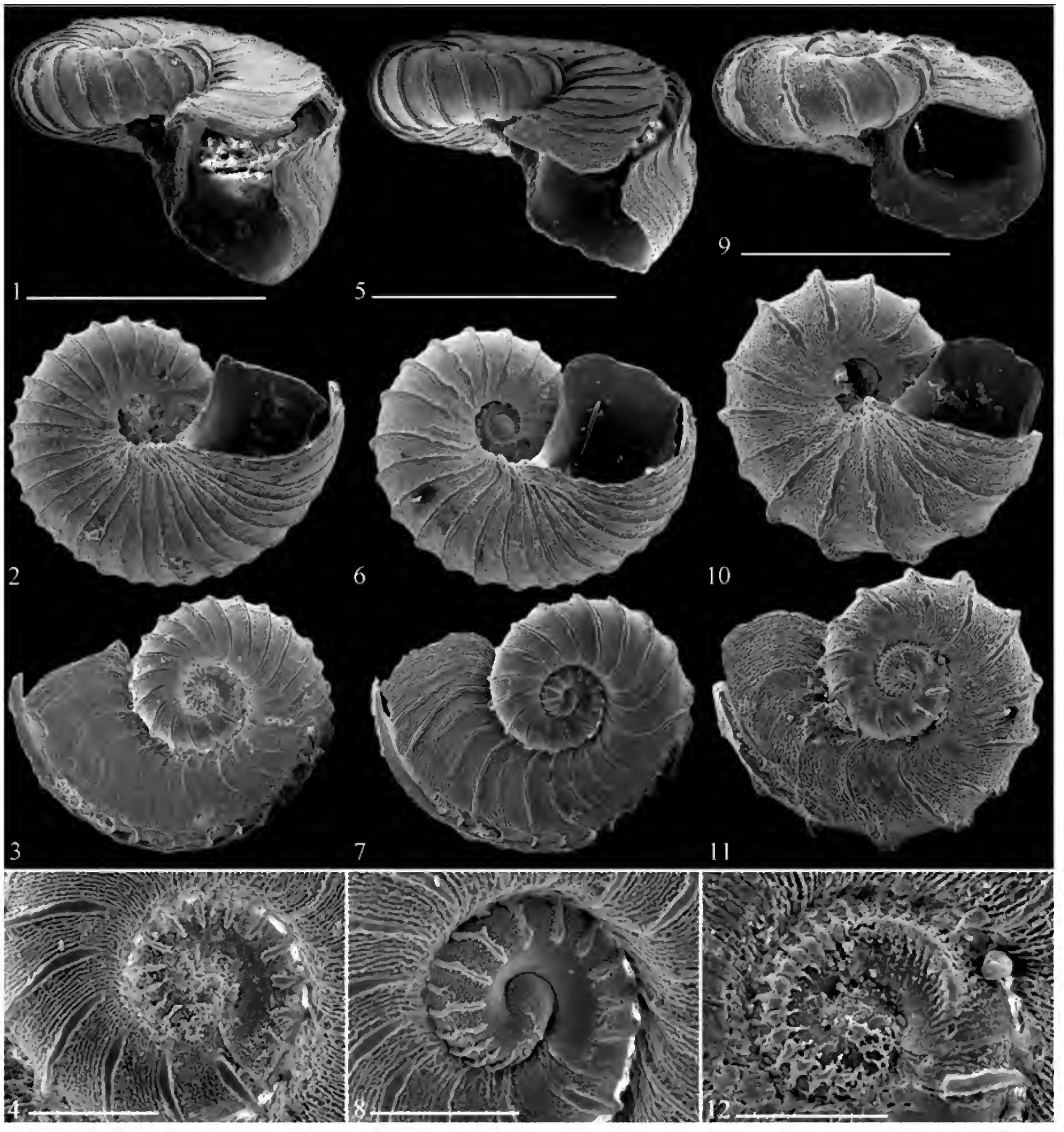
Sinezona semicostata Burnay et Rolán, 1990

REMARKS. *Sinezona semicostata* was described by Burnay & Rolan (1990) from material collected at a depth of few meters at Boavista island (Cape Verde archipelago, eastern Atlantic), but it is also known from the Canary Islands and Madeira (Hernández et al., 2011; Geiger, 2012). The place-

ment in genus *Sinezona* Finlay, 1926 is indicated by the anteriorly closed slit. This character is difficult to observe in many shells, because the apertures of shells found in shell grit are usually damaged.

Twelve specimens have been found at Linosa in shell grit manually collected by SCUBA diving at Punta Calcarella (south-east of Linosa island, Sicily Channel) at a depth of about 35 m, most of them fully mature (Figs. 1–8), representing the first Mediterranean record (SBMNH 456687, 7; PMF 8). Although similar to *Sci. azorensis*, *Sin. semicostata* is readily distinguished by the protoconch sculpture composed of half as many and much stronger axial cords (Figs. 1–4). The species' range is herewith expanded from the Cape Verde Archipelago, Madeira, and the Canary Islands, into the Mediterranean Sea.

Because *Sci. costata* d'Orbigny, 1824, a rather variable species, was found in numerous specimens



Figures 1–12. Scissurellids from Linosa, Pelagian Islands, Italy, 35 m. Figures 1–4. *Sinezona semicostata*. Figures 5–8. *Sinezona semicostata*. Figures 9–12. *Scissurella azorensis*. Scale bars shell = 500 µm. Scale bars protoconch = 100 µm.

in the same sample, we could exclude the possibility that the *Sin. semicostata* specimens were juvenile *Sci. costata*. In particular *Sin. semicostata* differs from *Sci. costata* by the much more depressed overall shape, the adapically angulated and flat shoulder as opposed to being horizontally oriented, the stronger and fewer axial ribs, and the wide umbilicus in *Sin. semicostata*. *Sinezona semicostata* is much smaller (to 0.67 mm) and the teleoconch II consists of about 0.3–0.5 whorl compared to up to 1.125 teleoconch II whorls in *Sci. costata* growing to 1.7 mm.

Anatoma Woodward, 1859
Type species: *Scissurella crispata* Fleming, 1828 (M: misidentified; SD: Geiger, 2012)

Anatoma crispata (Fleming, 1828)

REMARKS. The species is commonly, but mistakenly, indicated as part of the Mediterranean malacofauna (see Geiger, 2012 for comprehensive chresonymy). Geiger (2012) questioned some of his own earlier identifications of those Mediterranean occurrences, which were made prior to the revision by Høisaeter & Geiger (2011), but was unable to re-evaluate that material prior to publication. Re-examination of material from USNM has confirmed the earlier suspicion. The following *A.* "*crispata*" lots were re-identified as:

Anatoma aspera (Philippi, 1844): USNM 181621, 181630, 181631, 181600, 181616, 181623, 181620.

Anatoma eximia (Seguenza, 1880): USNM 181597, 181601,181598, 181599.

Anatoma tenuisculpta (Seguenza, 1880): USNM 83386, 126631, 181592.

The *A. aspera* records confirm the known distribution of the species, with one additional locality from Crete Island, representing one of the easternmost locations.

Anatoma eximia was re-surrected by Geiger (2012) as a valid species. It was described from fossil material from Gallina (near Reggio Calabria, Italy). The depositional environment of Gallina is well described by Dell'Angelo et al. (1998: 139): the levels described by Seguenza show sign of gravitational flow and canalization of debris. The outcrop represents an epibathyal fauna dated to lower Pleistocene with additional material from the upper Pliocene and more littoral assemblages, referred to lower Pleistocene, with cold (or boreal) guests. More recent works (Ruggiero & Raia, 2014; La Perna & Vazzana, 2014; Vazzana et al., 2014) deal with the Calabrian (lower Pleistocene) fauna and reported the presence of cold guests, such as *Pseudamussium peslutrae* (Linnaeus, 1771) = *P. semptemradiatum* (O.F. Müller, 1776). The Recent records of *A. eximia* are from the Mediterranean adjacent northeastern Atlantic, with a single record from the Mediterranean Sea (off Malaga). The new records are all from the North Atlantic. It appears that *A. eximia* should also be considered a cold guest at the type locality.

The new records of *A. tenuisculpta* are both from the North Atlantic as well as the Mediterranean (Sicily).

Anatoma eximia (Seguenza, 1880)
Anatoma tenuisculpta (Seguenza, 1880)

REMARKS. The publication date for those two taxa was erroneously indicated as 1877 by Geiger (2012), which, however, was the date of acceptance of the manuscript. Serge Gofas (pers. comm.) kindly pointed out that error.

DISCUSSION

Despite the Mediterranean Sea being one of the best-studied bodies of water on the planet, including its malacofauna (e.g., Parenzan, 1970; Sabelli et al., 1990; Barash & Danin, 1992; Cossignani et al., 1992; Giannuzzi-Savelli et al., 1994, 1997, 1999, 2001, 2003, 2014; Ardovini & Cossignani, 1999; Doneddu & Trainito, 2005; Cossignani & Ardovini, 2011; Gofas et al., 2011; Scuderi & Terlizzi, 2012) new discoveries can still be made. Those are not necessarily restricted to minute molluscs; the re-discovery of the abalone species *Haliotis stomatiaeformis* (= *H. neglecta*) at Malta island, is a particularly striking example (Geiger, 1998; Geiger & Owen, 2001), as well as the cone species known from that general area (*Conus vayssierei* Pallary, 1906; *Conus desidiosus* A. Adams, 1853; *Conus fumigatus* Hwass in Bruguière, 1792).

Micromolluscs (< 5 mm total shell length: see Geiger et al., 2007 for review) are more in need of study and yield many more discoveries. Despite the very recent global monographic treatment of the scissurellids (Geiger, 2012), new discoveries can still be made as exemplified by the present contribution. It is striking, that both the abalone cited above, as well as the scissurellids reported here, have been found in the Southern Tyrrhenian Sea and the Sicily and its surrounding islands. Some of it may be due to available material and novel sensitivity of collectors. However, none of the numerous samples from North Africa, France, Spain, and the Adriatic Sea have yielded novel scissurellids (D. Geiger, pers. obs.).

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Evaluating and measuring biodiversity in a subterranean light-gradient

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ABSTRACT The structure and composition of the biodiversity have been analysed in a light gradient of a case-study cave in Northern Italy to evaluate the influence of light in promoting, limiting, or altering it. Minor quantitative variations have been found along the gradient but remarkable qualitative differences have been recorded and discussed on the composition of the biodiversity proceeding from the full light of the entrance toward the darkness of the deep cave. Light intensity proved to be the main limit for many troglobiont an troglophilic species migration from or to the inner part of the cave. The subterranean environment is here discussed as a model for assessing also the epigean biodiversity considering the ecological limits in conservation problems of vulnerable environments.

KEY WORDS biodiversity; biospeleology; conservation; ecology; karst.

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INTRODUCTION

Biodiversity, defined as all hereditarily based variations at all levels of organization, from the genes within a single local population or species, to the species composing all or part of a local community, and finally to the communities themselves that compose the living parts of the multifarious ecosystems of the world (Wilson, 1988), is a simple name given to a huge complexity. This complexity is probably the greatest limit for its complete understanding and its full evaluation and measuring, is almost impossible. If measuring the whole biodiversity is a limit many methods to give a good representative quantification have been proposed (Hill et al., 2005). Most of them are based on species indicators, representative for the whole community and useful for comparisons between different places, or on environmental parameters linked to the species richness (Caoduro et al., 2014), as a compromise to manage a fundamental resource for our planet without knowing it in detail. Studying the hypogean environments, usually composed by a scarce number of high specialized species and simple communities, offers the rare occasion to have a nearly complete measure of the whole local biodiversity and a good understanding of its structure. A global evaluation of subterranean biodiversity is however still scarce in literature (Culver et al., 2006) where single species indicators (or groups of) are more often used to compare different caves (Culver & Pipan, 2009; Latella et al., 2012), instead of evaluating the whole biodiversity of a single one.

Caves are not closed environments and measuring biodiversity in caves must consider contamination rates from more or less troglophilic organisms and how much cave organisms remain isolated or migrate to other places, according with the superfi-

cial underground environment concept (MSS in Juberthie et al., 1980). Understanding the parameters that influence, promote or limit the biodiversity of a cave can be important to understand how biodiversity complexity evolves in a resource-limited environment. Light gradient is here considered as the main direct limit for autotrophs' ecology, diversification and, influencing also the temperature, evaporation, humidity and other physical parameters, indirectly the key factor for all the other levels of the local food net. The case-study of the cave of Ponte Subiolo is here presented, a well known cave since historical times with an almost straight and barely sloping development with a long light gradient at the entrance which make possible to separate the main steps of the disappearing of the light and its influence on the biodiversity of the cave.

In this study the changes in the biodiversity have been evaluated in relation to the light gradient to examine the species richness, its composition and the dynamics related to a transition zone between epigean and subterranean environments. Evaluating and quantifying how the light influences subterranean communities as a limiting factor for biodiversity can be helpful in understanding how conservation measures promote stable and rich subterranean communities.

MATERIAL AND METHODS

The cave of Ponte Subiolo is located in a subalpine continental area of northern Italy (45°52'18.13"N, 11°40'8.94"E) at 175 m a.s.l. in a narrow valley covered mostly by *Carpinus-Fagus* woods. The cave is a natural part of the dolomitic karst system of the Altopiano di Asiago, partially altered by human activity and occasionally used by tourists since the XIX century. It develops almost horizontally whit a moderate sloping for 260 m from the entrance (Fig. 1). The entrance of the cave is located in the middle of an emi-circus of dolomite rocks (10 m diameter), never exposed to direct sunlight and with scarce surrounding vegetation and with a continuous gradient of light in the straight passage toward the hypogean area. The light gradient was here measured directly with a a luxmeter (1 lux resolution) and indirectly, using the presence of chlorophyll photosynthesis as an environmental parameter, from full light (photosynthesis present) to complete and permanent darkness (photosynthesis absent or not observed), for a length of 20 m and 4 m average diameter tunnel. Photosynthesis was defined by the presence of different kinds of vegetation in three different locations where a pitfall trap has been placed: entrance, in permanent shadow but with full indirect light (C1: 0.5 m from the entrance), where the last living vascular plant (*Parietaria officinalis* L.) was recorded together with non-vascular plants, mosses and algae; twilight zone, an intermediate point between traps C1 and C3 (C2: 8 m from the entrance) just after the last non-vascular plant (*Asplenium trichomanes* L.) fertile and with erect structure was recorded, together with true mosses and algae; dark zone, with a complete and permanent darkness (C3: 20 m from the entrance) just after the last photosynthetic organism (Algae). After C3 some weak indirect light was still recognizable from the human eye but no photosynthetic organisms were found and 0 lux were recorded by the luxmeter.

Temperature and relative humidity recorded have been measured in the three points during seasonal investigations. To evaluate the biodiversity of the cave three pitfall traps, containing fresh meat (chicken liver) as attractive and salt water for killing and preserve, have been placed in the three locations with increasing darkness (1, 2, 3) and left for about three continuous years (from 19/07/2011 to 18/03/2014), seasonally checked to evaluate their conditions, attractiveness and impact on the local ecosystem. To prevent damage to the deep cave ecosystem, deep cave biodiversity was evaluated qualitatively placing non-trapping meat baits in all along the cave every 50 m and checking them occasionally, recording the species observed. A small underground river located in the deepest part of the cave (about 200 m from the entrance) was investigated placing water traps (plastic bottles with meat) to check the presence of water macroinvertebrates during October 2011.

To evaluate the species exchanges between the cave an the external woodland 6 pit-fall traps have been placed in the hemicycle outside the cave during the same time-period in different environments: 3 (A1, A2, A3) at 2-5 m from C1 in a cave-like environment (rock slope with scarce erbaceous vegetation, Fig. 2) and 3 (B1, B2, B3) at 6-10 m when the rocky ground left its space for the earthly soil of the *Carpinus-Fagus* woodland (Fig. 3).

Figure 1. Perspective of the study area with the light gradient and the disposition of the three inner pitfall traps (C1, C2, C3) from the opening of the cave to the starting point of the permanent darkness, in the moment of maximum illumination.

Figure 2. Entrance of the cave of Ponte Subiolo with the maximum limit of the direct sunlight traced on the ground. Picture taken in a sunny day at 13:34, June 12, 2014.

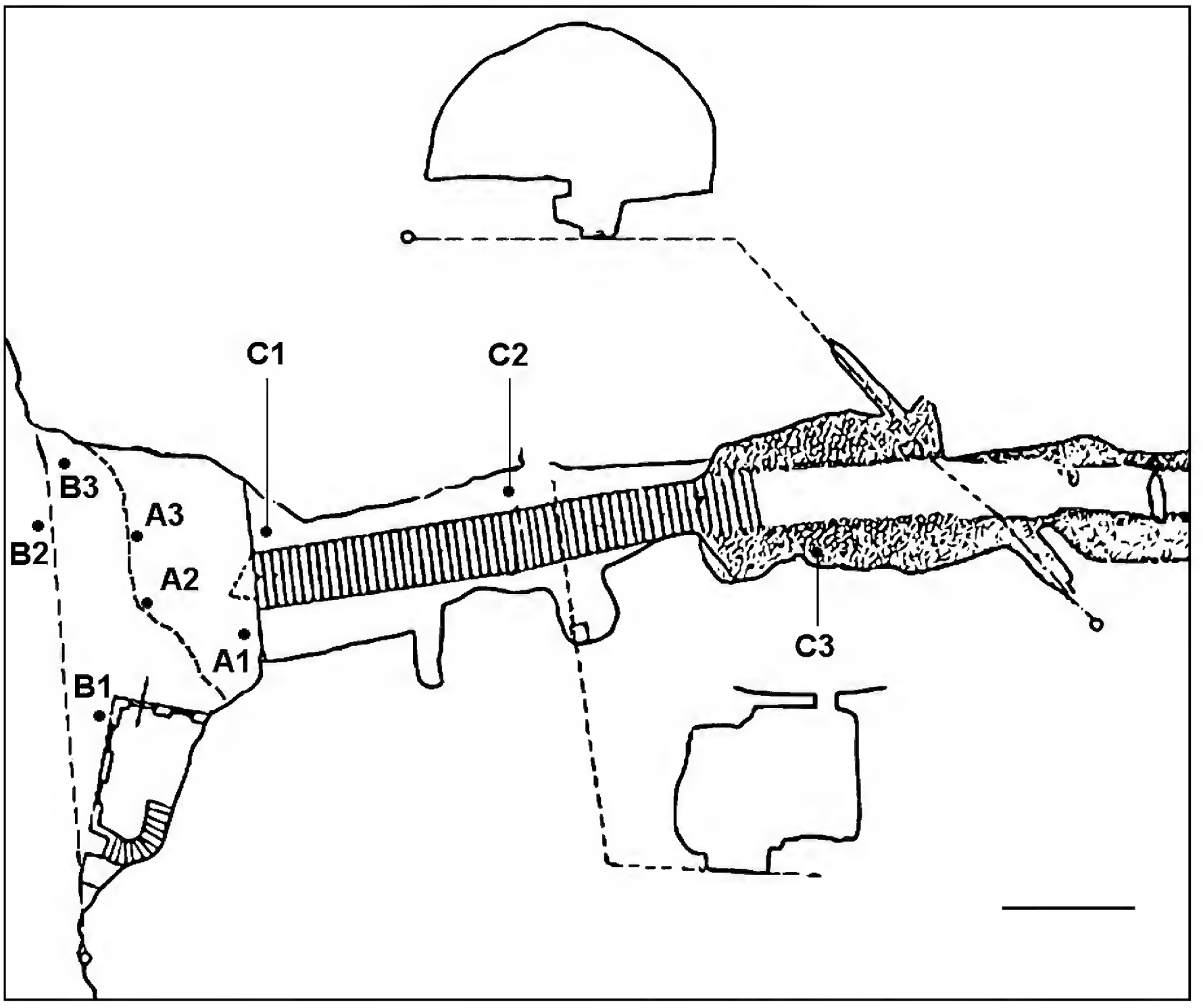

Figure 3. Land survey of the study area (courtesy Gruppo Grotte Giara Modon, modified) with the disposition of the three pitfall traps inside the cave (C1, C2, C3), the three pitfall traps under the outer cave ceiling (A1, A2, A3), the three pitfall traps on the woodland edge (B1, B2, B3). Scalebar 5m.

To compare the biodiversity in the light gradient Shannon-Wiener Index and Species Evenness were measured considering the specimens collected in the three cave pitfall traps. Mean values of Chao2 index (Chao, 1984) were measured with software EstimateS (Colwell, 2009) to evaluate the richness of unique species. Ecological categories (trophic habits and troglophily, here intended the progressive adaptation to form subterranean communities low or absent in Trogloxenes, moderate in Troglophiles, high in Troglobiont) were inferred using information available on the single species when available from literature and morphological characters (mouth parts, depigmentation, expansion of limbs or sensilla, etc.) directly observed. Since the ecology of all the species was not completely known Sket separation between eutroglophile and subtroglophile (Sket, 2008) have not been used here.

Taxonomical identification has been done here at Order level to separate main different functional strategies to live in a subterranean environment. Lower level of identification was used when necessary to better describe single units, and species level was used for all individuals collected as functional, morphological distinct units as "morphospecies" (SP1, SP2, etc...) to evaluate quantitatively their diversity and richness. Only adults or high vagile immatures (i.e. Orthoptera) have been considered to avoid bias due to direct egg-layings inside the

traps occurred by some Diptera. Coleoptera have been here considered as walker as their primary moving strategy since all the species collected were linked to the subterranean environment where flight, when available, is used occasionally. The Analysis of Variance at significance 0.05 has been used to compare the specimens and species collected in the three cave traps. Biomass have been evaluated by measuring the wet weight of the specimens, grouped by taxa, with an electronic balance with sensitivity 0.1g.

RESULTS

Physical air parameters (Temperature/Humidity) attested on a annual average difference between one trap and another of 4.53°C and 18%: 4.50/17% from the external area to the entrance of the cave (C1), 4.85/18% from C1 to C2 and 4.25°C/19% from C2 to C3, reaching the nearly constant absolute parameters for the whole cave in C3 of 12°C/82%.

Maximum light measures were obtained during summer: 572 lux in the shadows of the external part of the cave, 127 lux at C1, 68 lux at C2 and 0 lux at C3.

The overall biodiversity in the three years of sampling attested on: 624 invertebrate specimens belonging to 35 different species collected in the three cave traps placed in the cave (Table 1). To these numbers must be added the autotrophs present in the study area: 4 different species belonging to: Magnoliophyta, Pteridophyta, Bryophyta, Chlorophyta, and the occasional presence Trogloxene/Troglophile vertebrates, *Vulpes vulpes* (Linnaeus, 1758), *Rhinolophus hipposideros* Bechstein, 1800, *R. ferrumequinum* Schreber, 1774, which visited the cave and rested there non-continuously for some days/months, the Troglophile spiders *Nesticus cellulanus* (Clerck, 1757) and *Pholcus phalangioides* (Fuesslin, 1775) never trapped but frequently observed in the area between C1 and C2, and at least one species of Fungi was observed occasionally. No invertebrates were collected during water samplings and no bacteria, protozoan or microinvertebrates were here considered. Deep cave observations recorded a progressive but not constant diminish in the number of species. The species collected in C3 were also observed till 80 m from the entrance, where the flyers disappeared. From 80 to 140 m only walkers have been observed and after 140 m where the floor of the cave is frequently submerged by interstitial water, no species were observed.

The total number of species recorded in the cave of Ponte Subiolo in the three years is 44.

Soil invertebrates species have been collected in almost equal numbers in the three cave traps (Table 2), not significant different in ANOVA one way test, both for the number of species (P: 0.69, 24 dof) and number of specimens collected (P: 0.32, 52 dof). A large part of the animals collected are detritivores, but the ratio with predators is close to 1 proceeding toward the darkness. Even if the trophic categories have been evaluated only by a descriptive point of view, the percent of Troglobiont species increased over the Trogloxene species from light to darkness, with a high and nearly constant number of Troglophile species collected in all the gradient, something expected for a cave transition zone, which confirms the goodness of the trapping procedure and the representativeness of the community considered in the analyses.

All these percents should be however considered in the vagility of their components which remained in nearly constant ratio (walkers/flyers) in all the cave traps (1.2, 0.9, 1.4). As expected, most of the Trogloxene species in traps C2 and C3 were flyers while all the Troglobiont species were much less vagile walkers. With the exception of one trogloxene Calliphorid fly (body parts occasionally found from the entrance to 80 m inside the cave), some Troglophile species were recorded alive in good numbers both in darkness as full light such as the flyers Diptera (Phoridae), Hymenoptera (Icneumonidae) or Trichoptera (Limnephilidae) as well as the walker millipede (Polydesmidae). Some troglobiont species, collected or observed more than twice (and supposed not to be occasional encounters), never reached the full light entrance of the cave (C1) as the Pseudoscorpion, *Neobisium torrei* (Simon, 1881), and the Isopoda, *Spelaeonethes nodulosus* Verhoeff, 1932, while the millipede, *Typhloiulus tobias* (Berlese, 1886), and the cave beetle, *Orotrechus targionii* (Dalla Torre, 1881), never passed the edge of darkness (C3).

Two invertebrates, the isopod, *Androniscus brentanus* Verhoeff, 1932, and the springtail (Collembola) were frequently observed on the rocks from the deepest of the cave to the entrance.

Trap	Taxonomic Group	Morpho-species	Individuals	Feeding	Troglophily	Vagility
C1	Aracnida	SP1	1	Predator	Trogloxene	Walker
C1	Aracnida	SP2	1	Predator	Troglophile	Walker
C1	Aracnida	SP3	1	Predator	Troglophile	Walker
C1	Acaroidea	SP1	1	Predator	Troglophile	Walker
C1	Diplopoda	SP1	5	Detritivore	Troglophile	Walker
C1	Collembola	SP1	7	Detritivore	Troglobiont	Walker
C1	Orthoptera	SP1	9	Detritivore	Troglophile	Walker
C1	Trichoptera	SP1	7	Detritivore	Troglophile	Flyer
C1	Coleoptera	SP1	1	Predator	Trogloxene	Walker
C1	Coleoptera	SP2	1	Detritivore	Trogloxene	Walker
C1	Coleoptera	SP3	1	Detritivore	Trogloxene	Walker
C1	Coleoptera	SP4	1	Detritivore	Troglophile	Walker
C1	Coleoptera	SP5	5	Detritivore	Troglophile	Walker
C1	Coleoptera	SP6	2	Detritivore	Troglobiont	Walker
C1	Hymenoptera	SP1	3	Detritivore	Troglophile	Flyer
C1	Hymenoptera	SP2	2	Predator	Troglophile	Flyer
C1	Diptera	SP1	85	Detritivore	Trogloxene	Flyer
C1	Diptera	SP2	3	Detritivore	Trogloxene	Flyer
C1	Diptera	SP3	1	Detritivore	Trogloxene	Flyer
C1	Diptera	SP4	1	Detritivore	Trogloxene	Flyer
C1	Diptera	SP5	1	Detritivore	Troglophile	Flyer
C1	Diptera	SP6	1	Detritivore	Troglophile	Flyer
C1	Diptera	SP7	1	Detritivore	Troglophile	Flyer
C1	Diptera	SP8	1	Detritivore	Troglophile	Flyer
C2	Aracnida	SP4	1	Predator	Troglobiont	Walker
C2	Aracnida	SP5	1	Predator	Troglobiont	Walker

Table 1. Specimens collected in the three cave traps with their taxonomical and ecological categories.

Trap	Taxonomic Group	Morpho-species	Individuals	Feeding	Troglophily	Vagility
C2	Pseudoscorpiones	SP1	2	Predator	Troglobiont	Walker
C2	Scorpiones	SP1	1	Predator	Troglophile	Walker
C2	Acaroidea	SP2	1	Predator	Trogloxene	Walker
C2	Diplopoda	SP1	18	Detritivore	Troglophile	Walker
C2	Hymenoptera	SP1	53	Predator	Troglophile	Flyer
C2	Hymenoptera	SP2	3	Predator	Troglophile	Flyer
C2	Diptera	SP1	126	Detritivore	Troglophile	Flyer
C2	Diptera	SP2	13	Detritivore	Trogloxene	Flyer
C2	Diptera	SP3	2	Detritivore	Trogloxene	Flyer
C2	Diptera	SP4	1	Detritivore	Trogloxene	Flyer
C2	Diptera	SP5	1	Detritivore	Trogloxene	Flyer
C2	Diptera	SP6	1	Detritivore	Trogloxene	Flyer
C2	Diptera	SP7	1	Detritivore	Trogloxene	Flyer
C2	Isopoda	SP1	4	Detritivore	Troglophile	Walker
C2	Isopoda	SP2	4	Detritivore	Troglobiont	Walker
C3	Aracnida	SP5	1	Predator	Troglobiont	Walker
C3	Aracnida	SP6	2	Predator	Troglobiont	Walker
C3	Pseudoscorpiones	SP1	1	Predator	Troglobiont	Walker
C3	Opiliones	SP1	1	Detritivore	Troglophile	Walker
C3	Diplopoda	SP1	2	Detritivore	Troglophile	Walker
C3	Diplopoda	SP2	5	Detritivore	Troglobiont	Walker
C3	Trichoptera	SP1	1	Detritivore	Troglophile	Flyer
C3	Coleoptera	SP7	7	Predator	Troglobiont	Walker
C3	Hymenoptera	SP1	70	Predator	Troglophile	Flyer
C3	Diptera	SP1	142	Detritivore	Troglophile	Flyer
C3	Diptera	SP2	14	Detritivore	Troglophile	Flyer
C3	Diptera	SP3	8	Detritivore	Trogloxene	Flyer

Table 1. Specimens collected in the three cave traps with their taxonomical and ecological categories.

Springtails always maintained their nearly-white/transparent pigmentation, and were never encountered under daylight so night habits are supposed. On the contrary isopods were occasionally observed even on the rocks, even under full indirect daylight with a slightly darker (pink) pigmentation respect the completely white-nearly transparent observed in the deep cave individuals.

Biodiversity measured in the three cave traps in terms of species evenness was almost equally distributed, with a light decreasing proceeding deeper in the cave. A bit more evident but not remarkable was the decreasing in the Shannon-Wiener Index, but significant in Species Richness halved from the light to the darkness (Table 3). This trend is maintained also when considered in a wider range of 50 computed repetitions where Chao2 slightly diverges (from 0 to 32%) from the species rarefaction curve (Fig. 4). Animal biomass from sampled invertebrates shows a non linear progression from light to darkness (Table 4) and is almost equally distributed between flyers (7.1 g) and walkers (7.2 g) but dominated by few species: the large and trogloxenic Calliphorid flies within the flyers and by the troglophilic/trogloxenic Diplopoda within the walkers.

In the external traps (A1, A2, A3, B1, B2, B3) 288 specimens were collected in 51 species, 14 of them (27%) found also in the traps inside the cave.

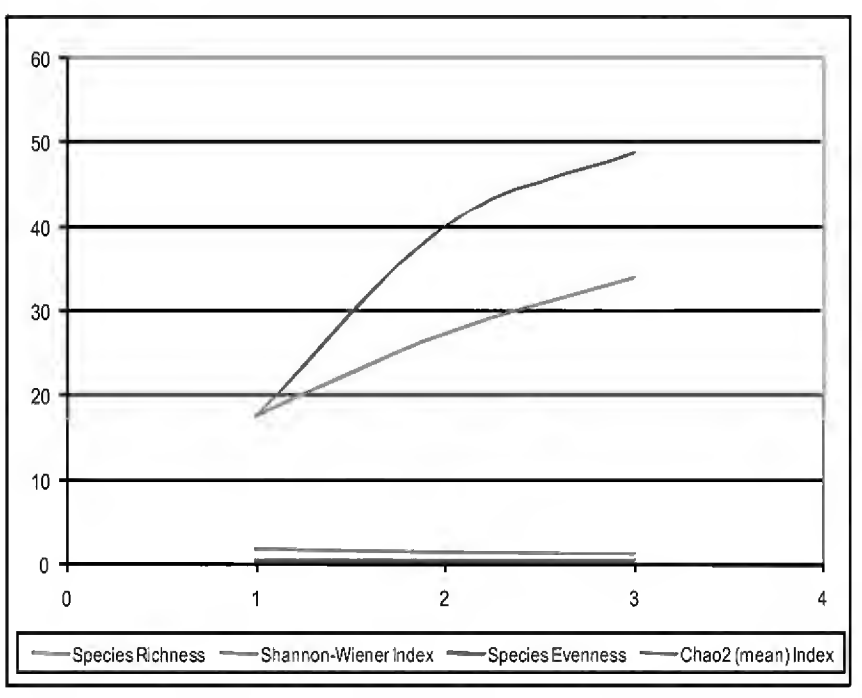

Figure 4. Comparison of the biodiversity estimators used, related to the number of individuals computed with EstimateS (x axis) in 50 repetitions, for to the three cave trap sites, and the number of species (y axis).

CONCLUSIONS

The light-gradient (together with other air parameters related to it) seems to have a moderate influence in changing on the overall subterranean biodiversity and biomass of the cave studied. Even if the length of the gradient here considered is remarkably long for a semi-natural karstic cave, the difference between the three cave traps in terms of biodiversity is quantitatively very low, but it should be considered also qualitatively. The slight decreasing of the number of species, proceeding from full light to full darkness, is the result of a replacement of species and strategies that makes the overall biodiversity almost constant: specialized deep cave species take the place of less specialized epikarst species.

In a model of a dynamic subterranean environment (Giachino &Vailati, 2010) the cave of Ponte Subiolo confirms again that some traditionally defined troglobiont species are generally not exclusive of the deep cave habitat. However it should be noted how the presence of light seems to be a real limit for others. Our results indicate that seems some species don't cross (or at least we can presume don't use to cross at day/season level) the line of permanent darkness (or limit for chlorophyll photosynthesis), forming separate subterranean communities. Chlorophyll photosynthesis stopped at 1 lux where the last alga was found and vascular plants stopped at 130 lux leaving the range between 130 to 50 lux to non vascular plants and the range between 50 to 1 to unicellular algae. If we exclude trogloxenic species collected or observed only once that may be related to occasional intrusions, very few species of the woodland habitat have been frequently found in the cave and almost all of them limited to the external part, and vice versa. We can presume that this barrier is not absolute but these records suggest that for some troglobionts, the migration rates from cave to cave are very low and should be considered in terms of many years or absent.

This is supported also by the historical records (Paoletti et al., 2009): in more than 20 years from 1992 to 2013 the invertebrate populations of the cave of Ponte Subiolo are nearly the same. Even if located in a karst area near other caves with different fauna, species contaminations and migration between caves seem to be extremely reduced. Large

Trap	Groups	Species	Specimens	Predators	Detritivores	Trogloxene	Troglophile	Troglobiont
1	9	20	142	25%	75%	33%	58%	8%
2	8	18	227	39%	61%	39%	33%	28%
3	8	12	254	42%	58%	8%	58%	33%

Table 2. Sum of the categories and abundance of the specimens collected in the three cave traps.

Trap	Species Richness	Shannon-Wiener Index	Species Evenness
C1	24	1.79	0.56
C2	17	1.50	0.53
C3	12	1.29	0.52

Table 3. Biodiversity estimators directly calculated on the sampled specimens.

	C1	C2	C3	Total
Diptera	1	3	2.3	6.3
Diplopoda	0.6	2.2	1.8	4.6
Orthoptera	1.4	n.p.	n.p.	1.4
Isopoda	n.p.	0.7	n.p.	0.7
Hymenoptera	<0.1	0.3	0.3	0.6
Coleoptera	<0.1	0.2	0.1	0.3
Aracnida	<0.1	0.2	<0.1	0.2
Trichoptera	0.2	<0.1	<0.1	0.2
Collembola	<0.1	0	0	<0.1
Total	3.2	6.6	4.5	

Table 4. Biomass measured in the three traps grouped by taxon. Values are reported in grams, "n.p." is for a taxon not present in the trap and "<0.1" is for the weights (wet) lower than the sensitivity of the balance.

invertebrates like *Troglophilus cavicola* (Kollar, 1833) or *Meta menardi* Latreille, 1804 can be commonly found in natural caves or military galleries in the surroundings (<2 km) but have never been collected in the Cave of Ponte Subiolo and vice versa large and easy to see invertebrates of this cave (*Gryllomorpha dalmatina* Ocskay, 1832 or *Typhloiulus tobias*) have never been observed or are extremely rare in the surroundings (Battiston unpublished data).

A single case does not allow any generalization but the topic structure of this cave and its history in its natural and anthropic context supports the idea that it should not be an exception.

By a methodological point of view comparing the records from the external traps with the internal traps show a remarkable abundance of specimens inside the cave represented by few species and the opposite outside. This can be due to the trap stability: more efficient in a protected environment and less in an open one subjected to rainfalls, interactions with large predators or scavengers or other unpredictable disturbing factors.

The almost gradual progression of this trend from the cave to the external area and to the woodland suggests however an increasing of dispersion and diversification of life. This should be carefully investigated in further studies and considered in its methodological implications.

The qualitative distribution of biodiversity observed under a light gradient has remarkable implications for the conservation of the subterranean environments; they seem to be stable by a qualitative point of view, but they may be not in a quantitative point of view, and any loss of species can have long term effect to the biodiversity and be a threat for the resilience of its ecological system. Dispersions and concentrations of species and individuals should be considered in assessing biodiversity both in subterranean and epigean contexts.

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Sesbania bispinosa (Jacq.) W. Wight and *Trifolium repens* L. (Fabales Fabaceae) two new legume records for natural flora of the United Arab Emirates

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ABSTRACT In this report, we have recorded for the first time the presence of *Sesbania bispinosa* (Jacq.) W. Wight and *Trifolium repens* L. (Fabales Fabaceae) in natural flora of the United Arab Emirates (UAE). Based on extensive field surveys and literature review, it was apparent that these species have not been recorded before in the UAE flora.It might be important to mention that the two new records have great economic and agricultural importance. Both species are spontaneously occurring in the natural habitat and considered as good forage and can adapt to a wide range of environmental conditions. Specimens of both newly recoded species are deposited in the Sharjah Seed Bank and Herbarium (SSBH), UAE. Descriptions and photographs of these species are provided. The new records of vascular plants in UAE flora would help ecologists and conservation biologists in more potential scientific research and natural resources exploitations.

KEY WORDS Naturalized plants; new record; *Sesbania bispinosa*; *Trifolium repens*; United Arab Emirates.

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INTRODUCTION

Fabaceae or Leguminosae is one of the most widespread flowering plants families with about 751 genera and over ca. 19,500 species (Lewis et al., 2005). Fabaceae species range from dominant tropical canopy trees to tiny alpine annual herbs (Doyle, 1994) and are distributed throughout the tropical, subtropical and temperate regions of the world. In United Arab Emirates (= UAE), the family Fabaceae is represented by approximately 73 species and this paper reports *Sesbania bispinosa* (Jacq.) W. Wight and *Trifolium repens* L. as an addition to the Fabaceae flora of the country.

The Fabaceae species represent a significant element of the UAE flora and contribute significantly to structure and functioning of desert ecosystems of the country. It is interesting to note that despite of being first record in the country, *S. bispinosa* was found with more than hundred individuals growing in Wadi Al-Ain. Existence of this species in the natural habitats with high abundance shows its rapid naturalization. At present, globalization is facilitating and intensifying the intentional and unintentional introduction of plant species across the globe.

Accordingly, the data sets of biological records are likely to grow even faster, providing a wealth of research opportunities for ecologists and conservation biologists in understanding the main drivers of biodiversity loss. Knowledge of the spatial and temporal distribution of species is vital to many areas of biological research (Powney & Isaac, 2015). Biological recording has grown markedly in recent decades and the size and taxonomic breadth of

species distribution datasets are expected to rise (Dickinson et al., 2012; Miller-Rushing et al., 2012). In the past few years, many plant species were added as new records to the UAE flora (Böer & Chaudhary, 1999; Shahid & Rao, 2014a, 2014b; Gairola et al., 2015; Mahmoud et al., 2015).

As the UAE is experiencing a fast growth and development, mega sizes of commercial and agricultural exchange, there is a big possibility of spontaneous occurrence of new vascular plants to the country's flora. This paper reports the presence of two legume species, *S. bispinosa* and *T. repens* for the first time in the natural flora of the UAE.

MATERIAL AND METHODS

During field explorations in 2013–2015, the Sharjah Seed Bank and Herbarium team collected the specimens of *S. bispinosa* and *T. repens* for the first time in the UAE. Along with plant samples, all relevant field data including geographic coordinates of the collection sites, associated species and habitat in which plants grow have been recorded. The specimens were studied in detail and identified using relevant flora and literatures. Drs. Ahmed El Banhawy and Samia Heneidak, expert taxonomists in the regional flora of the Middle East, also confirmed the identification of the two species. After identification, the specimens were processed and deposited in the herbarium of SSBH.

The review of literature further confirmed that these species have not been reported from the UAE (Jongbloed, 2003; Karim & Fawzy, 2007).

RESULTS AND DISCUSSION

Sesbania bispinosa (Jacq.) W. Wight
=*Aeschynomene bispinosa* Jacq.
=*Sesbania aculeata* (Willd.) Pers.

COMMON NAMES. Prickly sesban, Dnchifibre, and Dhaincha.

EXAMINED MATERIAL. In the UAE, we have recorded *S. bispinosa* in four wet sites in Wadi Al Ain, Al Ain city (N: 24.169242, E: 55.658084 Alt.: 236 m, N: 24.210189 E: 55.756487 Alt.: 276 m, N: 24.204791 E: 55.739821 Alt.: 262 m and N: 24.188811 E: 55.698345 Alt.: 249 m). More than 150 individuals of the species were recorded from these sites. These included young, flowering, fruiting and senescent individuals.

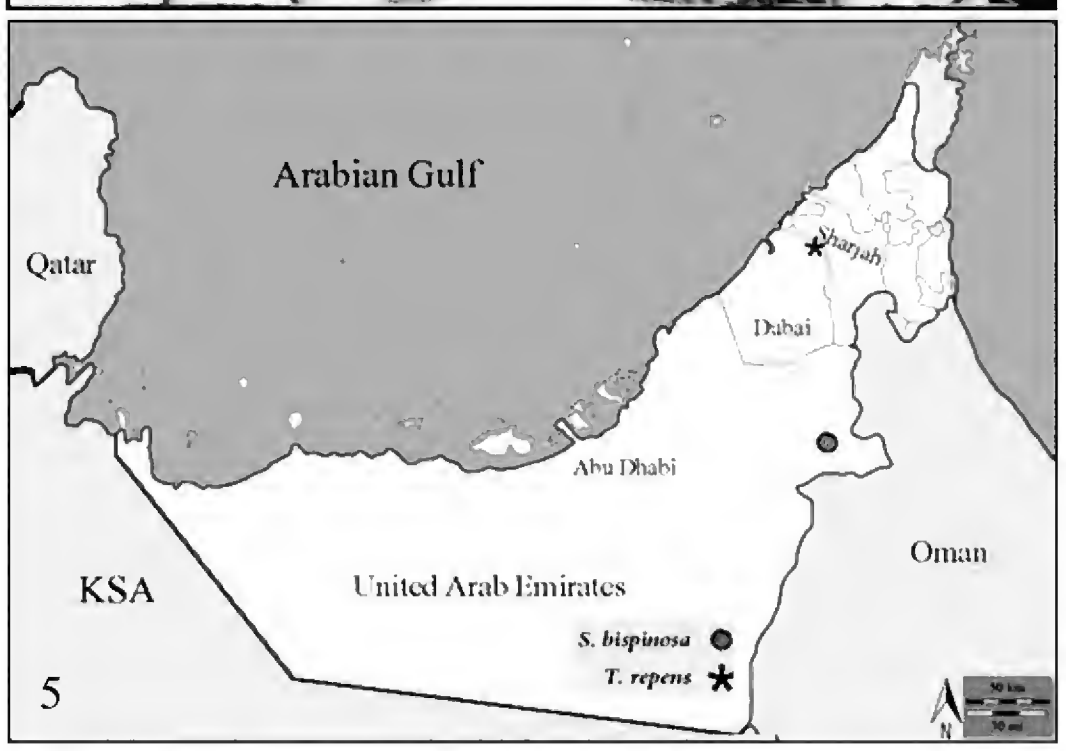
REMARKS. *Sesbania bispinosa* is an annual or biennial, erect herb, sometimes suffrutescent, 1–3 m tall; stems semi-woody glabrous or sparsely pubescent when young, sparsely aculeate; leaves paripinnate; leaflets oblong, obtuse, mucronate, sparsely pilose on margins and midrib below; stipules 6–10 mm long; inflorescence raceme, 3–12-flowered; corolla pale yellow, violet flecked; fruit glabrous, somewhat curved; seeds pale brown, olive-green or greenish-black, ellipsoid; flowers and fruits were recorded in May (UAE). The associate species recorded with *S. bispinosa* were *Phragmites australis* (Cav.) Trin. ex Steud., *Juncus socotranus* (Buchenau) Snogerup, *Prosopis juliflora* (Sw.) DC., *Cynodon dactylon* (L.) Pers., *Ipomoea aquatica* Forssk., *Eclipta prostrata* (L.) L. and *Typha domingensis* Pers.

Trifolium repens L.
=*Trifolium repens* var. *giganteum* Lagr.-Foss.

COMMON NAMES. White clover, Dutch clover, Ladino clover.

EXAMINED MATERIAL. In June 2013, we have recorded 5 individuals of *T. repens* from Emirate highway (N: 25.224, E: 55.559 and Alt.: 187), Dubai, UAE.

REMARKS. *Trifolium repens* is glabrous to glabrescent, prostrate, short-lived perennial or annual under moisture stressed conditions (Hutchinson et al., 1995). Stolon consists of a series of internodes separated by nodes. Each node bears a trifoliolate leaf. Leaflets 1–4 cm long, broadly obovate, rounded or retuse at the apex, if the node comes into contact with moist soil, adventitious roots may form from the root primordia closest to the ground (Thomas, 1987); petiole long; stipules broad at the base, sheathing, ending in a subulate apex; inflorescence globose raceme, 15–25 mm broad; flowers scented; calyx 2–6 mm, 10-nerved; teeth unequal; corolla white or pinkish; fruit linear, 3–4 seeded. Flowering and fruiting in May and June (United Arab Emirates). In the collection site, *T. repens* was growing in a sandy roadside habitat close to a wide sandy plain. This site generally receives some irrigation water from Dubai municipality to maintain the roadside landscape plants. The associate species of



Figures 1–3. *Sesbania bispinosa*. Fig. 1: habitat. Fig. 2: flowers. Fig. 3: stem with flower, spines and leaf base. Figure 4. *Trifolium repens*, herbarium specimen. Figure 5. The recording points of both the species.

T. repens were *Centropodia forsskalii* (Vahl) Cope, *Coelachyrum piercei* (Benth.) Bor., *Eragrostis barrelieri* Daveau, *Eremobium aegyptiacum* (Spreng.) Asch., *Gisekia pharnacioides* L., *Moltkiopsis ciliata* (Forssk.) I.M. Johnst., *Salvadora persica* Wall., *Spergularia marina* (L.) Griseb. and *Tragus racemosus* (L.) Haller.

In a study conducted by Mousa & Fawzi (2009), they did not record *S. bispinosa* in the same study area. This indicates that this species has introduced after their survey and it rapidly adapted and naturalized to the local habitat of the study area as indicated by the presence of more than 150 individuals.

The fast naturalization of *S. bispinosa* under the environment of the UAE indicates that this species might have an invasive ability and threaten the unique indigenous flora of the country. In similar context, Wu et al. (2003) highlighted naturalization

as an important step of the primary phases of plant invasion and suggested comprehensive monitoring of naturalized species to collect important information about potential invaders. Consequently, careful monitoring for the distribution and abundance of rapidly naturalizing species such as *S. bispinosa* in the different habitats of United Arab Emirates should be taken into consideration.

CONCLUSIONS

It is a well established fact that due to recent increase in international trade and travel, inflow of alien species tends to gradually increase worldwide. Both *S. bispinosa* and *T. repens* are newly recorded alien species to the natural flora of the UAE. The magnificent growth of *S. bispinosa* in the United Arab Emirates renders this species as a good candidate as economic crops under the natural conditions of the UAE.

However, the economic exploitation of this species necessitates careful records for its distribution and abundance in the different habitats of the country. Some of the previous new vascular plant records have made great contributions to our understanding of alien invasion plant within UAE. So, the mechanisms of arrival of newly recorded alien plants species in the country need to be determined. This will help in understanding the origins and pathways of arrival of invasive species and can help developing strategies for preventing future introduction and safeguarding native plant diversity.

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New and interesting *Carabus* Linnaeus, 1758 (Coleoptera Carabidae) from Korean Peninsula

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ABSTRACT

An extensive contribution to the genus *Carabus* Linnaeus, 1758 (Coleoptera Carabidae) from Korean Peninsula is provided. One new species and 14 new subspecies are described and figured: *Carabus* (*Acoptolabrus*) *planicranion* n. sp., *C.* (*Carabus*) *szeli obong* n. ssp., *C.* (*Carabus*) *angustus dopyeong* n. ssp., *C.* (*Carabus*) *sternbergi gimhwa* n. ssp., *C.* (*Carabus*) *sternbergi goheungicus* n. ssp., *C.* (*Carabus*) *sternbergi jindoensis* n. ssp., *C.* (*Carabus*) *sternbergi deogyusan* n. ssp., *C.* (*Carabus*) *cartereti peacedam* n. ssp., *C.* (*Carabus*) *fraterculus yongwangicus* n. ssp., *C.* (*Acoptolabrus*) *constricticollis microcolasellus* n. ssp., *C.* (*Acoptolabrus*) *leechi viniciosalamii* n. ssp., *C.* (*Acoptolabrus*) *leechi drouini* n. ssp., *C.* (*Coptolabrus*) *jankowskii byeoksanensis* n. ssp., *C.* (*Coptolabrus*) *smaragdinus buangun* n. ssp., *C.* (*Coptolabrus*) *smaragdinus euaureus* n. ssp. A new natural hybrid is described and figured: *C.* (*Leptocarabus*) *seishinensis seishinensis* Lapouge, 1931 x *C.* (*Leptocarabus*) *semiopacus* Reitter, 1895. Two taxonomic changes are proposed: *C.* (*Isiocarabus*) *kirinicus* Csiki, 1927 bona species and *C.* (*Isiocarabus*) *saishutoicus* Csiki, 1927 bona species and additional information are provided for several little known taxa.

KEY WORDS

Carabus; new taxa; Republic of Korea; Democratic Republic of Korea; Korea Peninsula.

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INTRODUCTION

The Korean Peninsula extends southwards for about 1,100 km from continental Asia (Manchuria) into the Pacific Ocean and is surrounded by the Sea of Japan (East Sea) to the East, and the Yellow Sea to the west, the Korea Strait connecting the first two bodies of water. A number of islands surrounds the Peninsula. The Amnok River and the Duman River separates Korea from China and Russia. The Korean Peninsula has plains in the western and southern parts, while the eastern and northern parts are mountainous. The main mountain range is named Baekdudaegan that runs through most of the length of the Korean Peninsula, from Paektu Mountain (the highest point 2744 m) in the north to Jirisan in the south.

The Korean Peninsula is part of the East Asian monsoonal region. The typical vegetation of the temperate middle regions includes a deciduous hardwood forest that varies floristically from south to north. Conifers occur in places that are especially cold or recently disturbed. The warm-temperate southern part of the ecozone includes the hornbeam species *Carpinus tschonoskii* Maxim. and *C. laxiflora* (Siebold et Zucc.) Blume. Other characteristic species in the southern part are pine *Pinus thunbergii* Parl., maple *Acer formosum* Carrière, *A. palmatum* Thunb., oak *Quercus acutissima* Carruth., and snowbell *Styrax*. The bamboo *Phyllostachys* is

also characteristic of this warm temperate area, although it occurs mainly in areas that have been disturbed by forest clearing or cultivation. The cool-temperate northern part supports forests of the oak species *Quercus mongolica* Fisch. ex Ledeb., *Q. serrata* Murray, and the fir *Abies holophylla* Maxim. Other cool temperate deciduous trees include *Acer mono* (Maxim.) H.Ohashi, birch *Betula*, *Carpinus*, *Celtis chinensis* Bunge, Korean ash, *Fraxinus rhynchophylla* (Hance) A.E.Murray, walnut *Juglans mandshurica* Maxim., *Maackia amurensis* Rupr., *Platycarya strobilacea* Siebold et Zucc., *Prunus padus* (L.), *Pyrus ussuriensis* Maxim., willow *Salix*, and elm *Ulmus*. Very similar vegetation is present also in the middle and southern part of the peninsula in the mountain areas up to 1000/1500 m.

The genus *Carabus* Linnaeus, 1758 in the Korean Peninsula is very rich in terms of species and subspecies and it is characterized by the presence of a number of endemic taxa (Kwon & Lee, 1984; Deuve, 1990; 1991; 2004; Deuve & Mourzine, 1993; Brezina, 2003). Particularly the species belonging to the subgenera *Parhomopterus* Lapouge, 1931, *Acoptolabrus* Morawitz, 1886, and *Coptolabrus* Solier, 1848 are splitted in many separate species or subspecies due to the fact that the different populations are often confined to the isolated and favourable biotopes of the mountainous regions.

Tatum (1847) described the first *Carabus* species from Korea: *C. monilifer* (= *C. smaragdinus monilifer*). Lapouge (1929-1932) and Breuning (1932-1936) treated extensively the Korean *Carabus* in their famous monographs. An extensive book on the Korean *Carabus* was provided by Kwon & Lee (1984). Others contribution are provided by Born (1922) and Kwon & Park (1989).

The aim of this paper is to improve the knowledge of the genus *Carabus* of the Korean Peninsula. One new species and 14 new subspecies are described and figured: *C.* (*Acoptolabrus*) *planicranion* n. sp.; *C.* (*Carabus*) *szeli obong* n. ssp.; *C.* (*Carabus*) *angustus dopyeong* n. ssp.; *C.* (*Carabus*) *sternbergi gimhwa* n. ssp.; *C.* (*Carabus*) *sternbergi goheungicus* n. ssp.; *C.* (*Carabus*) *sternbergi jindoensis* n. ssp.; *C.* (*Carabus*) *sternbergi deogyusan* n. ssp.; *C.* (*Carabus*) *cartereti peacedam* n. ssp.; *C.* (*Diocarabus*) *fraterculus yongwangicus* n. ssp.; *C.* (*Acoptolabrus*) *constricticollis microcolasellus* n. ssp.; *C.* (*Acoptolabrus*) *leechi vinicios-alamii* n. ssp.; *C.* (*Acoptolabrus*) *leechi drouini* n. ssp.; *C.* (*Coptolabrus*) *jankowskii byeoksanensis* n. ssp.; *C.* (*Coptolabrus*) *smaragdinus buangun* n. ssp.; *C.* (*Coptolabrus*) *smaragdinus euaureus* n. ssp. A new natural hybrid between species is described and figured: *C.* (*Leptocarabus*) *seishinensis seishinensis* Lapouge, 1931 x *C.* (*Leptocarabus*) *semiopacus* Reitter, 1895. Two taxonomic changes are proposed: *C.* (*Isiocarabus*) *kirinicus* Csiki, 1927 bona species; *C.* (*Isiocarabus*) *saishutoicus* Csiki, 1927 bona species and additional informations are provided for several little known taxa.

ACRONYMS. CIR: Ivan Rapuzzi private collection.

RESULTS

Carabus (*Isiocarabus*) *kirinicus* Csiki, 1927 bona species (Figs. 5–8)

kirinicus Csiki, 1927 nom. pro *auricollis* Born, 1922
auricollis Born, 1922 nec Waterhouse, 1867

EXAMINED MATERIAL. *Carabus* (*Isiocarabus*) *fiduciarius* Thomson, 1856 (Figs. 1–4): 1 male and 2 females: China, Hubei, Mt. Daba Shan, Gushui (sub *C. fiduciarius tim* Kleinfeld, 1999) (CIR); 2 males and 1 female: China, Sichuan, Wanyuan, Mt. Hua-e-shan (sub *C. fiduciarius tim*) (CIR); 1 male: China, Kiang-si, Kiu-kiang (CIR); 2 males: China, Fujian, Tainshan (CIR); 1 male and 1 female: China, Zhejiang, Mt. Dai-shan (CIR). *Carabus* (*I.*) *kirinicus* Csiki, 1927: 2 males and 1 female: Republic of Korea, Kyonggi-Do, Nam-yang-Ju-shi (CIR); 2 females: Republic of Korea, Kyonggi-Do, East from Seoul, Yangpyeong (CIR).

REMARKS. Described as a good species, *C.* (*Ohomopterus*) *auricollis* Born (1922) on two specimens (1 male: length 28 mm and 1 female: length 32 mm) from Korea without detailed locality. The name *auricollis* Born, 1922 was pre-occupied by *C. auricollis* Waterhouse, 1867 (= *C. blaptoides rugipennis* Motschulsky, 1861) and consequently changed in *kirinicus* Csiki, 1927. It was treated as a subspecies of *C.* (*Isiocarabus*) *fiduciarius* by Breuning (Breuning, 1927).

It can be treated as a separate species from *C. fiduciarius* Thomson, 1856 by the larger body size (31 mm to 35 mm); the larger, transverse and subrectangular shape of pronotum with wide borders

strongly bent upwards till the apex; the longer, slender and flatter elytra; the more regular sculpture of elytra; the less pubescent sternum. It seems to be endemic to the Central Western part of Korea peninsula (Kyonggi-Do, West Kangwon-Do; South Hawangae-Bukdo provinces) (Kwon & Lee, 1984) with a completely separate distribution from *C. fiduciarius* from Central East China (Shanghai, Anhui, Zhejiang, Jiangxi, Hubei, Hunan, Sichuan, Shaanxi provinces) (Deuve, 2013)

Carabus (Isiocarabus) saishutoicus Csiki, 1927

bona species (Figs. 9–12)

saishutoicus Csiki, 1927 nom. pro *insularis* Lapouge, 1911

insularis Lapouge, 1911, nec Hope, 1837

EXAMINED MATERIAL. 1 male and 1 female: Republic of Korea, Cheju Island, Mt. Hallasan (CIR); 2 female: Republic of Korea, Cheju Island, Mt. Hangla (CIR).

REMARKS. It was described as a subspecies of *C. fiduciarius* by Lapouge: *C. fiduciarius insularis* Lapouge, 1911, name not available because preoccupied by *C. insularis* Hope, 1837 and changed in *C. fiduciarius* var. *saishutoicus* Csiki, 1927. It was described from Quelpart Island (former name for Chejudo Island), its presence in northeastern China is very doubtful, probably due to a wrongly labelled specimen (Deuve & Li, 2000). From Chejudo Island it is known from several localities: Cheju, Hagwi, Mt. Hallasan, Sanch'o'ndan, So'gwip'o, So'ngp'anak (Kwon & Lee, 1984).

Carabus (*I.*) *saishutoicus* differs from *C. fiduciarius* by the following characteristics: darker colour, totally black or black with dark bluish or violet margins; pronotum smaller, less cordate and less transverse (1.25 times as broad as long for *C. saishutoicus* and 1.32 for *C. fiduciarius*), apex of pronotum laterally rounded; elytra more elongate, ovoid, strongly broader next to the middle distally; elytral sculpture smoother, perfectly triploid homodiname, striae very slightly and superficially punctured; male aedeagus: median lobe in lateral view more elongated and slender, apex longer (Fig. 10); apex in dorsal view (Fig. 11) longer and more rectilinear. From *C. kirinicus* it is easily distinguished by the following characters: smaller size; darker colour; less transverse pronotum (1.4 times as broad as long for *C. kirinicus*), apex of pronotum laterally rounded, base of pronotum with wide borders not bent upwards; shorter and more convex elytra; sculpture of elytra smoother, less interrupted primary intervals, striae less punctured; sternum pubescent; aedeagus shorter with enlarged median portion.

Carabus (Carabus) szeli obong n. ssp.

(Figs. 13–16)

EXAMINED MATERIAL. Holotype male, Democratic Republic of Korea, North Hamgyong Province, Mt. Obong, (ca 42.40 NL; 129.80 EL), 1/15.VII.2012, local collector legit. The holotype is deposited in the author's collection. Paratypes: males and females, same data as Holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 19 mm, maximum width of elytra: 7.1 mm. Head, pronotum and dorsum coppery-green, very shiny; palpi, antennae and legs black-brownish. Head short and thickened; very short neck; surface punctured, frontal impressions deep and rugulose, exceeding the margin of eyes; very convex eyes. Mandibles very short and strongly curved. Palpi very narrow and slender, labial palpi bisetose. Antennae short, extending with 4 antennomeres beyond pronotal base. Pronotum transverse (1.35 times as broad as long) and slightly cordate; sides of pronotum with wide borders bent upwards; basal angles rounded and strongly protruding behind the base. Elytra ovate, convex; elytral sculpture strong for the species, triploid heterodyname type; primary intervals convex, forming short links by deep foveae; secondary intervals convex and uninterrupted; tertiary intervals faintly and somewhat reduced. Male aedeagus: Figs. 14,15.

VARIABILITY. The variability concerns the size that ranges from 17.5 mm to 21 mm for the males and 19 mm to 23 mm for the females. The colour is variable: coppery and coppery with green lustre is dominant, rarely green, blue or black forms.

ETYMOLOGY. The new subspecies is named after the type locality.

REMARKS. Distinguished from the typical subspecies by the narrower pronotum, shorter and more

convex elytra; elytral sculpture with primary intervals strongly convex, forming shorter and rounded segments, secondary and tertiary strongly convex, faintly striate between the intervals; male aedeagus with apical lobe in lateral view smaller and thin, less curved; apex in dorsal view with apical lobe shorter and acuminated, strongly curved on the left.

Carabus (*Carabus*) *angustus dopyeong* n. ssp.

(Figs. 17–20)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Geonggi-do/Gangwon-do provincial border, Pass North from Dopyeong, 600 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit. The holotype is deposited in the author's collection. Paratypes: 6 males and 7 females, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 22.5 mm, maximum width of elytra: 7.4 mm. Colour black with metallic coppery lustre; dorsum, pronotum and head rather mat. Legs, palpi, antennae, and mandibles black-brownish. Head moderately thickened; surface of the head slightly punctured, strongly and roughly punctured at the margins of eyes and at the base; short neck. Eyes salient. Mandibles short. Palpi thin and long, labial palpi bisetose. Antennae thin and elongate, extending with 5 antennomeres beyond pronotal base and reaching the middle of elytra. Pronotum moderately sinuate, slightly transverse (1.28 times as broad as long), upper surface flat; sides of pronotum margined, bent upwards; hind angles rounded,long and protruding behind the base; surface punctured, strongly punctured at the base and at the sides. Elytra very elongate, narrow, oval, slightly convex, maximum width near the apex; shoulders very salient, angulate; sculpture triploid heterodyname, primary segments larger and more elevated, forming chains of short links; secondary and tertiary intervals of the same size forming lines uninterrupted. Male aedeagus typical of the species but well characterized: the median lobe in lateral view is stronger and longer with simple apex, not uncinate (Fig. 18); the apex in dorsal view is longer and less dilated laterally (Fig. 19).

VARIABILITY. Very little variability: the length of the body ranges from 20.8 mm to 25 mm.

ETYMOLOGY. The new subspecies is named after the type locality.

REMARKS. The new taxon is characterized from all the other *C. angustus* forms from North Korea by the larger size, more elongate and flat body, and the shape of male aedeagus. This is the first time that *C. angustus* is recognized from South Korea.

Carabus (*Carabus*) *sternbergi gimhwa* n. ssp.

(Figs. 21–24)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Gyeonggi-do/Gangwon-do provincial border, Pass North from Dopyeong, 600 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit. The holotype is deposited in the author's collection. Paratypes: 8 males and 4 females, same data as holotype; 2 males and 2 females, Republic of Korea, Gangwon-do province, South from Gimhwa, 450 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit; 3 males and 6 females, Republic of Korea, Gyeonggi-do province, between Pocheon and Gimhwa, Dopyeong, Baegun valley, 350-400 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit;1 male and 5 females Republic of Korea, Gangwon-do province, Gimhwa, Maewoldae fall, 400 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit. The Paratypes are deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 26.5 mm, maximum width of elytra: 10.2 mm. Dorsal side shiny coppery. Legs, palpi, antennae, and mandibles black. Close to *C.* (*Carabus*) *sternbergi sternbergi* Roeschke, 1898 and *C.* (*Carabus*) *sternbergi longior* Breuning, 1975 (Breuning, 1975) but distinguished by the following characters: smaller and slender in general; pronotum very elongate and sinuate with the hind angles acute and more strongly protruding behind the base; surface of pronotum strongly and densely punctured; elytra ovate and elongate, more convex with smoother sculpture; smaller and thinner male aedeagus; in lateral view the tooth on the median lobe is smaller and less pointed, smooth (Fig. 22). The apex in dorsal view is shorter and less curved (Fig. 23).

VARIABILITY. In general very little variability: the length of the body ranges from 22 mm to 27 mm

for the males and 26 mm to 27.5 mm for the females. The colour is very constant, occasionally coppery with green lustre.

ETYMOLOGY. The new subspecies is named after the type locality.

Carabus (Carabus) sternbergi goheungicus n. ssp. (Fig. 25)

EXAMINED MATERIAL. Holotype female, Republic of Korea, Goheung peninsula, Paryeongsan, 200 m, 10/17.VII.2012, I. Rapuzzi and L. Caldon legit. The Holotype is deposited in the author's collection. Paratype: 1 female, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Female. Length including mandibles: 30.5 mm, elytral width: 10.9 mm. Colour black with few metallic lustre brownish-copper on dorsum, moderately mat; pronotum slightly shiny and colourful. Head thickened. Frontal impressions rugulose, exceeding anterior margin of eyes; vertex slightly convex, surface of the vertex punctured; short neck; surface punctured. Pronotum slightly wide (1.32 times as broad as long), scarcely sinuous, basal angles short. Elytra oval, elongate, disc depressed, maximum width of elytra at the middle; shoulders marked and rounded; sculpture triploid heterodyname type: only the primary intervals are interrupted by small foveae; secondary and tertiary intervals are uninterrupted and of the same size; between the primary and tertiary intervals are two series of striae more or less aligned, sometimes confluent.

VARIABILITY. No variability.

ETYMOLOGY. The new subspecies is named after the Goheung peninsula where the type locality is situated.

REMARKS. *Carabus sternbergi goheungicus* n. ssp. differs from *C. sternbergi honamensis* Kwon et Lee, 1984 by the stronger and densely punctured surface of head and pronotum; slightly sinuate and more convex pronotum; more elongate elytra; elytral sculpture less prominent, primary foveae indistinct; between primary and tertiary elytral intervals there are two rows of points. From *C. namhaedoensis* Kwon et Lee, 1984 the new taxon differs by the stronger and larger shape of the body; more convex elytra; more strongly and densely punctured surface of head and pronotum. Further examination of male specimens will permit to understand the correct systematic position of the new taxon: a subspecies of *C. sternbergi* (as supposed in this article), a subspecies of *C. namhaedoensis* or a separate different species.

Carabus (Carabus) sternbergi jindoensis n. ssp. (Figs. 26–29)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Jindo Island, 8.VIII.2010, unknown legit. The Holotype is deposited in the author's collection. Paratype: 1 female, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 24.3 mm, maximum width of elytra: 8.8 mm. Dorsal side coppery, very shiny. Legs, palpi, antennae, and mandibles black. Head moderately thickened, surface very shiny, short neck. Pronotum not sinuate, upper surface convex; sides of pronotum marginated, very slightly bent upwards; basal angles short and rounded. Elytra quite short, oval, convex, maximum width near the apex; shoulders slightly salient, rounded; sculpture triploid heterodyname, primary segments larger and more elevated, forming chains of short links with deep foveae; secondary and tertiary intervals of the same size forming uninterrupted lines; punctured striae. Male aedeagus characteristics: in lateral view (Fig. 27) the apical lobe is very short and large, asymmetric; strongly carinate and convexly protruding on the ventral side of the mediane lobe (Fig. 27). In dorsal view the apex is moderately dilated at the base, and the apex is very short and large (Fig. 28).

VARIABILITY. Very little variability of the female paratype: the upper surface is more mat.

ETYMOLOGY. The species is named after the type locality.

REMARKS. *Carabus sternbergi jindoensis* n. ssp. is easily distinguished from all other *C. sternbergi* subspecies by its short and convex body shape and by the distinctive morphology of the aedeagus.

Carabus (Carabus) sternbergi deogyusan n. ssp.
(Figs. 30–33)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600 m, 8/15.VII.2007, I. Rapuzzi and L. Caldon legit. The holotype is deposited in the author's collection. Paratypes: 9 males and 25 females, same data as holotype; 2 females, Republic of Korea, Cholla Bukdo, Deogyusan, 10 km North from Gucheondong, 550 m, 7/15.VII.2007, I. Rapuzzi and L. Caldon legit. The paratypes are deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 23.4 mm, maximum width of elytra: 8.5 mm. Colour of elytra coppery with margins, pronotum and head gold-green, very shiny. Legs, palpi, antennae, and mandibles black-brown. Head very moderately thickened, sparsely and faintly punctured. Pronotum sinuate, transverse (1.36 times as broad as long), upper surface convex; surface of pronotum very shiny and very faintly punctured, not rough. Elytra oval, elongate and very convex; maximum width of elytra at the apical third; shoulders very salient; sculpture triploid nearly homodyname, primary intervals forming chains of long segments; secondary and tertiary intervals forming uninterrupted lines; punctured striae. Male aedeagus very distinctive: in lateral view (Fig. 31) the apical lobe is very large and long, spatula-shaped; the median lobe is very strongly carinate and very convexly protruding on the ventral side. In dorsal view the apical lobe is moderately dilated at the base, and the apex is very short and curved on le left (Fig. 32).

VARIABILITY. The variability of paratypes relates to the size that ranges from 22 mm to 24.8 mm for the males and 23.2 mm to 27.3 mm for the females. The colour is variable: coppery and coppery with green margins is dominant, rarely dark blue form.

ETYMOLOGY. The new subspecies is named after the type locality.

REMARKS. The new subspecies seems to be endemic to the Deogyusan Peak and closest mountain area.

Carabus (Carabus) cartereti peacedam n. ssp.
(Figs. 34–37)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Gangwondo, "Peace Dam", NE Hwacheon 400 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit. The Holotype is deposited in the author's collection. Paratypes: 5 males and 36 females, same data as Holotype; 3 males and 2 females, Republic of Korea, Gangwondo, NE Hwacheon, E Pungsan, 350 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit; 28 males and 51 females, Republic of Korea, Gangwondo, 20 km NW Inje, 500 m, 3/13.VII.2012 I. Rapuzzi and L. Caldon legit. The paratypes are deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 24.6 mm, maximum width of elytra: 9.3 mm. Colour of elytra coppery with some green lustre, shiny. Legs, palpi, antennae, and mandibles black. Head very moderately thickened, very sparsely and faintly punctured, vertex smooth. Pronotum not sinuate, sides of pronotum with borders bent upwards; basal angles rounded and stronglyprotruding behind the base; surface of pronotum not punctured but rough. Elytra oval, quite short and rather convex; shoulders very salient; sculpture marked, triploid heterodyname type: primary intervals forming chains of short segments with deep foveae, secondary intervals forming uninterrupted lines, tertiary intervals partially reduced (especially from the middle of elytra to the apex); punctured striae. Male aedeagus: in lateral view (Fig. 35) the median lobe is more developed than in the typical subspecies, the apical lobe is larger; the median lobe is convexly protruding on the ventral side. In lateral view the apex is bent, forming a sort of tip of foil (Fig. 36).

VARIABILITY. The variability of paratypes concerns the size that ranges from 23 mm to 26 mm for the males and 23.5 mm to 27 mm for the females. The colour is very constant, only very few specimens are green with coppery lustre; the females are usually rather mat. The elytral sculpture in some case are less marked, and sometimes more homodyname type.

ETYMOLOGY. The new subspecies is named after the type locality, the "Peace Dam" build near the border of Democratic Republic of Korea.

REMARKS. The range of *C. cartereti peacedam* n. ssp. very close to that of *C. sternbergi gimhwa* n. ssp. We did not find any sympatric locality but no transitional forms are known. A sympatric locality (Democratic Republic of Korea, Wonsan, Hwangyong San) for the two species was reported by Deuve (Deuve & Li, 2009) and confirmed by several specimens of the two species preserved in my collection.

Carabus (*Leptocarabus*) *seishinensis* aff. *seuglaki* Kwon et Lee, 1984 (Fig. 38)

EXAMINED MATERIAL. 2 males and 1 female, Republic of Korea, Southeast from Gurye, Mt. Paegusan, I. Rapuzzi and L. Caldon legit (CIR).

REMARKS. This *Carabus* is close to *C. seishinensis seunglaki* from Mt. Jirisan but with a different elytral sculpture with stronger and elevated intervals; pronotum slightly slender.

Carabus (*Leptocarabus*) *seishinensis elongatipennis* Imura et Yamaya, 1994 (Fig. 39)

EXAMINED MATERIAL. 10 males and 12 females, Democratic Republic of Korea, South Pyongan Prov., Songchun city, Kubong-dong, 1/5.VI.2011, local collector legit (CIR).

REMARKS. The new locality expands the range of this taxon to the South.

Carabus (*Leptocarabus*) *seishinensis seishinensis* Lapouge, 1931 x *C.* (*Leptocarabus*) *semiopacus* Reitter, 1895 (Figs. 40–42)

EXAMINED MATERIAL. *Carabus* (*L.*) *seishinensis* x *C.* (*L.*) *semiopacus* Reitter, 1895 1 male: Republic of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600 m, 8/15.VII.2007, I. Rapuzzi and L. Caldon legit (CIR).

Carabus (*L.*) *seishinensis* (Figs. 43–46), numerous males and females, Republic of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600 m, 8/15.VII.2007, I. Rapuzzi and L. Caldon legit (CIR).

Carabus (*L.*) *semiopacus* (Figs. 47–50), numerous males and females, Republic of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600 m, 8/15.VII.2007, I. Rapuzzi and L. Caldon legit (CIR).

DESCRIPTION OF THE HYBRID SPECIMEN. Length including mandibles: 23.5 mm. The fenotype is the closest to *C. seishinensis* in general. The head is slightly thicker, intermediate between the parental species. The pronotum is less cordate, slightly bent upwards, hind angles rounded and shortly protruding behind the base as in *C. semiopacus*. Sculpture of elytra triploid heterodyname type, primary segments larger and more elevated, forming chains of long links by deep foveae; secondary and tertiary intervals equal, forming lines uninterrupted; quaternary intervals reduced in grains. Male aedeagus similar to *C. seishinensis* but the apical lobe in lateral view is longer and less curved. The apex in dorsal view is longer and narrower.

REMARKS. The hybrid was sampled in the field, in mixed Broadleaf Forest. In this area *C. semiopacus* is less abundant than *C. seishinensis*.

Carabus (*Leptocarabus*) *vogtianus horvatovichi* Deuve, 1992 (Figs. 51–53)

EXAMINED MATERIAL. 6 males and 9 females, Republic of Korea, Geonggido/Gangwondo provincial border, Pass North from Dopyeong, 600 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit; 1 male and 1 female, Republic of Korea, Gangwondo province, "Peace Dam", NE Hwacheon 400 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit; 2 males and 4 females, Republic of Korea, Gangwondo province, Gimhwa Maewoldae fall, 400 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon legit (CIR).

REMARKS. *Carabus* (*L.*) *vogtianus horvatovichi* was described from the Paykon-san Massif, 30 km Northeast from Kaesong in the Democratic Republic of Korea near the Republic of Korea border (Deuve, 1992). The first record of *C. vogtianus* for the Republic of Korea was from Mount Kwandak (Lassalle, 1999) which very probably belongs as well to the subspecies *horvatovichi*.

Fig. 1. *Carabus* (*Isiocarabus*) *fiduciarius*, male, 27.5 mm, China, Sichuan, Wanyuan, Mt. Hua-e-shan (sub *C. fiduciarius tim*) (CIR). Fig. 2. Idem, aedeagus: median lobe in lateral view. Fig. 3. Idem, aedeagus: apex in dorsal view. Fig. 4. Idem, female, 30.5 mm, China, Zhejiang, Mt. Dai-shan (CIR). Fig. 5. *C.* (*I.*) *kirinicus*, male, 34 mm, R. of Korea, Kyonggi-Do, Nam-yang-Ju-shi (CIR). Fig. 6. Idem, aedeagus: median lobe in lateral view. Fig. 7. Idem, aedeagus: apex in dorsal view. Fig. 8. Idem, female, 35 mm, R. of Korea, Kyonggi-Do, East from Seoul, Yangpyeong (CIR).

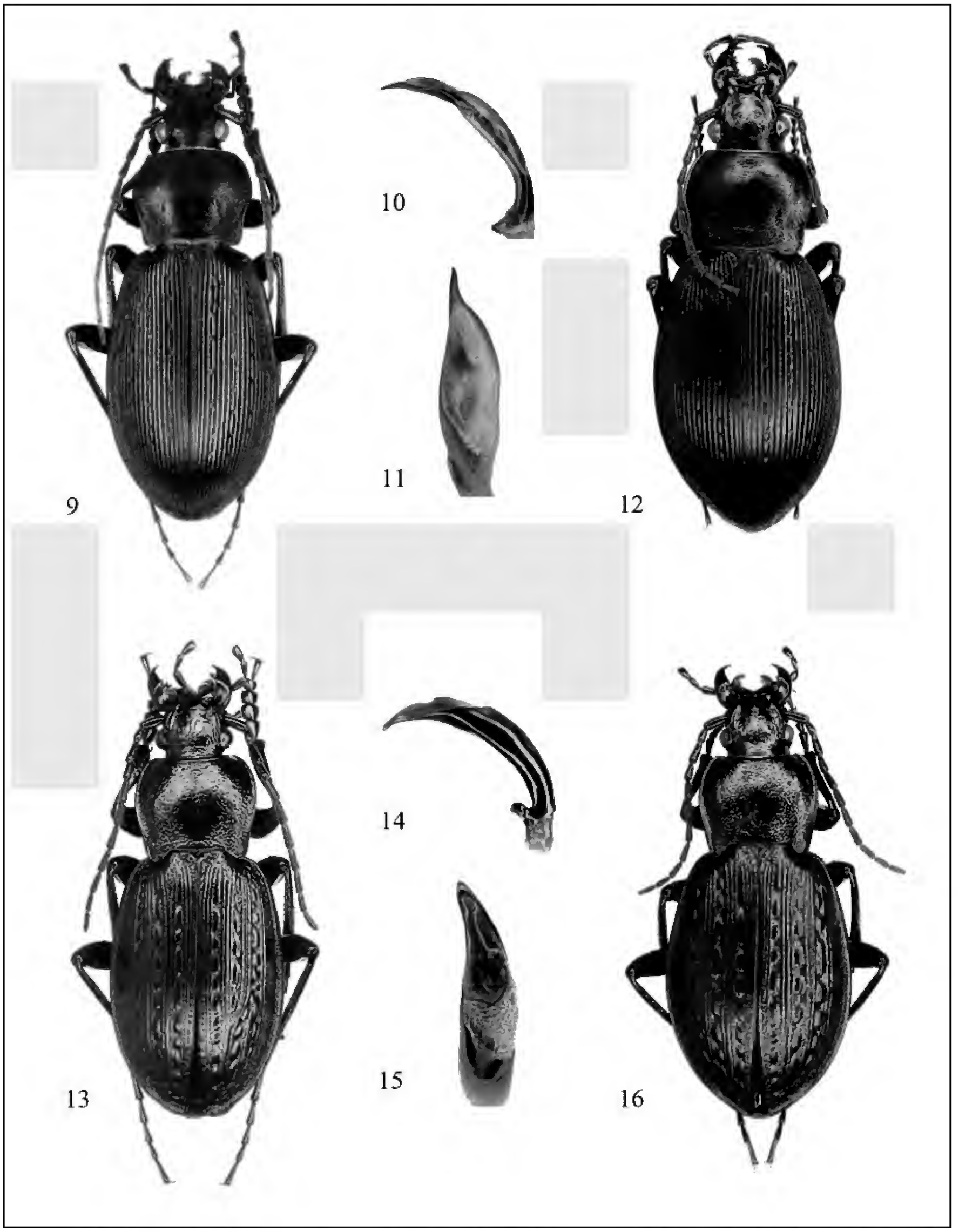

Fig. 9. *Carabus* (*Isiocarabus*) *saishutoicus*, male, 26.5 mm, R. of Korea, Cheju Island, Mt. Hallasan (CIR). Fig. 10. Idem, aedeagus: median lobe in lateral view. Fig. 11. Idem, aedeagus: apex in dorsal view. Fig. 12. Idem, female, 31 mm, R. of Korea, Cheju Island, Mt. Hangla (CIR). Fig. 13. *C.* (*Carabus*) *szeli obong* n. ssp., holotype male. Fig. 14. Idem, aedeagus: median lobe in lateral view. Fig. 15. Idem, aedeagus: apex in dorsal view. Fig. 16. Idem, paratype female, 20 mm. D.R. of Korea, North Hamgyong Province, Mt. Obong, (ca 42,40 NL; 129,80 EL), 1/15.VII.2012, local collector leg.

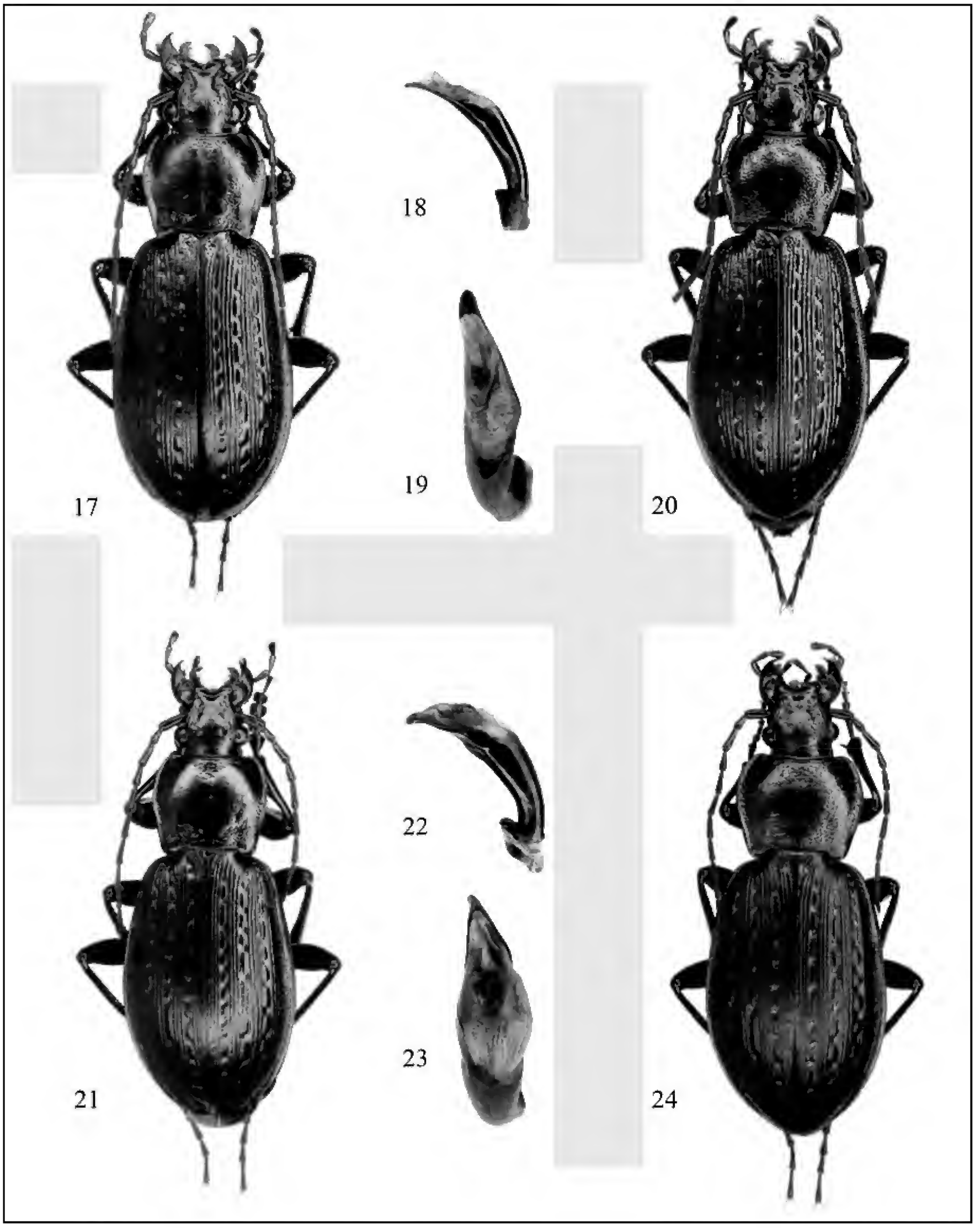

Fig. 17. *Carabus* (*Carabus*) *angustus dopyeong* n. ssp., holotype male. Fig. 18. Idem, aedeagus: median lobe in lateral view. Fig. 19. Idem, aedeagus: apex in dorsal view. Fig. 20. Idem, paratype female, 23.5 mm, R. of Korea, Geonggi-do/Gangwon-do provincial border, Pass North from Dopyeong, 600 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon leg. Fig. 21. *C.* (*C.*) *sternbergi gimhwa* n. ssp., holotype male. Fig. 22. Idem, aedeagus: median lobe in lateral view. Fig. 23. Idem, aedeagus: apex in dorsal view. Fig. 24. Idem, paratype female, 27.3 mm, R. of Korea, Gyeonggi-do/Gangwon-do provincial border, Pass North from Dopyeong, 600 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon leg.

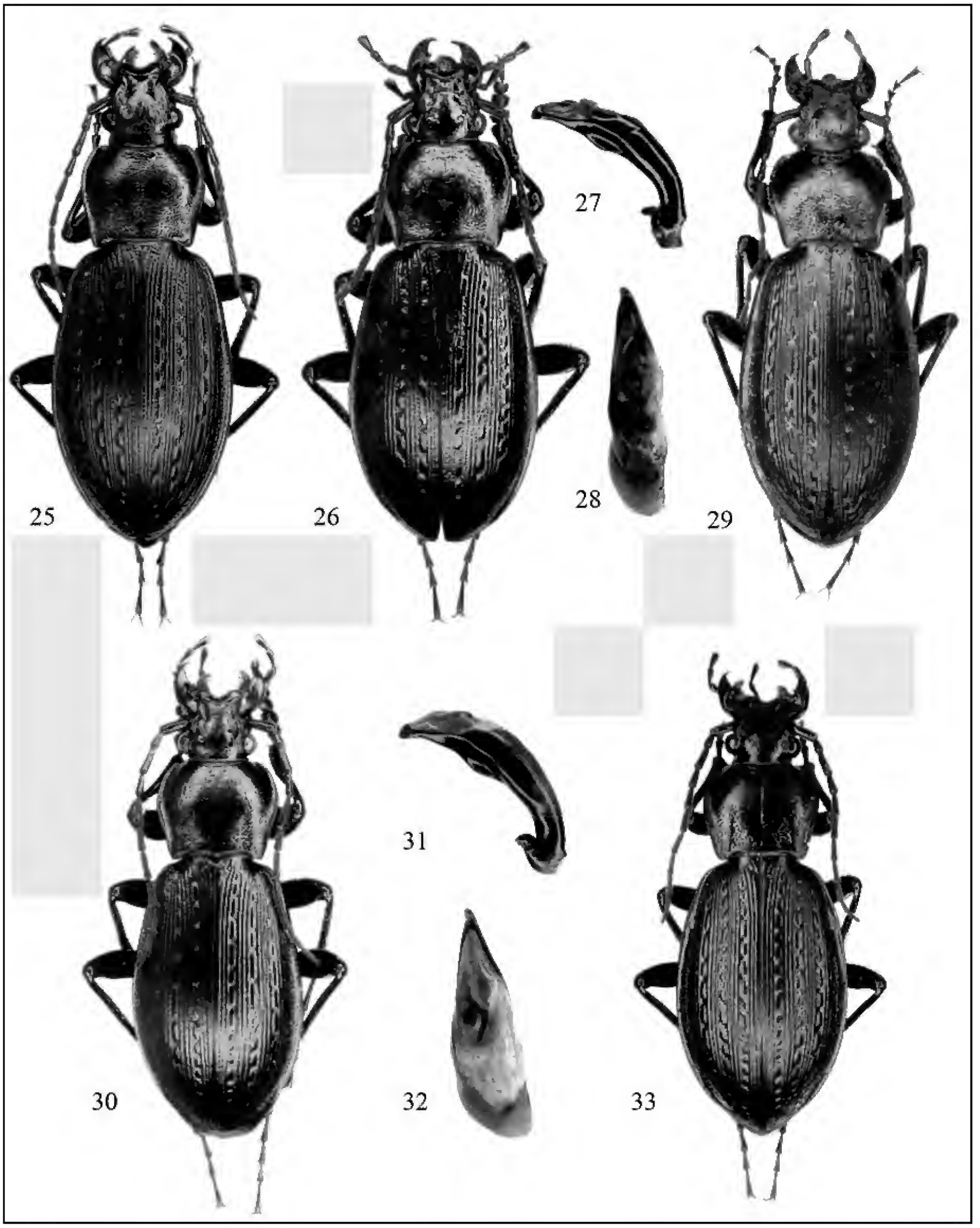

Fig. 25. *Carabus* (*Carabus*) *sternbergi goheungicus* n. ssp., holotype female. Fig. 26. *C.* (*C.*) *sternbergi jindoensis* n. ssp., holotype male. Fig. 27. Idem, aedeagus: median lobe in lateral view. Fig. 28. Idem, aedeagus: apex in dorsal view. Fig. 29. Idem, paratype female 24.5 mm. R. of Korea, Jindo Island, 8.VIII.2010, unknown leg. Fig. 30. *C.* (*C.*) *sternbergi deogyusan* n. ssp., holotype male. Fig. 31. Idem, aedeagus: median lobe in lateral view. Fig. 32. Idem, aedeagus: apex in dorsal view. Fig. 33. Idem, paratype female, 26.5 mm. Republic of Korea, Cholla Bukdo, Deogyusan, 10 km North from Gucheondong, 550 m, 7/15.VII.2007, I. Rapuzzi and L. Caldon leg.

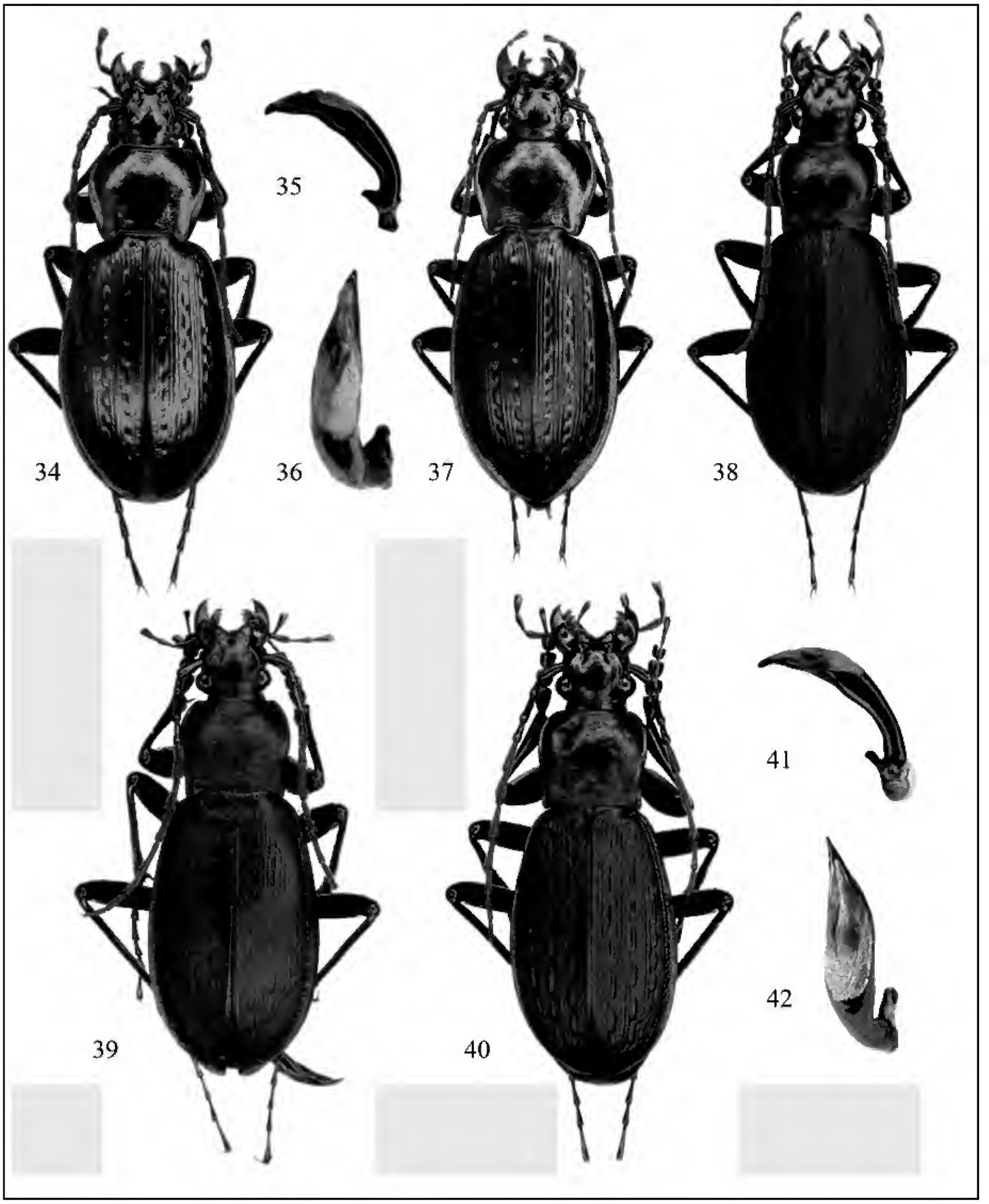

Fig. 34. *Carabus* (*Carabus*) *cartereti peacedam* n. ssp., holotype male. Fig. 35. Idem, aedeagus: median lobe in lateral view. Fig. 36. Idem, aedeagus: apex in dorsal view. Fig. 37. Idem, paratype female, 26 mm, R. of Korea, Gangwondo, "Peace Dam", NE Hwacheon 400 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon leg. Fig. 38. *C.* (*Leptocarabus*) *seishinensis* aff. *seuglaki*, male, 24 mm, R. of Korea, Southeast from Gurye, Mt. Paegusan, I. Rapuzzi and L. Caldon leg. (CIR). Fig. 39. *C.* (*L.*) *seishinensis elongatipennis*, male, 27 mm, D.R. of Korea, South Pyongan Prov., Songchun city, Kubong-dong, 1/5.VI.2011, local collector leg. (CIR). Fig. 40. *C.* (*L.*) *seishinensis seishinensis* x *C.* (*L.*) *semiopacus*, male, 22.5 mm, R. of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600m, 8/15.VII.2007, I. Rapuzzi and L. Caldon leg. (CIR). Fig. 41. Idem, male aedeagus: median lobe in lateral view. Fig. 42. Idem, aedeagus: apex in dorsal view.

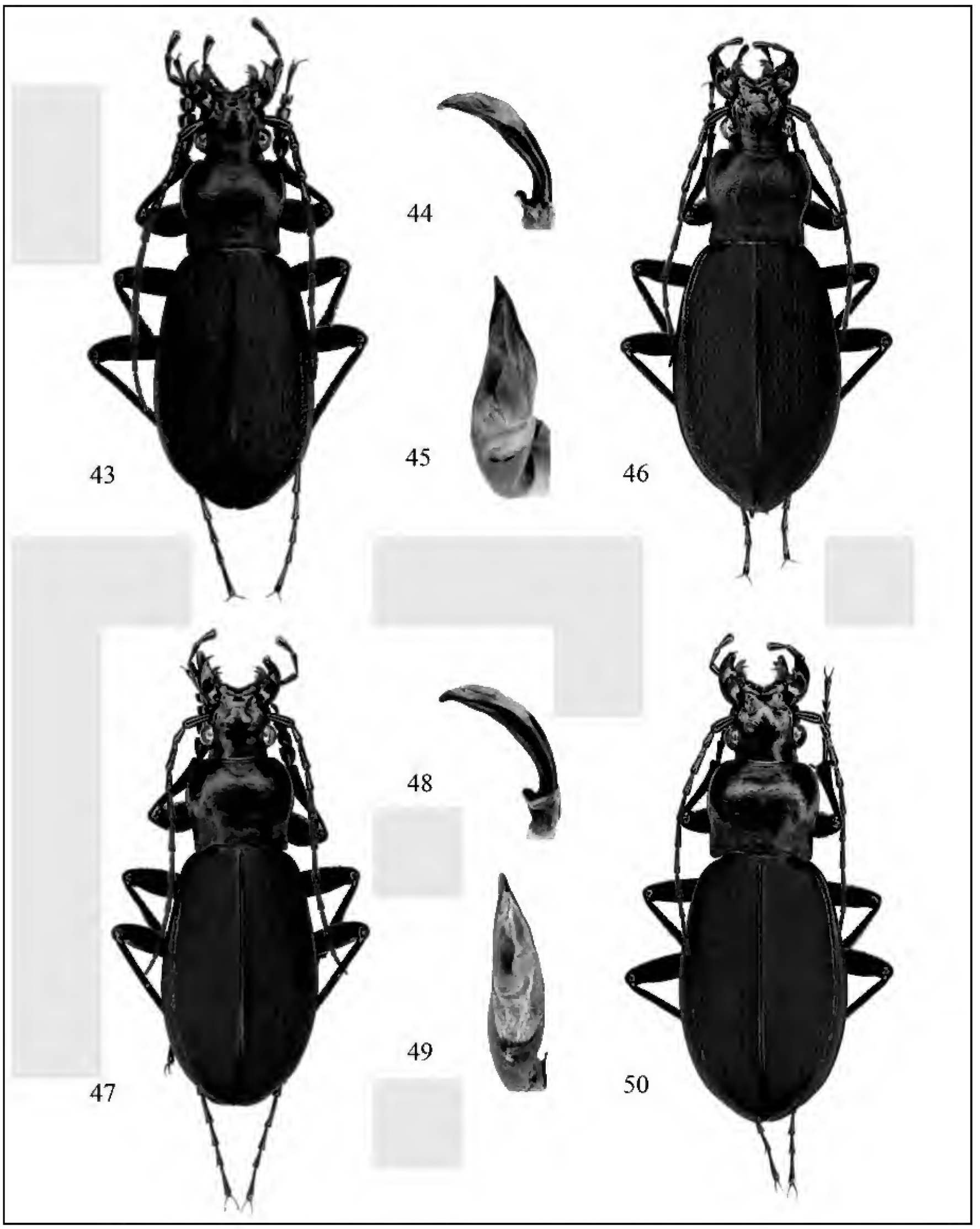

Fig. 43. *Carabus* (*Leptocarabus*) *seishinensis seishinensis*, male, 21 mm, R. of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600 m, 8/15.VII.2007, I. Rapuzzi and L. Caldon leg. (CIR). Fig. 44. Idem, aedeagus: median lobe in lateral view. Fig. 45. Idem, aedeagus: apex in dorsal view. Fig. 46. Idem, female 24.5 mm. Fig. 47. *C.* (*L.*) *semiopacus*, male 27 mm, R. of Korea, Cholla Bukdo, Muju Gun, Mt. Deogyusan, 1350/1600 m, 8/15.VII.2007, I. Rapuzzi and L. Caldon leg. (CIR). Fig. 48. Idem, aedeagus: median lobe in lateral view. Fig. 49. Idem, aedeagus: apex in dorsal view. Fig. 50. Idem, female, 29 mm.

Carabus (*Leptocarabus*) *fraterculus* aff. *jirisanensis* Ishikawa et Kim, 1983 (Fig. 54)

I collected a male specimen close to *C. fraterculus jirisanensis* on the Mt. Paegusan, southeast from Gurye. It differs from the specimens from Mt. Jirisan by the more regular elytral sculpture and by the shape of the aedeagus apex (Figs. 55, 56).

Carabus (*Diocarabus*) *fraterculus yongwangicus* n. ssp. (Figs. 57–60)

EXAMINED MATERIAL. Holotype male, Democratic Republic of Korea, South Hamgyong Province, Yongwang County, Mt. Komsan, 1/20.VII.2013, local collector leg. The holotype is deposited in the author's collection. Paratypes: 5 males 10 females, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 17.4 mm, maximum width of elytra: 7.1 mm. Dorsal side black with blue lustre, shiny. Legs, palpi, antennae, and mandibles black. Surface of head very wrinkled; supra antennary ridges very strong. Pronotum sinuate, upper surface convex; sides of pronotum marginated and crenate at the base; basal angles long and pointed. Elytra oval and convex, shoulders quite salient, rounded; sculpture triploid heterodyname, primary foveae very superficial. Male aedeagus characteristic of the species but more elongate and the apex in lateral view is strongly dilated (Figs. 58, 59).

VARIABILITY. In general, the variability of paratypes is very little, the length of the body ranges from 18.2 mm to 20.2 mm for the females.

ETYMOLOGY. The new subspecies is named after the Yongwan County, Mt. Komsan, where the type locality of the new taxon comes from.

REMARKS. *Carabus fraterculus yongwangicus* n. ssp. is easily distinguished from the other subspecies by the following characters: upper surface of head strongly wrinkled; pronotum more convex, basal angles more prominent and pointed; sculpture of elytra more regular; primary foveae very superficial; apex of aedeagus very dilated. The closest subspecies is *C. fraterculus ompoensis* Deuve, 1991 that lives more to the North but the latter has a shorter shape of elytra, a larger pronotum and different aedeagus.

Carabus (*Acoptolabrus*) *planicranion* n. sp. (Figs. 61–65)

EXAMINED MATERIAL. Holotype male, Democratic Republic of Korea, North Hamgyong Province, Mt. Obong, (ca 42,40 NL; 129,80 EL), 1/15.VII.2012, local collector legit. The holotype is deposited in the author's collection. Paratypes: 1 male and 5 females, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 28 mm, maximum width of elytra: 8.9 mm. Upper surface metallic, moderately shiny; head and pronotum cupreous green; green elytra with primary and secondary intervals black. Ventral face of head and pronotum gold-green, metallic; abdomen violet. Large, very flat and very long head; very long and large neck; supra-antennary ridge very strong , frontal foveae deep and rough, vertex the shape of a raised plate, strongly wrinkled. Eyes quite small and slightly salient. Labrum bilobate, multi-setulose; clypeus flat and smooth. Mandibles very developed, long with subparallel sides; retinacular teeth of mandibles bidentate. Palpi very long with the apical segment strongly dilated (simple in the females); penultimate segment of labial palpi bisetose. Ventral cephalic appendages (mentum, submentum, cardo, gula and gena) very flat, forming a single plane with the mandibles; gula and gena obliquely strongly wrinkled. Pronotum small, long and narrow (1.2 times as long as broad); apex of pronotum constricted and margined before the neck, sides slightly rounded in the middle, and strongly constricted before the base; hind angles salient and not protruding behind the base; surface of pronotum obliquely strongly wrinkled, median sulcus strongly marked. Elytra very narrow and very elongate, slender; shoulders narrow, not pronounced; disk of elytra convex; sculpture marked, triploid heterodyname type: primary intervals forming rectangular tubercles with large and superficially foveae; secondary intervals smaller and less elevated (the first secondary line is fused with the suture of elytra); tertiary intervals very reduced, forming grains. Legs very long and thin. 4th male protarsal segment without adhesive soles. Male aedeagus narrow and elongate; the median lobe in lateral view (Fig. 62) regularly curved, ostial membranous orifice long, strongly bent in the ventral side, apex quite large and rounded; in dorsal view (Fig. 63) the apex is long and very pointed.

VARIABILITY. In general, the variability of paratypes is very little; the length of the body of the male paratype is 27.6 mm; the female paratypes range from 32 mm to 37 mm. The elytra in the females are larger and more convex; only one female is more elongate. The colour is constant, except for four females with a pronotum coppery-red without green lustre.

ETYMOLOGY. The new species is named after the very characteristic flat head (Fig. 64).

REMARKS. The distinctive very flat shape of head of the new species is peculiar and unique in the whole genus *Carabus*; no other species belonging to the most flat subgenus (*Apoplesius*, *Platycarabus*, *Tribax*, etc.) have similar head structure. From several morphological characters it may remind *C.* (*Acoptolabrus*) *changeonleei* Ishikawa et Kim, 1983 (Fig. 66) but in the latter the head has a normal shape and is, in general, close to *C. mirabilissimus*.

Carabus (*Acoptolabrus*) *leechi viniciosalamii* n. ssp.
(Figs. 67–70)

EXAMINED MATERIAL. Holotype male, Democratic Republic of Korea, North Hamgyong Province, Mt. Wanta, 24.VII.2004, local collector legit. The holotype is deposited in the author's collection. Paratypes: 5 males and 1 female, same data as holotype; 1 male same data as holotype but 15.VII.2009. The Paratypes are deposited in the author's collection, and in the collections of Mr. V. Salami (Italy) and Mr. S. Dacatra (Italy).

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 28.4 mm, maximum width of elytra: 9.7 mm. Upper surface metallic, very shiny; head and pronotum cupreous-red; elytra gold-green with primary and secondary intervals black. Ventral face of head, pronotum and abdomen violet, metallic; femurs violet; tibiae, tarsi, palpi and antennae black. Head long and quite thickened; surface of head punctured and strongly wrinkled, frons with a raised smooth plate. Mandibles very elongate. Pronotum quite narrow (1.08 times as broad as long). Elytra quite broad and short, ovate and convex; sculpture of elytra triploid heterodyname type: primary intervals forming very raised short tubercles; secondary intervals smaller, less elevated and often reduced; tertiary intervals very reduced forming grains. Long legs. Male aedeagus narrow and regularly curved; in lateral view (Fig 68) the apex is long and pointed; apex in dorsal view (see Fig 69).

VARIABILITY. Little variability: the length of the body ranges from 25 mm to 26 mm for the males, the female is 32 mm.

ETYMOLOGY. The new beautiful subspecies is very cordially dedicated to my friend Mr. Vinicio Salami, entomologist and collector of Carabidae.

REMARKS. The new subspecies differs from all known *C. leechi* subspecies by the narrower pronotum, the shorter elytra, the sculpture of elytra with primary intervals formed by small tubercles and secondary intervals partially reduced. Moreover it is the northernmost known form of the species.

Carabus (*Acoptolabrus*) *leechi drouni* n. ssp.
(Figs. 71–74)

EXAMINED MATERIAL. Holotype male, Democratic Republic of Korea, North Hamgyong Province, Kilchu, Mt. Muhak, 8/19.VII.2006, local collector leg. The holotype is deposited in the author's collection. Paratypes: 1 female, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Close to *C.* (*A.*) *leechi viniciosalamii* n. ssp. but uniformly coppery-red; smaller size (23.5 mm); pronotum with very rounded sides; elytra elongate and more convex. The sculpture of elytra is very characteristic and somewhat similar to the *C.* (*Acoptolabrus*) *schrencki* "type"; in fact the primary intervals are very often fused with the secondary and tertiary ones, forming very large cell- shaped foveae. Male aedeagus (Figs. 72, 73): in lateral view the apical lobe is regularly curved and not dilated.

ETYMOLOGY. The new *Carabus* is very cordially dedicated to my friend Mr. Gontran Drouin (Quebec City, Canada), specialist of Palearctic Cerambycidae.

REMARKS. The new subspecies is very distinctive: particularly, the sculpture of elytra and the shape of pronotum makes possible to distinguish it easily from all other *C. leechi* subspecies. The closest form is *C. leechi auvrayorum* Deuve et Mourzine, 1993. From the latter, the new subspecies differs by the smaller, tiny and elongate head; the sculpture of elytra is less dense and the colour is shiny and uniformly coppery-red metallic. From *C. leechi leechi* Bates, 1888 the new subspecies has the same colour but differs by a smaller size (23.5 mm for *drouini* and 37 mm for *leechi*), a much more transverse pronotum, and a different sculpture of elytra.

Carabus (Acoptolabrus) leechi onjinsanicola Rapuzzi, 2009 (Fig. 75)

Described on two specimens from the Democratic Republic of Korea, North Hawanghae province, Onjin San Mts., I know the subspecies also from: Democratic Republic of Korea, South Hwanghae province, Unryul County, Mt. Kuwol, 954 m, local collector legit (CIR).

Carabus (Acoptolabrus) mirabilissimus mirabilissimus Ishikawa et Deuve, 1982 (Fig. 76)

Described from Taebaek San Mountain Range, Mt. Taebaek San it is widespread in a large sector of northern part of South Korea. I know the subspecies also from the following localities: Republic of Korea: Chungcheongbukdo/Gyeongsanbukdo provincial border, Mt. Sobaeksan (CIR); Gangwondo province, Taebaek San Mt. (CIR); Gangwondo, "Peace Dam", NE Hwacheon 400 m (CIR); Gyeonggido province, Gapyeong/Yangpyeong Counties border, Hwayasan Mt. (CIR)

Carabus (Acoptolabrus) mirabilissimus furumiensis Deuve, 2001 (Fig. 77)

Characterized by the spectacular and unusual coloration: blue to blue-green elytra and red to red-green head and pronotum, the subspecies seems to be endemic to Mt. Odaesan in the Gangwondo province (Republic of Korea). I found the subspecies in two different places on the Odaesan Mt.: Jingogae, 800 m (CIR) and Sangwonsa Temple vicinity (CIR).

Carabus (Acoptolabrus) mirabilissimus igniferescens Deuve, 1992 (Fig. 78)

Described from the northernmost part of Mts. Taebaeksan (Kumgangsan, Mt. Mammulsan) in the Democratic Republic of Korea, I collected the subspecies in the following locality in the Republic of Korea: Gangwondo province, South of Gimhwa, 450 m (CIR).

Carabus (Acoptolabrus) constricticollis aff. *limes* Rapuzzi, 2009 (Fig. 79)

I described the subspecies (Rapuzzi, 2009) on two females from Mt. Onjinsan, South Hawanghae, Democratic Republic of Korea; a new population very close to *C. constricticollis limes* was collected in the following locality: Democratic Republic of Korea, South Hwanghae province, Unryul County, Mt. Kuwol, 954 m, local collector legit (CIR); a male specimen made possible the drawing of the aedeagus (Figs. 80, 81).

Carabus (Acoptolabrus) constricticollis microcolasellus n. ssp. (Figs. 82–85)

EXAMINED MATERIAL. Holotype male, Democratic Republic of Korea, North Hamgyong Province, Mt. Obong, (ca 42,40 NL; 129,80 EL), 1/15.VII.2012, local collector legit. The holotype is deposited in the author's collection. Paratypes: 2 males and 1 female, same data as holotype; 1 female, same data as holotype but 5/29.VI.2008; 1 male, Democratic Republic of Korea, North Hamgyong province, Sechon, 1/10.VII.2004, local collector legit; 1 female, Democratic Republic of Korea, North Hamgyong province, Paeksa, 1139 m, VII.2004, local collector legit. The paratypes are deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Upper surface metallic, very shiny; head and pronotum cupreous-red; elytra green with primary and secondary intervals black. Close to *C.* (*A.*) *constricticollis colasellus* Deuve (1990) but smaller (23 mm versus 31 mm for *colasellus*); mandibles shorter and more curved; pronotum larger (1.15 times as long as broad); shorter body, ovate and convex. Antennae longer, reaching half of the elytra. Aedeagus small and relatively stout; in lateral view (Fig. 83) the apical lobe is elongate and very slightly dilated; the ostial membranous orifice large and long; apex in dorsal view (Fig. 84).

VARIABILITY. Little variability: the length of the body ranges from 20 mm to 23 mm for the males, and from 22 mm to 27 mm for the females. One female has cupreous- green elytra. The paratype male from Sechon is slightly more elongate, with longer antennae, and the apex of aedeagus is clearly more dilated.

ETYMOLOGY. The given name wants to point out the analogy of the new subspecies with *C.* (*A.*) *constricticollis colasellus* and also emphasize its smaller size.

REMARKS. Close to *C.* (*A.*) *constricticollis colasellus*, the new subspecies is clearly smaller and shorter with a larger pronotum and longer antennae. In the same area also lives *C.* (*A.*) *leechi viniciosalamii* n. ssp., *C.* (*A.*) *leechi drouni* and *C.* (*A.*) *leechi auvrayorum*. From all of them *C.* (*A.*) *constricticollis microcolasellus* n. ssp. differs by the very different shape of aedeagus, different pronotum and colour. The new subspecies is sympatric and syntopic with *C.* (*A.*) *planicaranion* but easily distinguished by its smaller size, smaller and not flatted head, the sculpture of elytra and the shape of aedeagus.

Carabus (*Acoptolabrus*) *constricticollis grallatorius* Roeschke, 1921 (Fig. 85)

In my collection is preserved one historical male specimen of *C.* (*A.*) *constricticollis grallatorius* that matches very well with the original description of Roeschke (Hauser, 1921). The original printed label reads as follows: Seishin Korea (= Chongjin, North Hamgyong province, Democratic Republic of Korea). This corresponds exactly with the type locality of the subspecies. The length of the specimen including mandibles is 32 mm; it is interesting to note the extraordinary development of the legs as Roeschke wrote in his original description and correctly confirmed by Hauser (1921). The antennae are exceptionally long as well, reaching the apical third of elytra. It is certainly a valid subspecies.

Carabus (*Acoptolabrus*) *schrencki lijingkeianus* Deuve, 2006 (Fig. 86)

EXAMINED MATERIAL. Democratic Republic of Korea, South Hamgyong province, Mt. Kachwari, local collector legit (CIR).

REMARKS. *Carabus* (*A.*) *schrencki* is widespread with different subspecies in a large area of Far East of Russia, North East China (Heilogjiang, Jilin, Liaoning provinces) and Northern part of Korea peninsula. Up to this day *C.* (*A.*) *schrencki lijingkeianus* Deuve (2006) is the southernmost subspecies for the Korean peninsula.

Carabus (*Acoptolabrus*) *jankowskii byeoksanensis* n. ssp. (Figs. 88–91)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Jeollabuk-do Province, Buan-gun, Byeonsanbando, 100/200 m, 13/20.VII.2012, I. Rapuzzi and L. Caldon leg. The holotype is deposited in the author's collection. Paratypes: 8 males and 8 females, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 35.2 mm, maximum width of elytra: 10.6 mm. Upper surface of elytra dark green, metallic-mat, intervals black, margins green with gold, very shiny; pronotum cupreous-red, the vertex less brilliant, head black with cupreous shades. Ventral side of head black, ventral side of pronotum and epipleura violet, metallic, abdomen black with violet shades; appendix black. Head quite short and thickened; neck short; surface of head punctured, frons convex and smooth. Mandibles quite short and strong. Pronotum slightly transverse (1.15 times as broad as long), cordate, margins not angled; upper slightly convex; sides of pronotum margined, slightly bent upwards; hind angles rounded, long, and protruding behind its base; surface punctured, strongly at the base and at the sides, median sulcus complete and shallow. Elytra ovate, convex; sculpture of elytra tetraploid heterodyname type: primary intervals large and raised forming quite long links; secondary intervals thinner and less raised forming short links; tertiary intervals forming raised grains; quaternary intervals reduced, forming small grains; very short and rudimental mucrons. Long and strong legs. Male aedeagus (Fig. 89, 90) typical of the species but a little smaller and thinner.

VARIABILITY. Little variability: the length of the body ranges from 33 mm to 36.5 mm for the males, from 36 mm to 40 mm for the females. Few specimens with slightly darker colour.

ETYMOLOGY. The new subspecies is named after the type locality.

REMARKS. The new subspecies is related to *C. jankowskii seoulensis* Deuve, 1998 and *C. jankowskii chinoensis* Kwon et Park, 1989 but easily distinguished by the following characters: shorter and stronger mandibles; cordate pronotum as in

chinoensis but the sides not angled as in *seoulensis*; hind angles of pronotum longer, protruding behind the base; shorter and more convex elytra; stronger and raised sculpture of elytra; primary intervals less interrupted. It is interesting to note that the Byeonsanbando Mountains is an isolated peninsula surrounded by plains in Southwest Korea; the area has a high ecological value because the habitats and ecosystem of rare plants and animals are well preserved. For that reason the area is under protection as Natural Treasures.

Carabus (Coptolabrus) smaragdinus buangun n. ssp. (Figs. 92–95)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Jeollabuk-do Province, Buan-gun, Byeonsanbando, 100/200 m, 13/20.VII.2012, I. Rapuzzi and L. Caldon legit. The holotype is deposited in the author's collection. Paratypes: 6 males and 6 females, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 41 mm, maximum width of elytra: 13.4 mm. Upper surface metallic, very brilliant; head, pronotum and elytra coppery-red; primary and secondary intervals of elytra black. Ventral side of pronotum and epipleura intense coppery-red, metallic, abdomen black with coppery shades; appendix black. Thickened and quite short head; large and short neck; vertex punctured, frons convex and strongly punctured, wrinkled; supraantennary ridge bent upwards; clypeus punctured; clypeus foveae very strong. Mandibles very developed and strong, sickle- shaped. Palpi very long with the apical segment strongly dilated (simple in the females); penultimate segment of labial palpi bisetose. Pronotum hexagonal, transverse (1.4 times as long as broad); sides strongly angled, margined, bent upwards; basal lobes rounded, slightly protruding the base; surface punctured and wrinkled, median sulcus very shallow. Elytra oval, large; disk of elytra convex; sculpture marked, triploid heterodyname type: primary intervals forming tubercles large and raised, about two times than the secondary ones; tertiary intervals very reduced forming grains. Legs very long and strong. Male aedeagus (Figs. 93, 94) with the characteristic shape for the species but the apex in lateral view is a little less dilated.

VARIABILITY. Little variability: the length of the body ranges from 38 mm to 42 mm for the males, from 44 mm to 51 mm for the females. The colour is constant, only few specimens are coppery-red with gold lustre.

ETYMOLOGY. The new subspecies is named after the type locality.

REMARKS. Because of its size the new subspecies is the largest for the species. The new subspecies is related to *C. smaragdinus branickii* Taczanowski, 1887 but the head is thickened, the pronotum strongly transverse, and the colour is more brilliant.

Carabus (Coptolabrus) smaragdinus euaureus n. ssp. (Figs. 96–99)

EXAMINED MATERIAL. Holotype male, Republic of Korea, Jirisan Nat. Park, Yeongrieongchi, 1200 m, 7/16.VII.2012, I. Rapuzzi and L. Caldon legit. The holotype is deposited in the author's collection. Paratypes: 1 male and 10 females, same data as holotype, deposited in the author's collection.

DESCRIPTION OF HOLOTYPE. Male. Length including mandibles: 39 mm, maximum width of elytra: 12 mm. Upper surface metallic, very shiny, brilliant; head, pronotum and elytra coppery-gold red; primary and secondary intervals of elytra black. Ventral side of pronotum and epipleura intense coppery-red, metallic, abdomen dark violet; appendix black. Head thickened and long; vertex punctured, frons slightly convex and punctured; clypeus sparsely punctured at its base. Mandibles very long and quite thin, sickle-shaped. Palpi very long with the apical segment strongly dilated (simple in the females); penultimate segment of labial palpi bisetose. Pronotum elongate, hexagonal, slightly transverse (1.2 times as long as broad); sides angled, margined, bent upwards; basal lobes rounded, not protruding the base; surface very strongly punctured. Elytra very elongated; disk of elytra very convex; sculpture marked, triploid heterodyname type: primary intervals forming oval and well spaced tubercles; secondary intervals smaller and rounded; tertiary intervals forming very rough grains; background of the elytra very roughly sculptured. Legs very long. Male aedeagus: Figs. 97, 98.

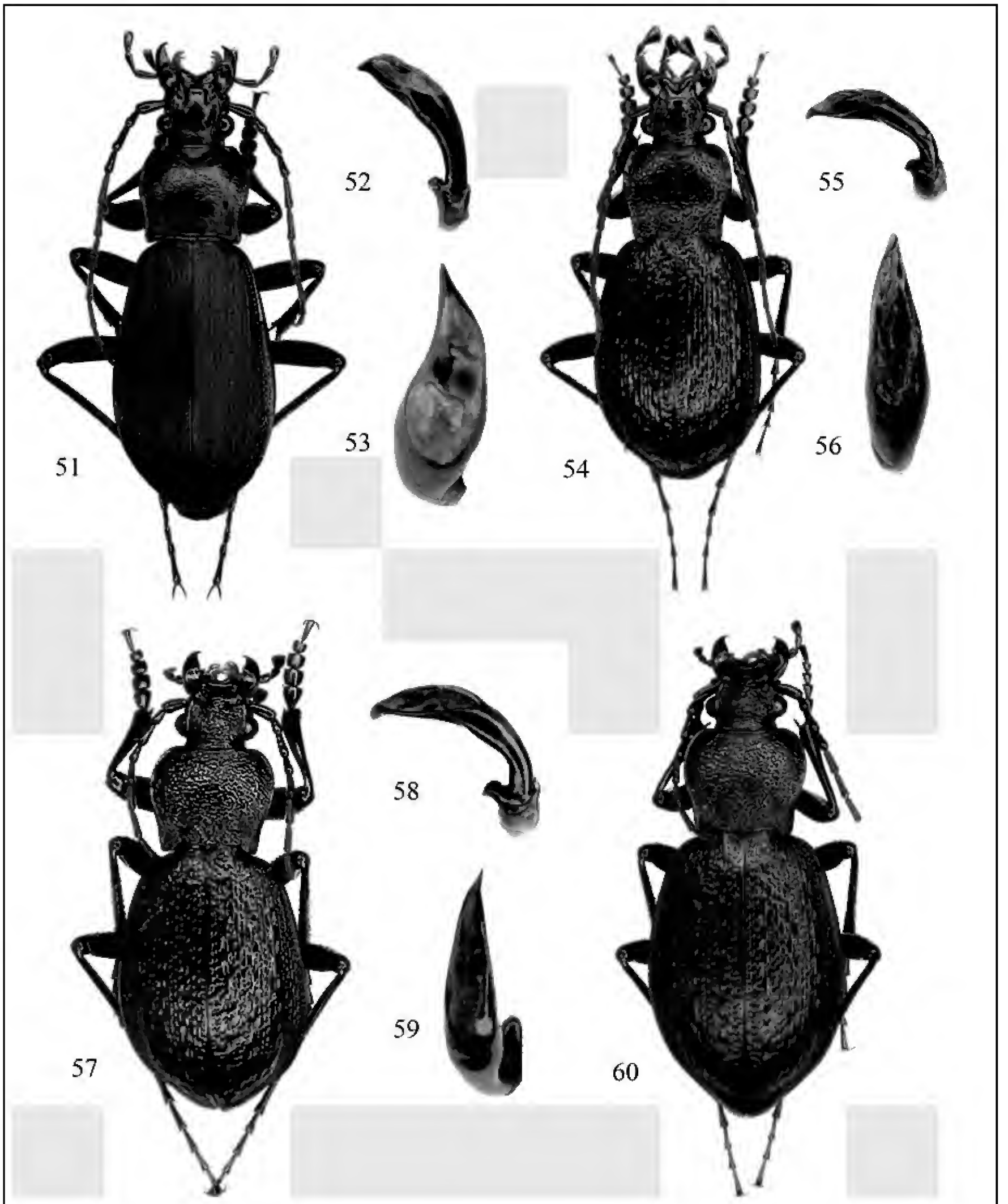

Fig. 51. *Carabus* (*Leptocarabus*) *vogtianus* aff. *horvatovichi,* male, 24 mm, R. of Korea, Geonggido/Gangwondo provincial border, Pass North from Dopyeong, 600 m, 3/13.VII.2012, I. Rapuzzi and L. Caldon leg. Fig. 52. Idem, aedeagus: median lobe in lateral view. Fig. 53. Idem, aedeagus: apex in dorsal view. Fig. 54. *C.* (*Diocarabus*) *fraterculus* aff. *jirisanensis*, male 18.5 mm, R. of Korea, Mt. Paegusan, Southeast from Gurye, 350 m, 9/15.VII.2012, I. Rapuzzi and L. Caldon leg. Fig. 55. Idem, aedeagus: median lobe in lateral view. Fig. 56. Idem, aedeagus: apex in dorsal view. Fig. 57. *C.* (*D.*) *fraterculus yongwangicus* n. ssp., holotype male, 17.4 mm. Fig. 58. Idem, aedeagus: median lobe in lateral view. Fig. 59. Idem, aedeagus: apex in dorsal view. Fig. 60. Idem, paratype female, 20 mm, D.R. of Korea, South Hamgyong Province, Yongwang County, Mt. Komsan, 1/20.VII.2013, local collector leg. (CIR).

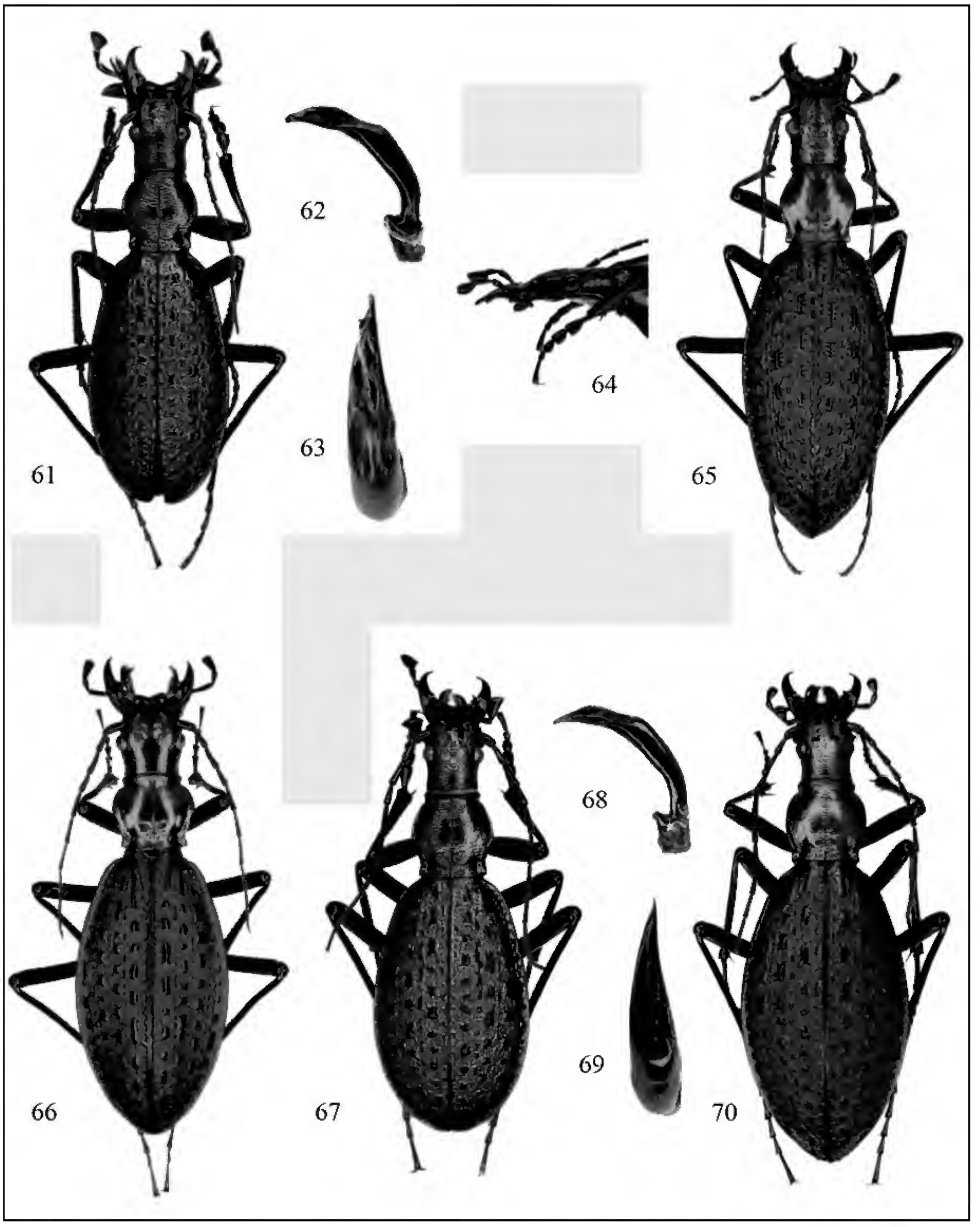

Fig. 61. *Carabus* (*Acoptolabrus*) *planicranion* n. sp., holotype male. Fig. 62. Idem, aedeagus: median lobe in lateral view. Fig. 63. Idem, aedeagus: apex in dorsal view. Fig. 64. Idem, head in lateral view. Fig. 65. Idem, paratype female, 37 mm, D.R. of Korea, North Hamgyong Prov., Mt. Obong, (ca 42,40 NL; 129,80 EL), 1/15.VII.2012, local collector leg. (CIR). Fig. 66. *C.* (*A.*) *changeonleei*, female, 31.5 mm, R. of Korea, Jirisan Mt., I. Rapuzzi and L. Caldon leg. (CIR). Fig. 67. *C.* (*A.*) *leechi viniciosalamii* n. ssp., holotype male. Fig. 68. Idem, aedeagus: median lobe in lateral view. Fig. 69. Idem, aedeagus: apex in dorsal view. Fig. 70. Idem, paratype female, 32 mm. D.R. of Korea, North Hamgyong Prov., Mt. Wanta, 24.VII.2004, local collector leg. (CIR).

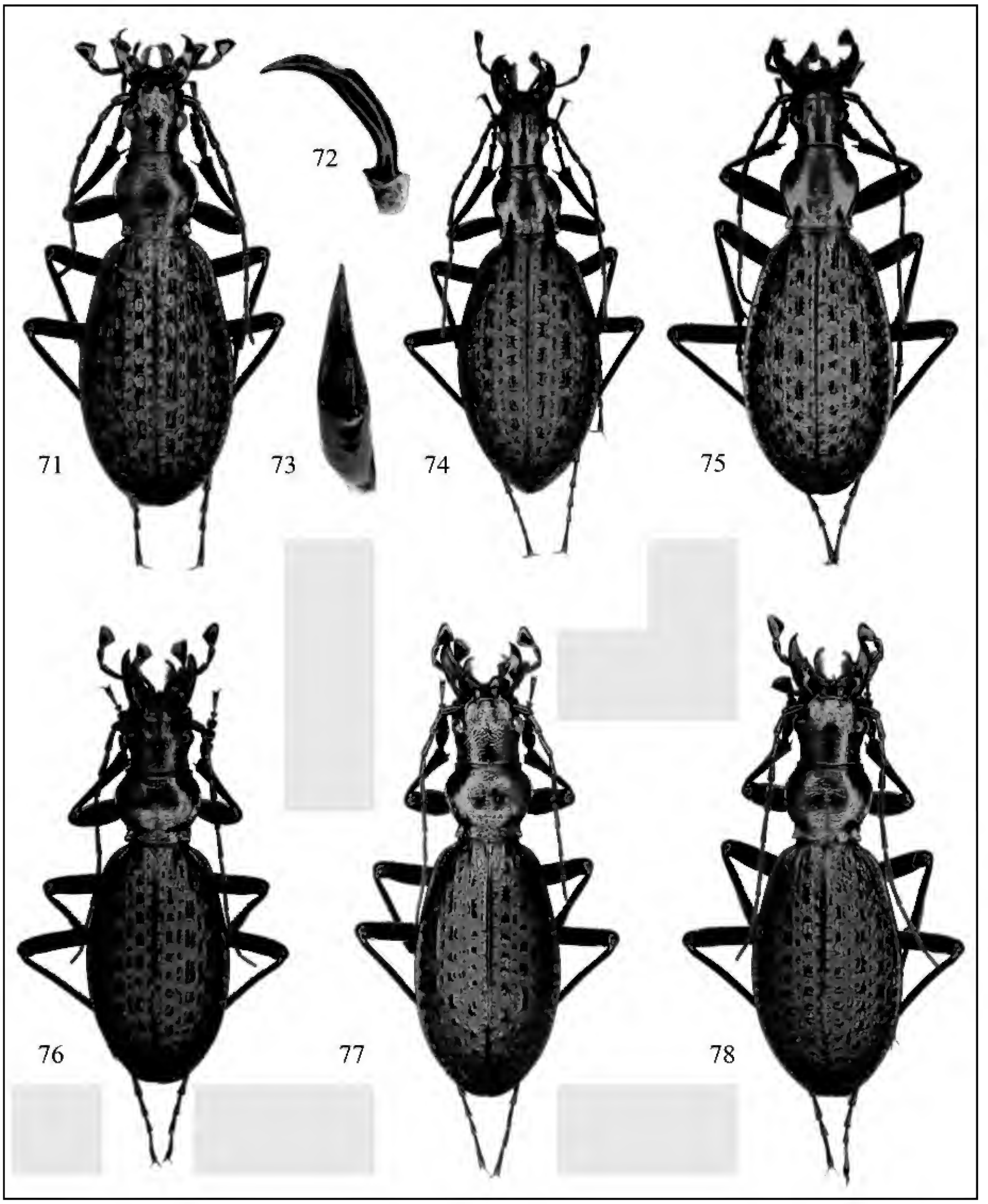

Fig. 71. *Carabus* (*Acoptolabrus*) *leechi drouini* n. ssp., male, 23.5 mm, D.R. of Korea, North Hamgyong Prov., Kichu, Mt. Muhak, 8/19.VII.2006, local collector leg. (CIR). Fig. 72. Idem, aedeagus: median lobe in lateral view. Fig. 73. Idem, aedeagus: apex in dorsal view. Fig. 74. Idem, female, 31.5 mm, D.R. of Korea, North Hamgyong Prov., Kichu, Mt. Muhak, 8/19.VII.2006, local collector leg. (CIR). Fig. 75. *C.* (*A.*) *leechi onjinsanicola*, male, 29.5 mm, D.R. of Korea, South Hwanghae province, Unryul County, Mt. Kuwol, 954 m, local collector leg. (CIR). Fig. 76. *C.* (*A.*) *mirabilissimus mirabilissimus*, male, 24.5 mm, R. of Korea, Gangwondo province, "Peace Dam", NE Hwacheon 400 m (CIR). Fig. 77. *C.* (*A.*) *mirabilissimus furumiensis*, male 26.5 mm, R. of Korea, Gangwondo province, Odaesan Mt., Jingogae, 800 m (CIR). Fig. 78. *C.* (*A.*) *mirabilissimus igniferescens*, male 26 mm, R. of Korea, Gangwondo province, South from Gimhwa, 450 m (CIR).

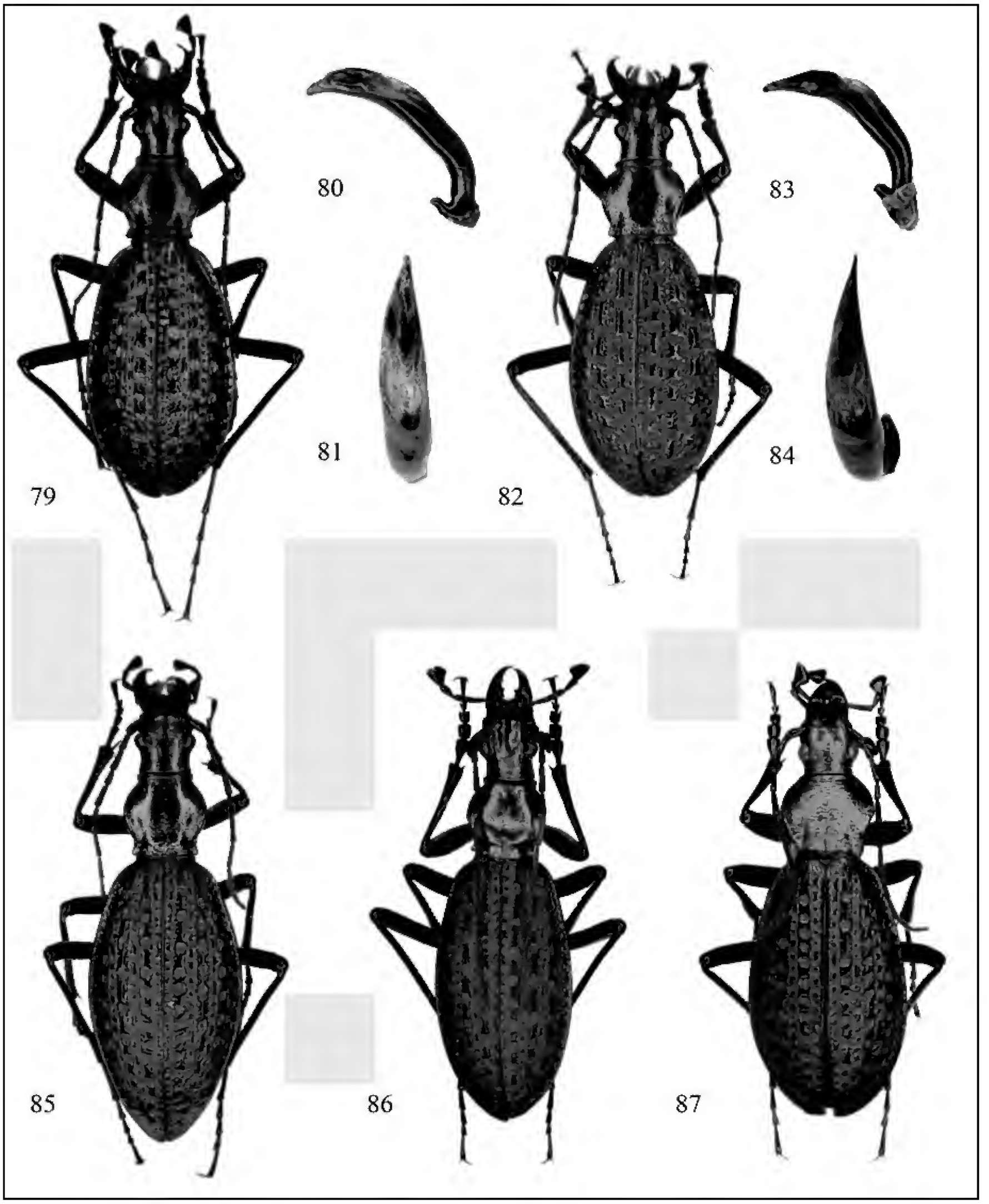

Fig. 79. *Carabus* (*Acoptolabrus*) *costricticollis* aff. *limes*, male 28 mm, D.R. of Korea, South Hwanghae province, Unryul County, Mt. Kuwol, 954 m, local collector leg. (CIR). Fig. 80. Idem, aedeagus: median lobe in lateral view. Fig. 81. Idem, aedeagus: apex in dorsal view. Fig. 82. *C.* (*A.*) *constricticollis microcolasellus* n. ssp., holotype male. Fig. 83. Idem, aedeagus: median lobe in lateral view. Fig. 84. Idem, aedeagus: apex in dorsal view. Fig. 85. Idem, paratype female, 22 mm, D.R. of Korea, North Hamgyong Province, Paeksa, 1139 m, VII.2004, local collector leg. (CIR). Fig. 86. *C.* (*A.*) *constricticollis grallatorius*, male 33 mm, Seishin Korea (= Chongjin, North Hamgyong province, D.R. of Korea) (CIR). Fig. 87. *C.* (*A.*) *schrencki lijingkeianus*, male 24 mm, D.R. of Korea, South Hamgyong province, Mt. Kachwari, local collector leg. (CIR).

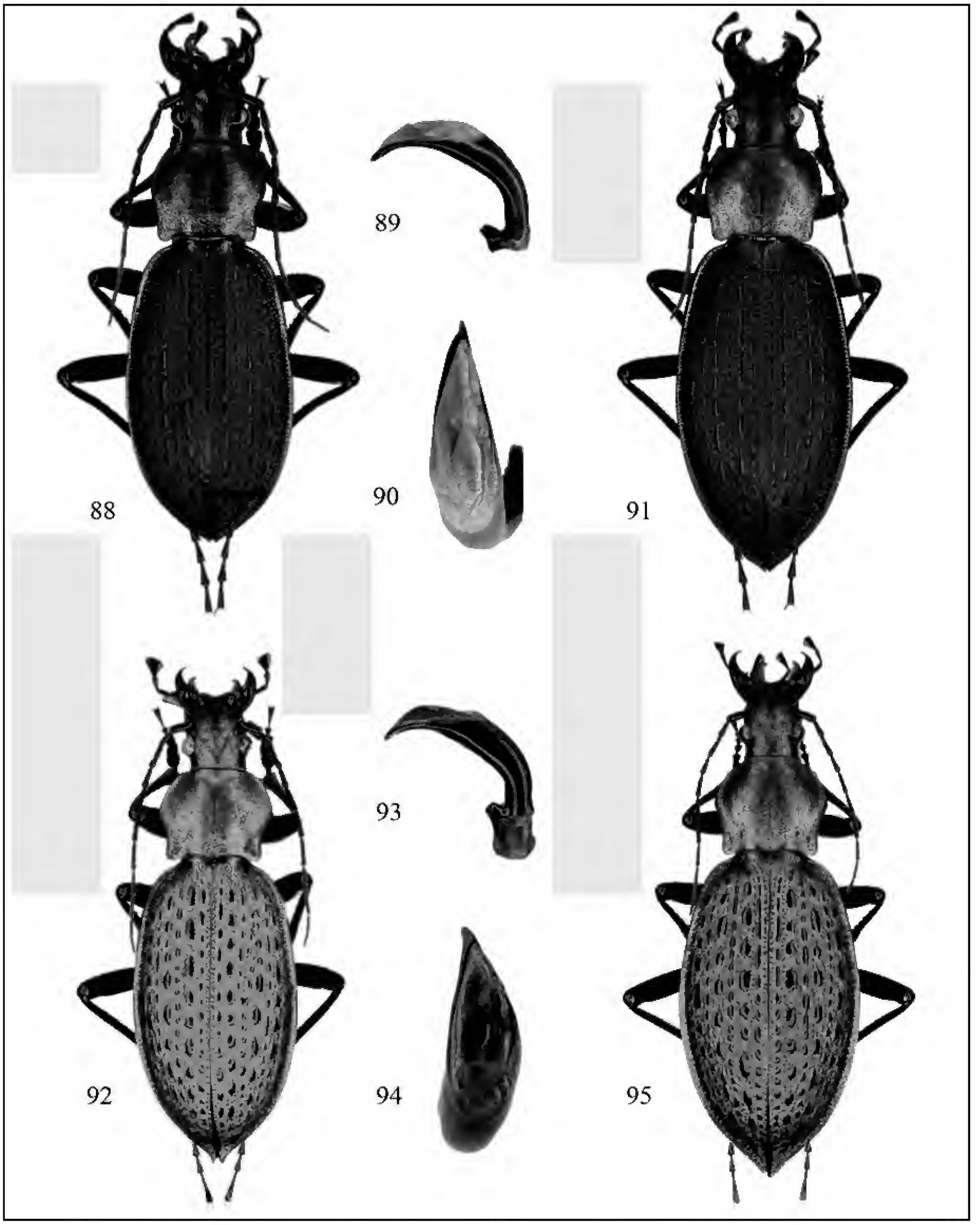

Fig. 88. *Carabus* (*Coptolabrus*) *jankowskii byeoksanensis* n. ssp., holotype male. Fig. 89. Idem, aedeagus: median lobe in lateral view. Fig. 90. Idem, aedeagus: apex in dorsal view. Fig. 91. Idem, paratype female, 37 mm, R. of Korea, Jeollabuk-do Province, Buan-gun, Byeonsanbando, 100/200 m, 13/20.VII.2012, I. Rapuzzi and L. Caldon leg. (CIR). Fig. 92. *C.* (*C.*) *smaragdinus buangun* n. ssp., holotype male. Fig. 93. Idem, aedeagus: median lobe in lateral view. Fig. 94. Idem, aedeagus: apex in dorsal view. Fig. 95. Idem, paratype female, 51 mm. R. of Korea, Jeollabuk-do Province, Buan-gun, Byeonsanbando, 100/200m, 13/20.VII.2012, I. Rapuzzi and L. Caldon leg. (CIR).

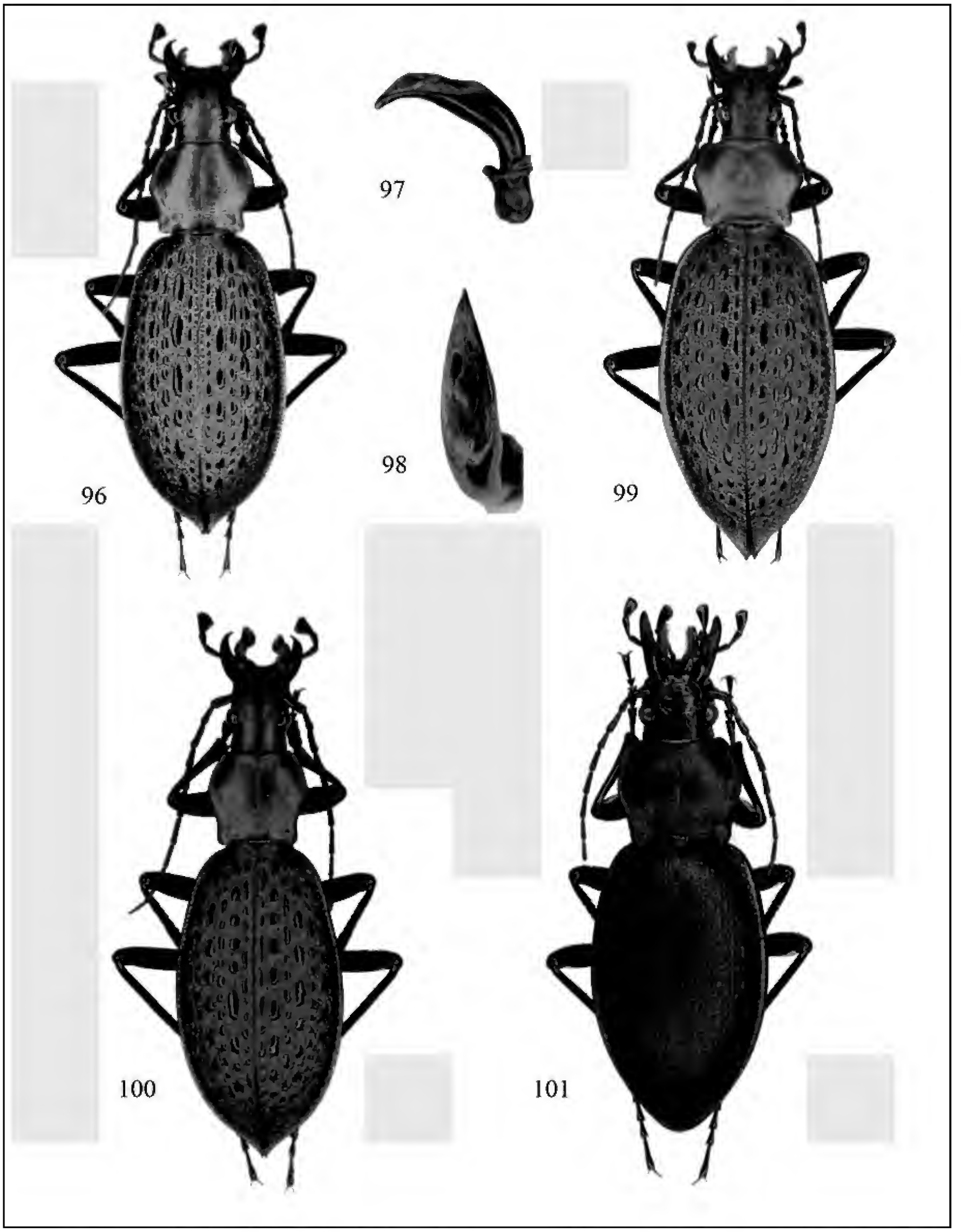

Fig. 96. *Carabus* (*Coptolabrus*) *smaragdinus euaureus* n. ssp., holotype male. Fig. 97. Idem, aedeagus: median lobe in lateral view. Fig. 98. Idem, aedeagus: apex in dorsal view. Fig. 99. Idem, paratype female, 43 mm, R. of Korea, Jirisan Nat. Park, Yeongrieongchi, 1200 m, 7/16.VII.2012, I. Rapuzzi and L. Caldon leg. (CIR). Fig. 100. *C.* (*Coptolabrus*) *smaragdinus euviridis*, male 38 mm, R. of Korea, Jirisan Mt., I. Rapuzzi and L. Caldon leg. (CIR). Fig. 101. *C.* (*Teratocarabus*) *azrael gaizhouensis*, female 24 mm, D.R. of Korea, Pyonganbukdo, Kwaksan County, Sinmi Island, Unjong-Ni 9/20.VII.2006, local collector leg. (CIR).

ETYMOLOGY. The new subspecies is named after the spectacular gold colour.

VARIABILITY. Little variability: the length of the body ranges from 41 mm to 44 mm for the females (the male paratype has the same size as holotype). The colour is constant; only one specimen is gold with green lustre.

REMARKS. The new subspecies is closely related to *C. smaragdinus euviridis* Ishikawa et Kim, 1983 but with different colour: dark "cold" green for *euviridis* and coppery-gold for euaureus. The size is larger as well as the shape of pronotum and the elytra.

Carabus (Coptolabrus) smaragdinus euviridis Ishikawa et Kim, 1983 (Fig. 100)

EXAMINED MATERIAL. One male Republic of Korea, Kyongsang-Namdo province, Mt. Chiri-san (= Jirisan Mt.), Chonwangbong, 1400-1900 m, Y. Imura leg. (CIR); 6 males and 2 females: Republic of Korea, Kyongsang-Namdo province, Jirisan Nat. Park, Byeoksoryeong, 1350 m, I. Rapuzzi and L. Caldon legit (CIR); 5 males and 4 females: Republic of Korea, Kyongsang-Namdo province, Jirisan Nat. Park, Gangcheong-ri, 250 m, I. Rapuzzi and L. Caldon legit (CIR).

REMARKS. The subspecies is endemic to the Jirisan Mountains and particularly in the area surrounding the highest peak (Chonwangbong peak) where *euviridis* lives at different altitudes (from 250 m to 1900 m) and different habitats. In the Southwest part of Jirisan massif the subspecies is replaced by *C. smaragdinus euaureus* n. ssp.

Carabus (Teratocarabus) azrael gaizhouensis Imura, 1996 (Fig. 101)

EXAMINED MATERIAL. 1 female, Democratic Republic of Korea, Pyonganbukdo, Kwaksan County, Sinmi Island, Unjong-Ni 9/20.VII.2006, local collector legit, in the author's collection.

REMARKS. First record for the Korean peninsula.

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Two new species of *Pseudosphegesthes* Reitter, 1913 from Greece and Turkey (Coleoptera Cerambycidae)

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ABSTRACT Two new species of *Pseudosphegesthes* Reitter, 1913 are described. One is from Peloponnese (Greece), the second one is from Southern Turkey. They are close to *Pseudosphegesthes bergeri* Sláma, 1982 from Crete (Greece).

KEY WORDS New species; Cerambycidae; Clytini; *Pseudosphegesthes*; Greece; Turkey.

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INTRODUCTION

Studying the interesting Cerambycidae collected by one of the authors (Ivo Jeniš) in Greece and thanks to the courtesy of our colleague and friend Ivo Martinů (Olomouc, Czech Republic) who gave us part of his interesting material collected in Greece for study, we found a *Pseudosphegesthes* Reitter, 1913 species that belongs to an unknown species related with the Cretan species *P. bergeri* Sláma, 1982. Moreover the first author had the opportunity to study a series of specimens of a *Pseudosphegesthes* collected in SW Turkey by the specialist of Buprestidae Maurizio Gigli (Rome, Italy) that belongs to a new species related to *P. bergeri* from Crete as well (Sláma, 1982).

The genus *Pseudosphegesthes* was introduced by Reitter (1913) for *Clytus cinereus* Laporte et Gory, 1836. According to the structure of the pronotum, head and elytra, it is very likely that it is a synonym of *Perissus* Chevrolat, 1863 described for *Perissus x-littera* Chevrolat, 1863 from Papua New Guinea. To establish this synonymy it will be necessary to study this Asiatic species.

ACRONYMS. BBuC: Boris Bubenik collection, Frýdek Místek, Czech Republic. BBC: Bartłomiej Bujnik collection, Elblag, Poland. GRC: Gianfranco Giannini and Gabriella Rondinini collection, Lissone, Milano, Italy. IJC: Ivo Jeniš collection, Náklo, Czech Republic. MGC: Maurizio Gigli collection, Rome, Italy. IMC: Ivo Martinů collection, Olomouc, Czech Republic. RPC: Radosław Plewa collection, Raszyn, Poland. PRC: P. Rapuzzi collection, Prepotto, Udine, Italy. GSC: Gianfranco Sama collection, Cesena, Italy.

Pseudosphegesthes bubeniki n. sp.
Figure 1

EXAMINED MATERIAL. Type material: Holotypus male, Greece: Peloponnese, Messenia, Dasochori, e.l. 5.V.2013, Boris Bubenik, Oliver Dulik and Ivo Jeniš legit (BBC); Paratypus: 42 males 35 females same data as Holotype (PRC, IJC, BBC, RPC); 1 female; Greece: Peloponnese, Chrousa, SW of Megalopoli, 1 female ex pupae, 14.VI.2012, Ivo Jeniš legit; 45 males and 43 females Greece: Peloponnese,

Arkadia, Vastas SW Megalopoli, 22.V.2014, e.l. Ivo Martinů legit (IJC, BBC, IMC, BBC, and PRC).

DESCRIPTION OF THE HOLOTYPUS. Male. Length 11 mm, width 2.5 mm. Body dark, almost black. Front large, broad, square, strongly and densely punctate; covered with recumbent short ash gray bristles, denser around eyes. In the middle of the front there is a short groove, more evident close to the antennal tubercles and evanescent towards the mouth. Pronotum longer than wide, bell-shaped with the largest portion just before the base. Scutellum round shaped, apex covered with silver pubescence. Elytra long, sides parallel, narrowed only towards the apex. Apex truncate without any teeth on the sides. Elytra deeply punctate. The punctures are small, with the same density on all surface, but a little smaller and not so dense towards the apex. Between humeri and scutellum there is a short carina, parallel with suture. Elytra black, covered with ash gray pubescence on the shoulders; there are two transverse ash gray bands: the first one is arched, starting just behind the scutellum, slightly leaning outside in the first half and then curved and reassembling towards the epipleurae. The second one is just behind the middle, transverse, thin, and climbs up again along the suture on its upper side. On the lower side it follows the shape of the upper side. Apex with confuse ash gray pubescence. Legs long, with several erect black setae on the inner side of femora and tibiae. Tarsi very long, mainly on the hind legs. The first segment of hind tarsi is more than twice as long as the other segments together. Antennae reaching the first third of the elytral length.

VARIABILITY. The length-range of the paratypes is between 7.1 and 11.5 mm for the males and 9.0 and 13.0 mm for the females. The females show the typical differences from the males of the genus: elytra larger and less acuminate towards the apex, antennae shorter and pronotum with punctuation smoother on the disk. Some males have the elytra covered with a very dense ash gray pubescence masking the individual bands.

ETYMOLOGY. The new species is dedicated to our friend Mr. Boris Bubeník (Frýdek Místek, Czech Republic) to thank him for collecting a large series of this species.

BIOLOGY. All the specimens were reared from dead branches of *Quercus pubescens* Willd.

REMARKS. *Pseudosphegesthes bubeniki* n. sp. is related to *P. bergeri* Sláma, 1982 endemic from Crete according to the elytral pattern. It shows indeed the same structure in the bands, with the transverse band thin, not enlarged along the suture; in fact it is projected toward the elytral base but remains of the same thickness. The new species is easy to distinguish from the Cretan species by the pronotum shape. More or less with parallel sides in *P. bergeri* and bell-shaped in the new species. The elytral bands are thinner in the new species and often wider in bergeri. Moreover, the third antennal segment is as long as the fourth in *P. bubeniki* n. sp., clearly longer in *P. bergeri*. From *P. cinerea* the new species is easy to distinguish by the pronotum shape: bell-shaped instead of parallel sided. It

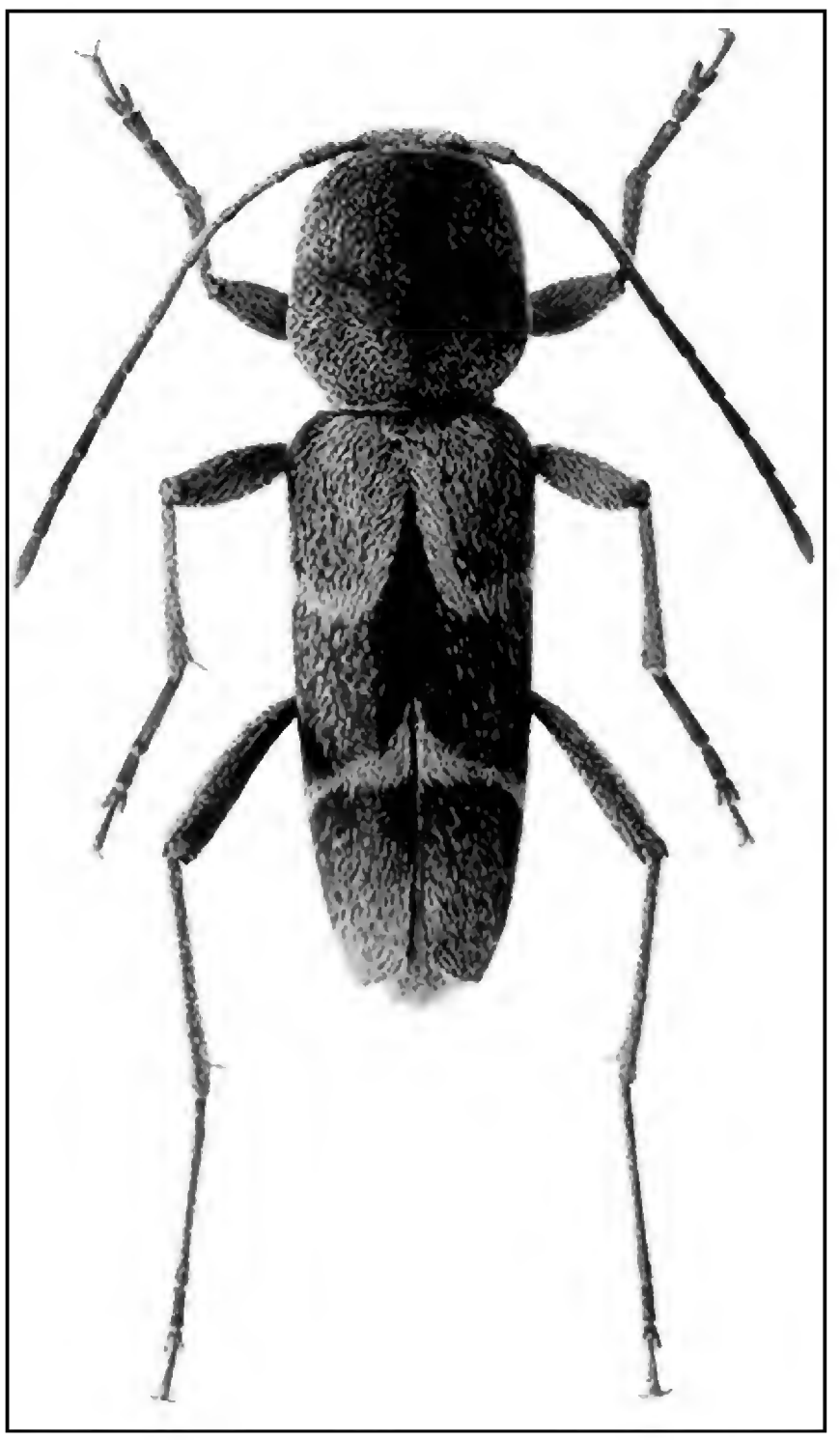

Figure 1. *Pseudosphegesthes bubeniki* n. sp., paratypus male, lenght 10.8 mm.

shows the same ratio in the length of the third and fourth antennal segments. The transverse light band in *P. cinerea* is clearly wider near the suture due to the fact that it is more or less parallel sided towards the elytral apex but is elongate along the suture towards the elytral base.

This new species is very interesting because it extends the range of the genus to the continental Greece. As for its features it stands in the middle way between *P. cinerea* and *P. bergeri*. It will be very interesting to study the population of *Pseudosphegesthes* from Northern Greece and former Yugoslavia.

Pseudosphegesthes giglii n. sp.
Figure 2

EXAMINED MATERIAL. Type material: Holotypus male Turkey: Antalya prov.: Karaovabeli, 1000 m., 23.VI.2003, ex larva *Quercus coccifera*, emerged 3.VII.2006, M. Gigli legit (PRC); Paratypus: 54 males and 36 females: same collecting data as holotypus, emerged 27.VII.2005; 15.VIII.2005; 3.VII.2006; 7.VIII.2006; 11.VII.2007; 2.VII.2008; VII.2011; V.2013; 1 male (PRC; GSC, and MGC); Turkey, Mugla prov., Fethye, 8-20.VIII.2001, G. Giannini legit. (GRC); 1 male, Turkey: Antalya prov., Gündoğmuş, 13.VI.1994, ex larva *Quercus*, S. Lundberg legit (GSC); 1 male, Turkey: Antalya prov., Gündoğmuş, 12.VI.1994, ex larva *Quercus*, S. Lundberg legit (GSC); 1 male Turkey: Mersin prov., north of Erdemli, 27.V.1996, ex larva *Quercus*, emerged 20.IV.1997, S. Lundberg legit (GSC).

DESCRIPTION OF THE HOLOTYPUS. Male. Length 6.5 mm width 2.0 mm. Body dark brown, mat. Front large with a deep unpunctured furrow between eyes. Head all covered with short, recumbent ash gray hairs, more densely around the eyes and up to the labrum. Pronotum long, clearly longer than large, about two times longer than wide with parallel sides. All pronotum is deeply punctured; in the middle of the disk is a longitudinal crest with very dense granules. Just above middle are two small round depressions placed at each side of the median ridge. Sides of pronotum are covered with dense, short, recumbent ash gray hairs; only few of these hairs on the disk. Scutellum rounded, glabrous. Elytra parallel, slightly narrowed only towards the apex. Elytral punctuation made by dense and small points on the whole surface. Two bands decorate the elytra: the basal band, in the first half, is arched towards the outer margin. This band starts just behind the scutellum and turns almost immediately to the outside. The second band is just behind the middle of the elytral length and is more or less transverse, enlarged close to the suture toward the apex and toward the base giving to this band a sort of "cross-shape". There are many ash gray recumbent short hairs on the shoulders, the lateral margins and the apical area. Apex obliquely truncate. Legs long with many very short, recumbent ash gray hairs, denser on the femora than on the tibiae. Tibiae with long, thin, light erect hairs, denser on the inner side, especially on the hind legs, sparser on the middle legs and quite absent on the forelegs. All

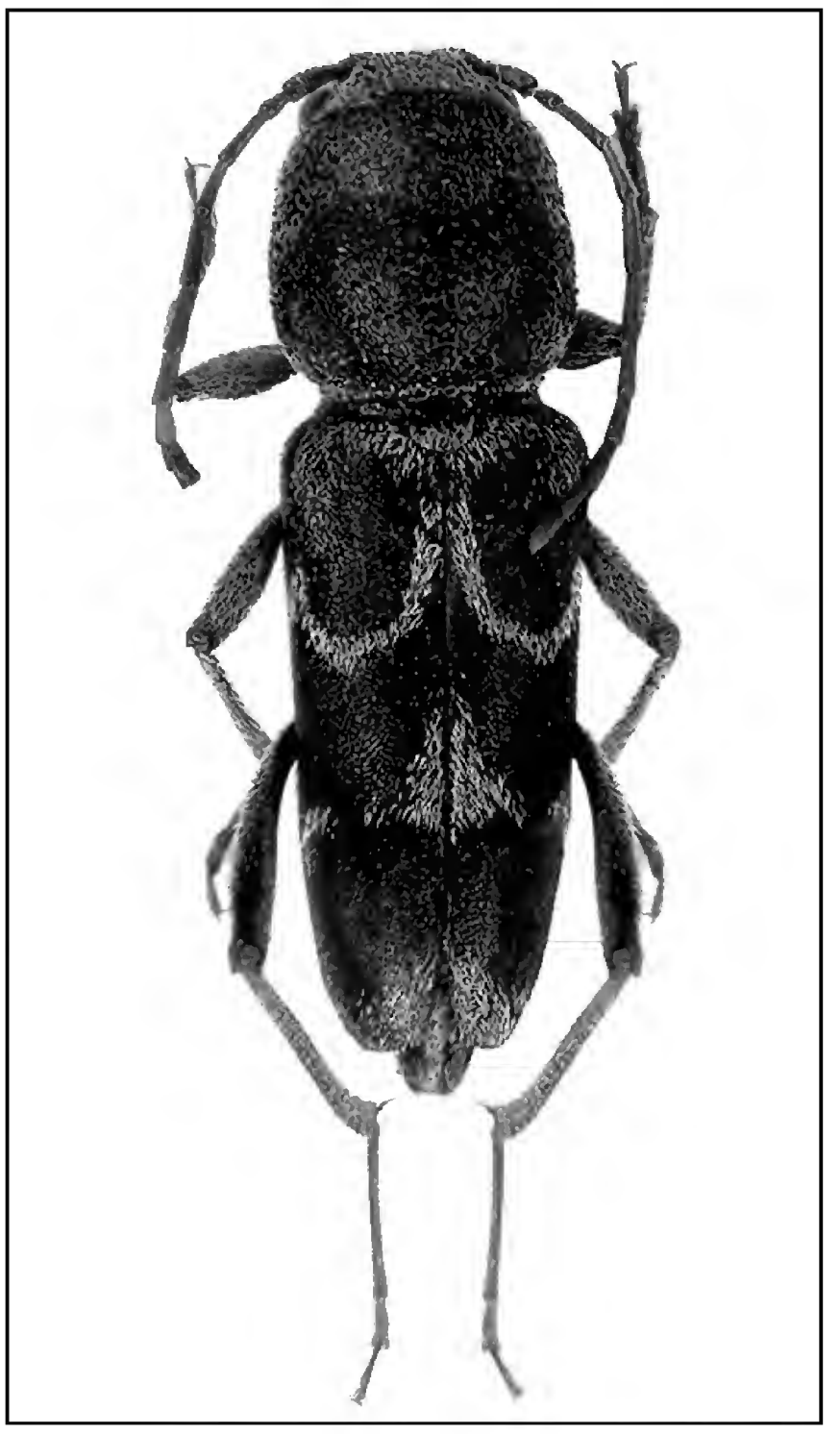

Figure 2. *Pseudosphegesthes giglii* n. sp., paratypus male, lenght 12.5 mm.

tarsi are long, hind tarsi particularly long, the first segment very long and the next very short, the second about five times shorter than the first and the third about one third than the second. Antennae of medium length, dark brown, segments second to fifth with several long ash-grey erect hairs at inner side; third segment a little longer than the fourth. All antennae covered with very short and recumbent ash-grey hairs.

VARIABILITY. The length range is between 6 and 13 mm for the males and 5 and 11 mm for the females. Some males show elytra quite entirely covered with ash gray hairs making the bands confused in this light pubescence. The ground color of the integuments is sometimes reddish-brown instead of dark-brown.

ETYMOLOGY. The new species is dedicated to our friend Mr. Maurizio Gigli (Rome, Italy).

BIOLOGY. All the specimens collected were reared from dead branches of *Quercus coccifera* L.

REMARKS. *Pseudosphegesthes giglii* n. sp. is related to the Cretan species *P. bergeri*. It is easy to distinguish them by the shorter antennae and the particular ratio of the hind tarsi: a very long first segment and very short next segments, the second about five times shorter than the first and the third about one third of the second; in the Cretan species this ratio is: second segment about four times shorter than the first and the third about half of the second. Third antennal segment slightly longer than the fourth; clearly longer in *P. bergeri*. From these features it is close to *P. bubeniki* n. sp. but easy to distinguish by the hind tarsi (which are similar in Greek species and *P. bergeri*). Comparing to the other Turkish species, the closest one is *P. longitarsus* Holzschuh, 1974 but it is very easy to distinguish them by the very long tarsi of *P. longitarsus* (Holzschuh, 1974). The other known Anatolian species are *P. samai* Danilevsky, 2000 and *P. brunnescens* Pic, 1897 (Löbl & Smetana, 2010) but these two species have very different elytral patterns and many others features (see Pic, 1897 and Danilevsky, 2000).

ACKNOWLEDGEMENTS

We are grateful to Boris Bubenik (Frýdek Místek, Czech Republic), Oliver Dulik (Nasobůrky, Czech Republic), Ivo Martinů (Olomouc, Czech Republic), Bartłomiej Bujnik (Elblag, Poland), Gianfranco Sama (Cesena, Italy), Maurizio Gigli (Roma, Italy), Gianfranco Giannini and Gabriella Rondinini (Lissone, Milano, Italy) for the opportunity to study the specimens collected during their scientific survey in Greece and Turkey. We are deep grateful to our friend Gontran Drouin (Sainte Hénédine, Québec, Canada) for the critical revision of the manuscript and for the revision of the english text.

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Kabatekiipsebium yemenensis new genus and new species from Arabic Peninsula (Coleoptera Cerambycidae)

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ABSTRACT *Kabatekiipsebium yemenensis* new genus and new species is described from Yemen and Oman. The new genus belongs to Psebiini Lacordaire, 1869 tribe and it is close to *Pectinopsebium* Adlbauer, 2012 and *Bostrychopsebium* Quentin et Villiers, 1971 but it is strictly related to *Pectinopsebium* by the shape of the antennae in both sexes. The new genus is easy to distinguish from all other genera of Psebiini by its particular shape of antennae, the length of the elytra and legs, and for the very small size of its body.

KEY WORDS New genus; new species; Cerambycidae; Psebiini; Yemen; Oman.

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INTRODUCTION

Among the Cerambycidae collected by my colleagues Petr Kabatek (Prague, Czech Republic) and Walter Grosser (Opava, Czech Republic) I found a series of Cerambycidae that belongs to a genus and species unknown. The new genus belongs to tribe Psebiini and is strictly related to *Pectinopsebium* Adlbauer, 2012 described from Kenya and *Bostrychopsebium* Quentin et Villiers, 1971 from East Africa (Quentin & Villiers, 1971).

ACRONYMS. NMC: Collection of National Museum Natural History, Prague, Czech Republic; PKC: Petr Kabatek collection (Prague, Czech Republic); PRC: Pierpaolo Rapuzzi collection, Prepotto, Udine, Italy; WGC: Walter Grosser collection (Opava, Czech Republic);

Kabatekiipsebium n. gen.

Type species. *Kabatekiipsebium yemenensis* n. sp.

DESCRIPTION. Male: very small and thin; head and pronotum deeply punctate; frons large, flat. Pronotum with several longitudinal thin and short wrinkles on the disk. Pronotum 2.5 times longer than wide, constricted before base, without teeth on sides, many long pale erect thin setae on the disk. These setae are slightly tilted forward. Eyes large, the two lobes are joined by several lines of ommatidia. Elytra short, two third longer than abdomen, the last four abdominal segments exceed the elytral apex. Elytra deeply punctured. The punctures are larger and denser on the sides, especially around the apex. In the middle of the disk is a long triangular depression. Elytra covered with long pale erect hairs, denser near the base and shorter and sparser towards the apex. Legs short, with small dense punctures, covered with several pale erect setae. Epipleurae densely and heavily punctured. Antennae simple for the first five segments and the last six segments very short. Each of the last six segments with a very long flabellum on the outside, flabellum longer than the whole antennal length.

Segments 1st, 3rd, 4th, 5th of the same length. 2nd segment a third longer than the first. Female: female differs from the male by the pronotum a little shorter, two times longer than wide. Elytra a little longer. Antennae shorter, simply without any flabellum or spine, made by 9 segments (9th to 11th segments are fused together). First to fifth segments cylindrical, 6th to 9th segments compressed and flat, slightly expanded externally. Elytra evidently shorter than abdomen. The last four abdominal segments exceed the elytral apex.

ETYMOLOGY. The new genus is dedicated to Petr Kabatek from Prague (Czech Republic) who collected the largest number of specimens known. The second part of the name refers to the tribe Psebiini.

REMARKS. According to the small size, the new genus is close to *Pectinopsebium* Adlbauer, 2012 and *Bostrychopsebium* Quentin et Villiers, 1971. It is strictly related to *Pectinopsebium* by the shape of the antennae in both sexes. It is easy to distinguish by the great length of the antennal flabella in male, as long as the whole antennal length, the segments with flabella that are very short and indistinct, but distinct and really longer in *Pectinopsebium*. The number of flabella is 6 instead of 8 in the African genus. In the females the last three antennal segments are fused in one segment only in the new genus, simple and distinct in the related genus. From *Bostrychopsebium* it differs by the longer elytra, very short in *Bostrychopsebium*. Antennal segments in *Bostrychopsebium* are simple and distinct except in *B. usurpator* Holzschuh, 1989 from Sri Lanka where male shows small flabella in the last 7 antennal segments. Pronotum is longer and legs are shorter in *Kabatekiipsebium* n. gen. than both the other related genera of this Tribe (*Bostrychopsebium* and *Pectinosebium*). The new genus is easy to distinguish from all other genera of Psebiini by its particular shape of antennae, the length of the elytra and legs, and for the very small size of its body.

Kabatekiipsebium yemenensis n. sp.

EXAMINED MATERIAL. Type material: Holotypus male, Yemen, Jabal al Fatk, Hawf NE Al Ghaydah, 16°39'N 53°05'E, 729 m., 12-13.V.2005, P. Kabátek legit (NMC); Paratypus: 9 males and 4 females, Yemen, Jabal al Fatk, Hawf NE Al Ghaydah, 16°40'N 53°04'E, 477 m., 12-31.III.2007, ex larva *Acacia* sp., P. Kabátek legit; 2 males, Yemen, Jabal al Fatk, Hawf NE Al Ghaydah, 16°39'N 53°03'E, 191 m., 1-2.IV.2007, ex larva *Acacia* sp., P. Kabátek legit; 1 male and 2 females, Yemen, Jabal al Fatk, Hawf NE Al Ghaydah, 16°40'N 53°05'E, 759 m., 1.IV.2007, P. Kabátek legit; 1 male, Oman, Dhofar prov., Jabal al Qamar, 10 Km N Dhalqut, 476 m., 16.70275°N53.19460°E, ex larva, W. Grosser legit; 1 male, Oman, Taqah env., 270-350 m., 18-21.IX.2003, R. Červenka legit. Paratypes in PKC, WGC, PRC.

DESCRIPTION OF THE HOLOTYPE. Male. Length 4.5 mm. Body black except for the elytra, legs and antennae which are dark brown. Antennae paler. Head deeply and thinly punctate, eyes very large and finely facetted. Frons plane and square. Several erect pale setae denser between eyes. Pronotum clearly longer than wide, about two times longer than wide. Black, strongly punctured with many short elongate thin wrinkles, clearly larger than the punctures on the head, several long light erect setae denser on the base than the apex. Elytra brown, deeply punctate. Punctures large and denser close to the suture. Elytra short, small, reaching farther than the middle of the abdomen. Apex rounded. In the middle is a deep triangular depression with its apex towards the elytral apex, and the base towards the elytral base. The base is covered with dense pale erect hairs. These hairs are clearly shorter and denser than the hairs on pronotum. Legs brown, short, with sparse erect pale hairs. Femora slightly enlarged and tibiae slightly arched. Antennae shorter than the body. First five segments normal, from the sixth to the eleventh very short with an extremely long flabellum at the apex of each.

VARIABILITY. The size of the males is between 4 and 6 mm; one male shows an elongate thin light spot on the middle of each elytra. Females completely dark brown. Antennae normal, without any flabellum, shorter, not reaching the middle of the body. Elytra with two white bands. The first one, just before shoulders, is interrupted before suture; the second one, behind the middle, is complete. The size of the females is between 3.5 and 6 mm.

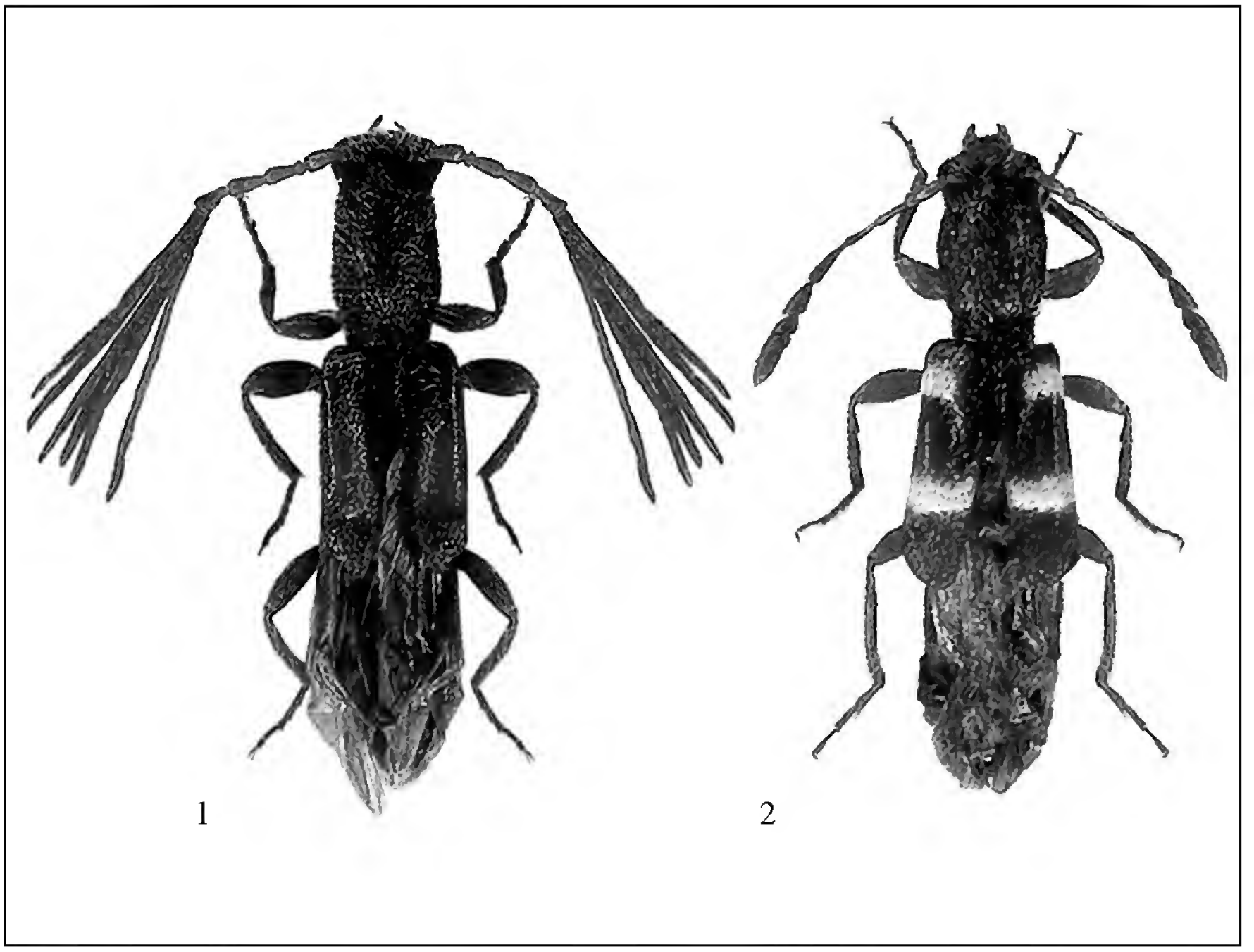

Figure 1. *Kabatekiipsebium yemenensis* n. gen. and n. sp., paratype male, lenght 5 mm.
Figure 2. *Kabatekiipsebium yemenensis* n. gen. and n. sp., paratype female, lenght 5.5. mm.

ETYMOLOGY. The new species' name refers to the region of the Arabian Peninsula where was collected the large part of specimens of the type series.

DISTRIBUTION AND BIOLOGY. *Kabatekiipsebium yemenensis* n. sp. is, at moment, known only from Southern Arabian peninsula.

The large part of the specimens of the type series was reared from *Acacia* sp. Other specimens was collected during the night at light traps.

REMARKS. *Kabatekiipsebium yemenensis* n. sp. is very interesting, in fact all known species of very small size Psebiini are from East Africa except for *Bostrychopsebium usurpator* Holzschuh, 1989 which is known from Sri Lanka (Holzschuh, 1989; (Löbl & Smetana, 2010; Adlbauer & Bjøørnstad, 2012.). Once again, this new species shows how the Southern Arabian peninsula's Fauna is connected with Eastern African Fauna.

ACKNOWLEDGEMENTS

I'm grateful to Mr. Petr Kabatek (Prague, Czech Republic) and Mr. Walter Grosser (Opava, Czech Republic) who gave me the opportunity to study this very interesting species collected in Yemen and Oman respectively. I'm deep grateful to my friend Gontran Drouin (Sainte Hénédine, Québec, Canada) for the critical revision of the manuscript and for the revision of the English text.

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On the presence of *Buprestis (Buprestis) magica* Laporte et Gory, 1837 (Coleoptera Buprestidae) in Italy

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ABSTRACT The present study confirmed the presence of *Buprestis* (*Buprestis*) *magica* Laporte et Gory, 1837 (Coleoptera Buprestidae) in Italy based on a male specimen preserved at the Museum of Natural History of Genoa (Italy), which, for some peculiar morphological characteristics, is described as a new subspecies: *B. magica doderoi* n. ssp. from Sardinia. The new subspecies is illustrated and compared with related taxa.

KEY WORDS Buprestidae; *Buprestis*; new subspecies; Sardinia.

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INTRODUCTION

Buprestis (*Buprestis*) *magica* Laporte et Gory, 1837 (Coleoptera Buprestidae) is widespread in Tunisia, Algeria, Morocco and Spain (Baviera & Sparacio, 2002; Kubán, 2006). In Italy, this species is signalized by Porta (1929 sub *B. octoguttata* a. *magica*), Luigioni (1929 sub *B. octoguttata* a. *magica*) and Obenberger (1938, 1941 sub *B. octoguttata* ssp. *magica*). Subsequently, these reports were attributed, with doubt, to *B. octoguttata corsica* Obenberger, 1941 (Curletti, 1985; Gobbi & Platia, 1995; for the exacte date description of "*corsica*" see also Schaefer, 1949 p. 206). After the taxonomic and geonemic revaluation of this species by Baviera & Sparacio (2002) there were not more data on the presence of *B. magica* in Italy (Curletti et al., 2003).

The present study confirms the presence of this species in Italy and highlights some morphological differences in the specimen of Sardinia examined and described below.

ACRONYMS. CGM: G. Magnani collection, Cesena, Italy. MCSNG: Collection of Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy. CIS: I. Sparacio collection, Palermo, Italy.

Buprestis (Buprestis) magica doderoi n. ssp.
Figures 1, 2, 5, 9, 13, 17

EXAMINED MATERIAL. Holotypus male, pinned with three original labels: Carloforte (Sardinia) A. Dodero - Var. magica Lap. - Collezione A. Dodero (red label) (MCSNG). Collection date: 1901–1912. A. Dodero travelled to Carloforte only three times, in 1901, 1902 e 1912 (R. Poggi *in verbis*).

Other examined material. *Buprestis magica magica*. Algeria, D. Fairmaire, teste Thery 1926, Museo Civico di Genova, 1 male (MCSNG). Algeria, Blida Chrea m. 1500, G. Magnani legit, ex larva *Cedrus atlantica,* 28.VI.1986, 1 male (CGM). S-Spain, Tarifa, IX.1983, 1 female, legit G. Dellacasa (MCSNG); S-Spain, Coto Doñana, XII.1984, 1 female, leg. Cortesogno (MCSNG); Spain, Cadiz, Conil El Colorado, 15.VII.1995, P. Coello legit, 2 males (CIS); Balearic Islands, Mallorca, Pollensa,

1 male and 1 female, leg. J. Jordà (MCSNG). *Buprestis octoguttata octoguttata* Linnaeus, 1758. Croatia, 2 males (MCSNG). Dalmatia, 1 female, leg. Kelecsényi (MCSNG). Germany, Chiemgau, Grassau Moor, 23.VII.1972, 2 males, leg. P. Brandl (CIS). Italy, Potenza, Pietra Castello, 15.VII.1996, 1 male, leg. F. Izzillo (CIS). *Buprestis octoguttata corsica*. S-Corsica, Partinello, 19.VII.1990, 1 male, leg. A. Paulian (CIS). *Buprestis aetnensis* Baviera et Sparacio, 2002. Italy, Sicily, Mount Etna north side, 2000 m asl, 14.VIII.1999, leg. C. Baviera (CIS), idem 1 female (CIS).

DESCRIPTION OF THE HOLOTYPUS. Male. Length 14.6 mm. Head, pronotum and elytra dark with feeble green or bluish lustre. Ventral surface dark with more metallic lustre. Presence of multiple yellow spots arranged on the dorsal surface as follows: 1 elongated spot on the inner edge of the eye, 1 on the lower edge and a smaller one on the upper-rear edge; pronotum with yellow lateral margins that continue forward on the anterior margin, 2 large spots on the posterior margin, contiguous but clearly distinct, joined by a small stretch; elytra with 4 spots reaching neither the suture nor the elytral margin; 1 humeral spot irregular and extended and a very small one on the elytral margin before the last pre-apical spot. Ventral surface with yellow spots disposed as follows: 4 in the prosternum, the more elongated upper, 2 spots elongated on the margin of prosternal process; 4 spots on the mesosternum; 4 spots on the metasternum; sternites 1–4 with isolated spots; anal sternite with 1 spot elongated along the basal half; other small spots are arranged on the coxae; femurs with spots of elongated shape on the lower edge that, at the articulation with the tibia, extend in part on the dorsal surface. Frons, antennae, legs and ventral surface with short, sparse and white pubescence.

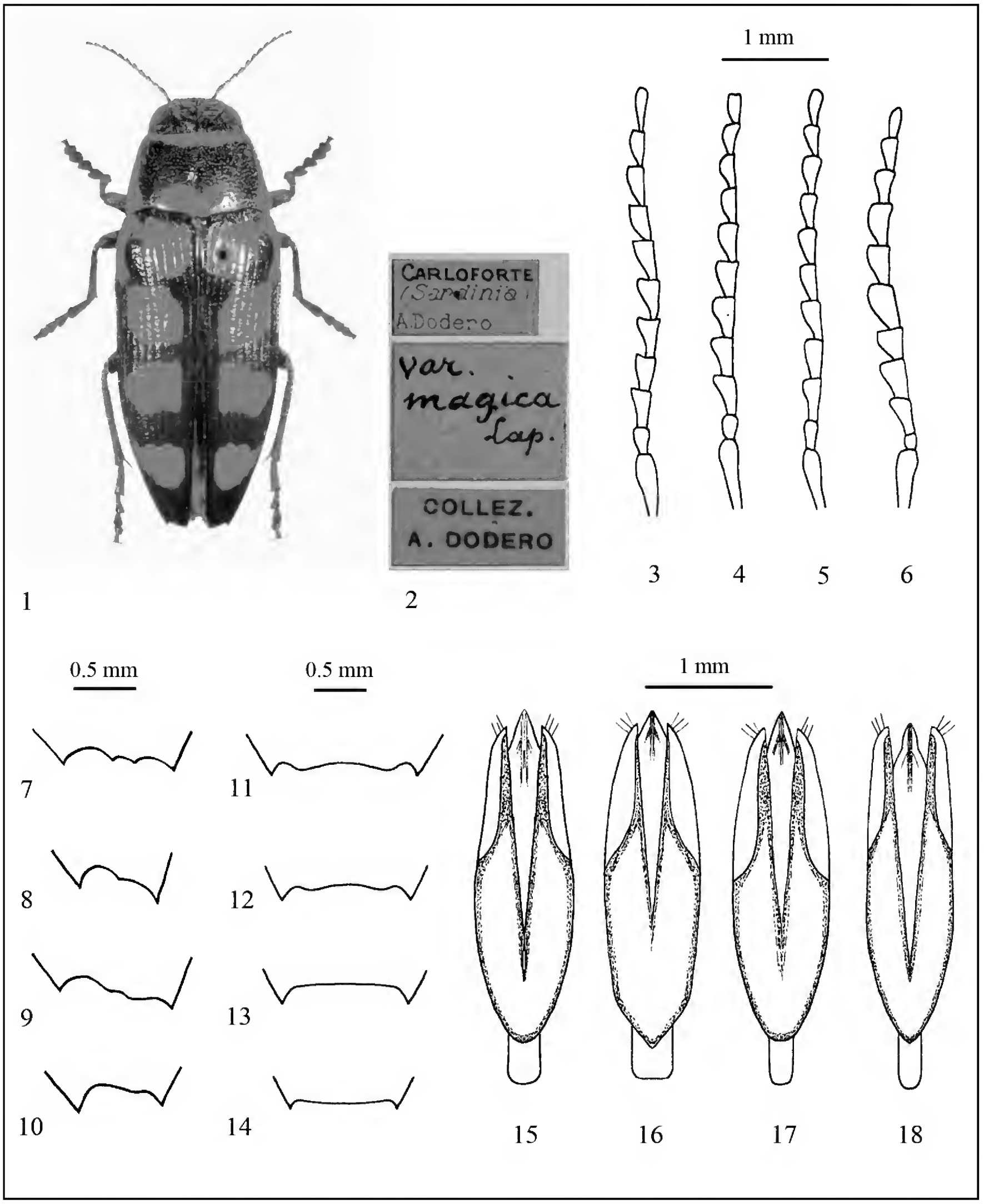
Epistome concave. Frons little hollowed with big and dense punctures; eyes big, protruding, inner margins almost straight, little converging dorsally. Antennae (Fig. 5) with first antennomere long and little dilated anteriorly, second one short, third antennomere denticulate, 4–10 little, denticulate but with obtuse outer angles, terminal antennomere elongated and rounded at apex. Pronotum 1.6 times as wide as long, transverse, regularly convex, lateral margins converging anteriorly, maximum pronotal width at basal third, anterior margin deeply biarcuate, medial lobe very slighty prominent, posterior margin very biarcuate, strongly lobate in the middle; pronotal sculpture consisting of big, deep and dense punctures, interspace between punctures with very little, superficial and sparse punctures. Scutellum subcordiform, 1.2 times as wide as long, microsculptured. Elytra 1.9 times as long as wide, slightly wider than pronotum at humeral part, subparallel at anterior two thirds, narrowed at elytral apices, elytral epipleura narrow not reaching the elytral apex; elytral sculpture consisting of regular striae of small points, deep and spaced; interstriae slightly convex with wide and superficial punctures, little and transverse lines, and background microsculpture not very evident; humeral swellings distinct; apex of elytra (Fig. 9) irregularly and obliquely truncate between two tooth-shaped protrusions: the margin is concave in the outer half, straight and irregular in the inner half. Legs relatively long and slender, all femora normal, not swollen; protibiae slightly, straight, wider distally and with the pre-apical emargination and 1 apical tooth; mesotibiae slender, nearly straight; metatibiae straight, flattened, 1–4 segments of tarsi dilated, the first one little and narrower than the other three; tarsal claws slender, hook-shaped slightly enlarged at the base. Prosternal process with a median furrow and big and sparse punctures; the sides are straight with apex truncate and rounded. Metasternum with punctures and a median furrow. Sternites microreticulated with elongated and irregular punctures, the first one with a little hollow at the center, anal sternite (Fig. 13) truncated and little concave at apex between two tooth-shaped protrusions.

Aedeagus (Fig. 17) with parameres pointed apically, larger around the middle and narrow and slightly hollow at apical half; microsculpture apical medium thickened; median lobe pointed apically.

VARIABILITY. Unknown.

ETYMOLOGY. The new subspecies is dedicated to Agostino Dodero (Genoa, Italy) who collected the specimen object of this study.

BIOLOGY AND DISTRIBUTION. The species of the genus *Buprestis* Linnaeus, 1758 usually develops on wood of various conifers (*Pinus*, *Picea*, *Abies*, *Larix*, ...). *Buprestis magica doderoi* n. sp. is known, at the moment, only from Southern Sardinia.



Figures 1, 2. *Buprestis* (*B.*) *magica doderoi* n. ssp. holotypus male (14.6 mm) with labels. Figures 3–6. Antennae of male of *B.* (*B.*) *magica magica* (Algeria) (Fig. 3), *B.* (*B.*) *magica magica* (Spain, Cadiz) (Fig. 4), *B.* (*B.*) *magica doderoi* n. ssp. (Fig. 5) and *B.* (*B.*) *octoguttata corsica* (Corsica, Partinello) (Fig. 6). Figures 7–10. Apex of elytra of male of *B.* (*B.*) *magica magica* (Algeria) (Fig. 7), *B.* (*B.*) *magica magica* (Spain, Cadiz) (Fig. 8), *B.* (*B.*) *magica doderoi* n. ssp. (Fig. 9) and *B.* (*B.*) *octoguttata corsica* (Corsica, Partinello) (Fig. 10). Figures 11–14. Anal sternite of male of *B.* (*B.*) *magica magica* (Algeria) (Fig. 11), *B.* (*B.*) *magica magica* (Spain, Cadiz) (Fig. 12), *B.* (*B.*) *magica doderoi* n. ssp. (Fig. 13) and *B.* (*B.*) *octoguttata corsica* (Fig. 14). Figures 15–18. Aedeagus of *B.* (*B.*) *magica magica* (Algeria) (Fig. 15), *B.* (*B.*) *magica magica* (Spain, Cadiz) (Fig. 16), *B.* (*B.*) *magica doderoi* n. ssp. (Fig. 17) and *B.* (*B.*) *octoguttata corsica* (Corsica, Partinello) (Fig. 18).

REMARKS. The description of *B. magica doderoi* n. ssp. was performed on a single male specimen that, however, appears well differentiated by the peculiar shape of the antennae, the apex of elytra, anal sternite and aedeagus (Figs. 5, 9, 13, 17).

In particular, this new subspecies is different from the surrounding populations of Tunisia, Algeria, Morocco and Spain, Balearic Islands included, attributed to *B. magica magica* (Figs. 3, 4, 7, 8, 11, 12, 15, 16) and those of Corsica attributed to *B. octoguttata corsica* (Figs. 6, 10, 14, 18); *B. magica doderoi* n. ssp. is different, also, from European populations of *B. octoguttata octoguttata* and Sicilian populations of *B. aetnensis* (see Baviera & Sparacio, 2002).

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Therapeutic use of *Rosmarinus officinalis* L. (Lamiales Lamiaceae) and description of its medicinal flora cortege in Algeria

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ABSTRACT *Rosmarinus officinalis* L. (Lamiales Lamiaceae), Rosemary, is an aromatic and medicinal plant distributed throughout the Mediterranean Sea and the rest of Europe. It is typically Mediterranean and in Algeria is widespread in different regions. *Rosmarinus officinalis* is known and used since ancient times for its culinary, medicinal and aromatic (in perfumery) virtues. It is widely used as a condiment in the Mediterranean basin and in England; also there are honey specially produced from the nectar of the flowers of Rosemary called "Honey of Narbonne" or "Rosemary honey". It is very used in agri-food as conservative and antioxidant, for the conservation of meat and fats. The essential oil used in doses greater than 2 to 3 drops/day would cause risk of nephritis and gastroenteritis. The leaves and flowering tops would have the same effect at excessive doses. Our work is focused on the study of the diversity of the floristic cortege of *R. officinalis* species taking into account two geographically different stations: Sidi Djilali and Beni Saf.

KEY WORDS *Rosmarinus officinalis*; medicinal flora; coastal station; steppe.

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INTRODUCTION

Traditional medicine and plants world live in close connection, as the first one draws its raw material from the second to make remedies. All drugs falling within Western medicine, must overcome a pharmacological experimentation in order to verify their activity and to ensure their safety.

Rosmarinus officinalis L. (Lamiales Lamiaceae) is one of the medicinal plants which are in use since antiquity in the entire Mediterranean basin. It is placed in the category of purifying plants for its action on the digestive and urinary systems and as stimulant plant for its essential oil showing anti-rheumatic virtues and positive effects on fertility and pregnancy. In gastronomy it is used also as a spice for food preparation and preservation of food (i.e. meat). Today, *R. officinalis* is entered in modern medicine through herbal nature specialties where it appears often in association with other plants.

MATERIAL AND METHODS

To study the dynamics of the floristic cortege of *R. officinalis*, it is necessary to know the factors that encourage their diffusion. To carry out this work we have chosen two stations located in two different areas of the country:

• coast: the station of Sidi Safi belonging to the municipality of Beni Saf

• steppe: station of Sidi Goretti belonging to the municipality of Sidi Djilali.

The two stations are located in semi-arid environments and characterized by a rainy season from November to April and a drought summer lasting about 5 to 6 months.

For all medicinal species and each station types, morphological, biological and phytogeographic distributions have been taken into account in order to assess the floristic richness of medicinal plants in the study area.

The oil of Rosmarinus officinalis

Rosmarinus officinalis essential oil contains scents of camphor, pinenes, cineol, and verbenone; it also contains flavonoids (diosmin, Luteolin), diterpenes, like the rosmadial and carnosolic acid, but also lipids (alkanes and alkenes), steroids (acid triterpenes aleanolique, acid ursotique), phenolic acids (rosmarinic acid, chlorogenic acid) and phytoestrogens, showing effects comparable to the female hormones.

Rosmarinus officinalis oil stimulates circulation and invigorates the nervous system, skin, liver and gall bladder. Is refreshing, antiseptic and antibacterial, and even diuretic and purifying; moreover, it is an antidepressant with antifungal properties, prevents and reduces spasms, tempers flatulence and regulates digestion. It hunts large colds and pain. And, on an emotional level, the oil soothes mental exhaustion and clarifies the spirit.

Use of Rosmarinus officinalis

The dried leaves of *R. officinalis* are commonly used in gastronomy (see I.T.E.I.P.M.A.I., 1991). Still, *R. officinalis* enters the composition of Vinegars. Its high content of borneol gives it powerful antiseptic properties which makes it the bactericide of choice in cannery (see I.T.E.I.P.M.A.I., 1991).

The essential oil used in doses greater than 2 to 3 drops/day would cause risk of nephritis and gastroentheritis (leaves and flowering tops would have the same effect at excessive doses).

The essential oil is avoided in people with epilepsy and hypertension, children and pregnant and lactating women.

The toxicity

A plant is considered toxic when it contains one or more substances harmful to humans or animals, the use of which causes death or more or less serious varied disorders (Fournier, 2001).

Many toxic plants are listed by several Anti Poison centres (see for example Patrick, 2003; Flesch, 2005).

The study of acute plant toxicity is usually performed by intra-peritoneal injections of different extracts in laboratory animals, the plant is considered toxic when the mean lethal dose (LD50) is 500 mg/kg or less (Marles & Norman, 1994). Among all deemed toxic plants, some are lethal in case of injection while others do cause minor, mainly digestive, disorders.

All parts of the plant have the toxic principles, but especially roots and seeds do, since they contain aconitine - a diterpenoid alkaloid - with a mainly neurological and cardiac toxicity (Flesch, 2005). Depending on the duration, frequency and quantity of toxic products to which an individual is exposed, there are several types of toxicities (Damien, 2002). Humans are constantly exposed to either acute or sub-acute or even chronic toxicity (Bismuth et al., 1987).

RESULTS AND DISCUSSION

Obtained results are shown in Table 1 and figures 1–4. The study area comprises 66 medicinal species distributed in 31 families, with the predominance of Lamiaceae (17%), Liliaceae (15%) and Apiaceae (8%). Asteraceae, Brassicaceae, Fabaceae and Cupressaceae are represented only by 6 or 5 %; while other families are only poorly represented.

Generally speaking, biological types or forms of the species reflect biology and a certain adaptation to the environment (Barry,1988).

The coexistence of many biological types, in a same station, no doubt accentuates the floristic richness of a given site, taking also into account the importance that annuals can take in arid zones during some favourable years (Florer & Pontanier,1982).

The spectrum composition of the study area revealed the predominance of Therophytes> Chamaephytes>Geophytes>Phanerophytes>Hemicryptophytes.

As said, the dominant biological type is represented by the Therophytes with a percentage of

TAXA	FAMILIES	BIO TYPES	MORPHO TYPES	COROTYPE
Ajuga chamaepitys (L.) Schreb.	Lamiaceae	TH	HA	EUR-MED
Allium nigrum L.	Amaryllidaceae	GE	HV	MED
Ammoides verticillata (Duby) Briq.	Apiaceae	TH	HA	MED
Aristolochia longa L.	Aristolochiaceae	GE	HV	MED
Arum italicum Mill.	Araceae	TH	HA	ATL-MED
Asparagus acutifolius L.	Liliaceae	GE	HV	MED
Asparagus albus L.	Liliaceae	GE	HV	W-MED
Asparagus stipularis Forsk.	Liliaceae	GE	HV	MACAR-MED
Asphodelus microcarpus L.	Liliaceae	GE	HV	MACAR-MED
Astragalus lusitanicus Lam.	Fabaceae	TH	HA	ALG-ORAN-MED
Borrago officinalis L.	Boraginaceae	TH	HA	W-MED
Bryonia dioica Jacq.	Cucurbitaceae	TH	HA	AS-EUR
Carduus pycnocephalus L.	Asteraceae	HE	HV	AS-EUR
Chamaerops humilis subsp *argentea* André	Arecaceae	CH	LV	MED
Chenopodium album L.	Chenopodiaceae	TH	HA	COSM
Chrysanthemum coronarium (L.) Spach	Asteraceae	TH	HA	MED
Chrysanthemum x *grandiflorum*	Asteraceae	TH	HA	END
Cynodon dactylon (L.) Pers.	Poaceae	GE	HV	COSM
Clinopodium nepeta (L.) Kuntze	Lamiaceae	CH	HV	AS-EUR
Daphne gnidium L.	Thymelaeaceae	CH	LV	MED
Daucus carota L.	Apiaceae	TH	HA	MED
Drimia maritima (L.) Stearn	Liliaceae	GE	HV	MACAR-MED
Echium vulgare L.	Boraginaceae	TH	HA	MED
Erica multiflora L.	Ericaceae	CH	LV	MED
Eryngium maritimum L.	Apiaceae	CH	LV	EUR-MED
Euphorbia helioscopia L.	Euphorbiaceae	TH	HA	AS-EUR
Fedia cornucopiae (L.) Gaertner	Valerianaceae	TH	HA	MED
Fumana thymifolia (L.) Spach ex Webb	Cistaceae	TH	HA	AS-EUR-MED
Globularia alypum L.	Plantaginaceae	CH	LV	MED
Herniaria hirsuta L.	Caryophyllaceae	TH	HA	PAL-TEMP
Jasminum fruticans L.	Oleaceae	CH	LV	MED
Juniperus oxycedrus L.	Cupressaceae	PH	LV	ATL-MED
Juniperus phoenicea L.	Cupressaceae	PH	LV	MED
Kundmannia sicula (L.) DC.	Apiaceae	TH	HA	MED
Lavandula dentata L.	Lamiaceae	CH	LV	W-MED
Lavandula multifida L.	Lamiaceae	CH	LV	MED
Lavandula stoechas L.	Lamiaceae	CH	LV	MED
Lobularia maritima (L.) Desv.	Brassicaceae	TH	HA	MED

Table 1. Listing of related medicinal species associated with *Rosmarinus officinalis* in the study area.

TAXA	FAMILIES	BIO TYPES	MORPHO TYPES	COROTYPE
Lonicera implexa Aiton	Caprifoliaceae	TH	HA	MED
Malva sylvestris L.	Malvaceae	TH	HA	MED
Marrubium vulgare L.	Lamiaceae	TH	HA	COSM
Muscari comosum (L.) Mill.	Liliaceae	GE	HV	MED
Muscari neglectum Guss. ex Ten.	Liliaceae	GE	HV	EUR-MED
Nepeta multibracteata Desf.	Lamiaceae	TH	HA	PORTUGAL A.N
Olea europea L.	Oleaceae	PH	LV	MED
Ononis spinosa L.	Fabaceae	CH	LV	AS-EUR
Pallenis maritimus (L.) Greuter	Asteraceae	TH	HA	MACAR-MED
Pinus pinaster Aiton	Pinaceae	PH	LV	W-MED
Pistacia lentiscus L.	Anacardiaceae	PH	LV	MED
Plantago major L.	Plantaginaceae	HE	HV	AS-EUR
Ranunculus repens L.	Ranunculaceae	TH	HA	PAL
Rhaphanus raphanistrum L.	Brassicaceae	HE	HV	MED
Retama raetam (Forssk.) Webb et Berthel.	Fabaceae	CH	LV	MED
Rosmarinus officinalis L.	Lamiaceae	CH	LV	MED
Rubia peregrina L.	Rubiaceae	TH	HA	ATL-MED
Rumex bucephalophorus L.	Polygonaceae	TH	HA	MED
Ruta chalepensis L.	Rutaceae	TH	HA	MED
Smilax aspera L.	Liliaceae	GE	HV	MAC-MED-ETH-IND
Tamus communis L.	Dioscoreaceae	TH	HA	ATL-MED
Tetraclinis articulata (Vahl) Mast.	Cupressaceae	PH	LV	IBERO-MAURIT-MATH
Teucrium fruticans L.	Lamiaceae	CH	LV	MED
Teucrium polium L.	Lamiaceae	CH	LV	EUR-MED
Thapsia garganica L.	Apiaceae	CH	LV	MED
Thymus serpyllum L.	Lamiaceae	CH	LV	END.N.A
Tulipa sylvestris L.	Liliaceae	GE	HV	EUR-MED
Viburnum tinus L.	Adoxaceae	CH	LV	MED

Table 1. Listing of related medicinal species associated with *Rosmarinus officinalis* in the study area.

about 41%. This dominance is primarily due to their resistance to drought in the steppe areas. Nevertheless, the Chamaephytes also keep a place very important with a percentage of 27%. Benabadji et al. (2004) reported that grazing promotes the installation, in a comprehensive manner, of the Chamaephytes often refused by herds. Geophytes are in 3rd position, followed by Phanerophytes (9%) with bulbous and rhizomatous medicinal species. Hemicryptophytes are scarsely represented in the study (only 5%), probably due to the poverty in organic matter of the soil, as previously stressed by Barbero et al. (1989).

From the morphological point of view, the vegetation of the study area is marked by heterogeneity between woody, herbaceous, perennials and annuals medicinal.

The herbaceous annuals are dominant in the study with a percentage of 41% which is probably connected to the invasion of Therophytes (which are generally herbaceous annual). Roman (1987)

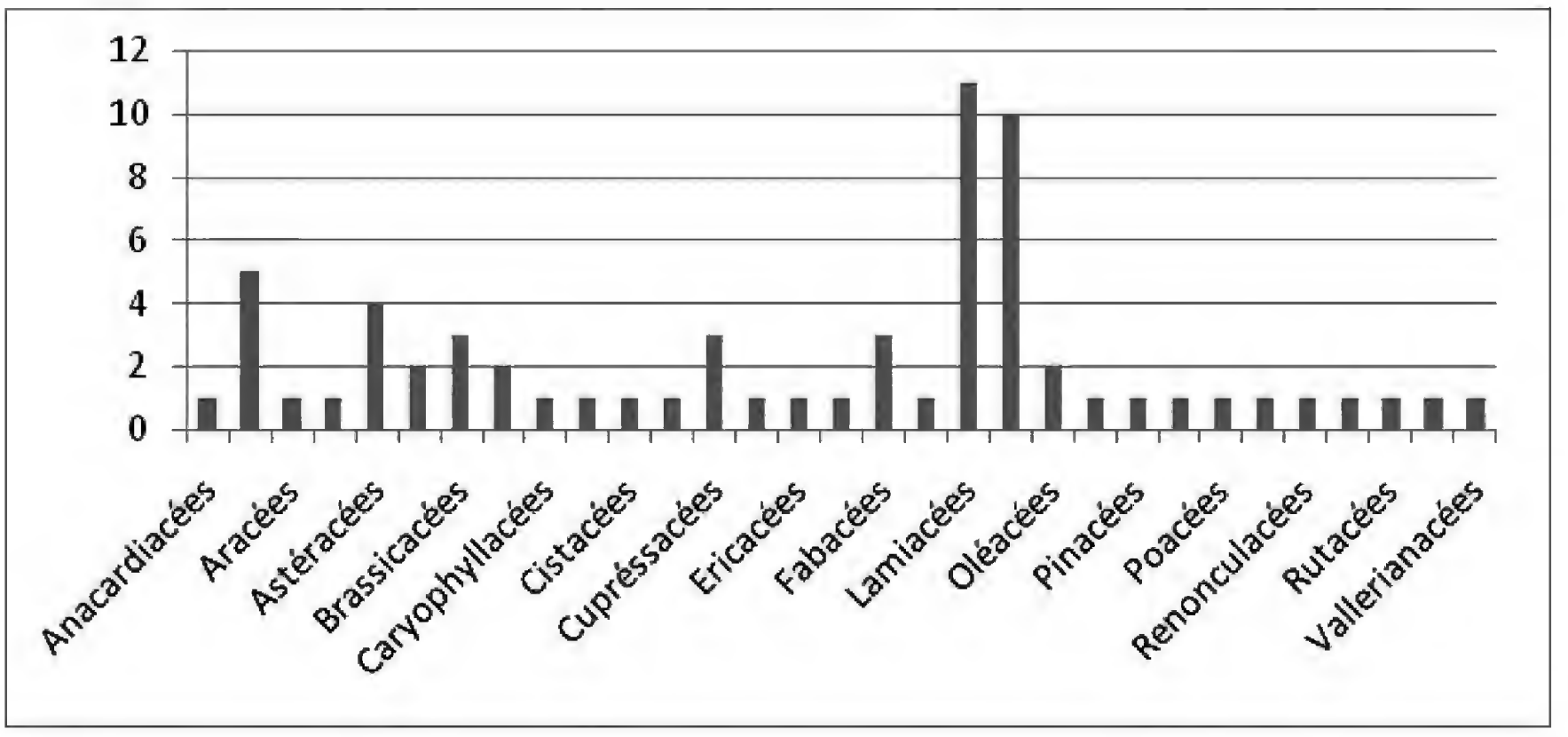

Figure 1. Percentage of families of medicinal plants from the study area.

already highlighted the existence of a good correlation between biological types and many phenomorphologic characters.

Despite the dominance of annuals, perennial woody plants retain an important place with 35%. Herbaceous perennials are the least represented with 24%.

Phytogeography is studying the distribution of plant species on the surface of the globe (see Lacoste & Salanon, 1969). The reasons why a species does not exceed the limits of its geographical range can be many including: climate, soil, history or isolation by natural barriers.

In our study we showed (Fig. 4) the predominance of the Mediterranean biogeographical types species with a percentage of 59%, followed by cosmopolitan elements (16%), Asian elements (6%) and Euro-Mediterranean and W-Mediterranean species (5% each). The other biogeographic elements are very little represented.

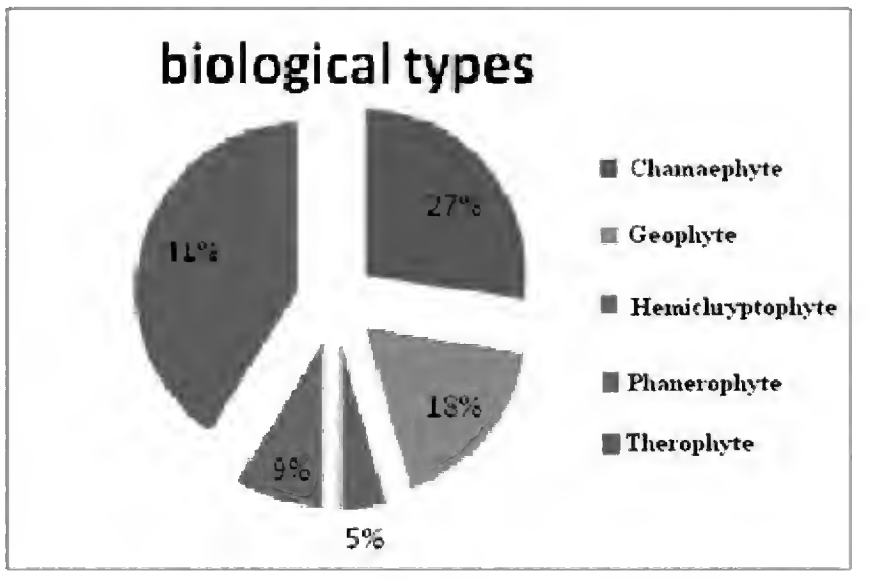

Figure 2. Biological types of medicinal plants from the study area.

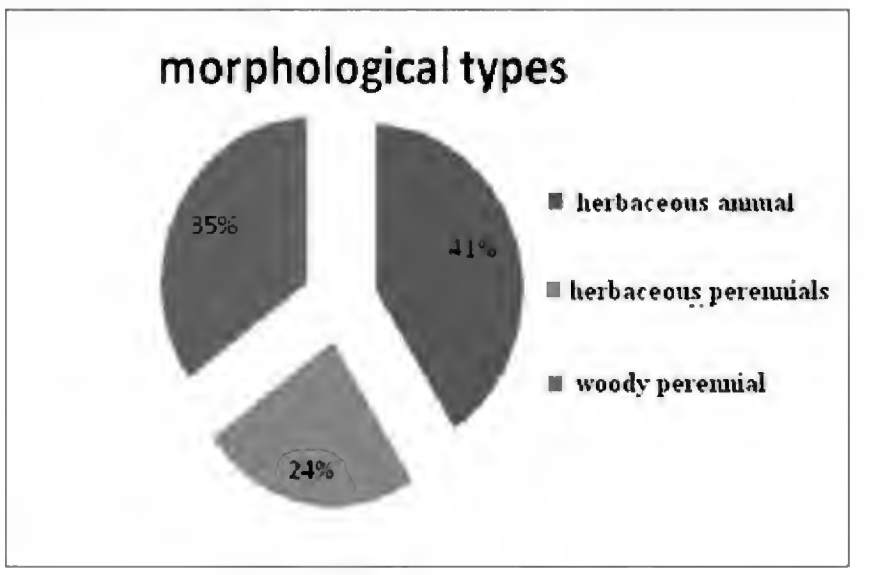

Figure 3. Morphological types of medicinal plants from the study area.

CONCLUSIONS

The therapeutic use of *R. officinalis* is analyzed.

Floristic cortege of Rosemary in the study area is marked by the dominance of Lamiaceae, Liliaceae and Apiaceae. Therophytes are dominant, reflecting a strong anthropic action.

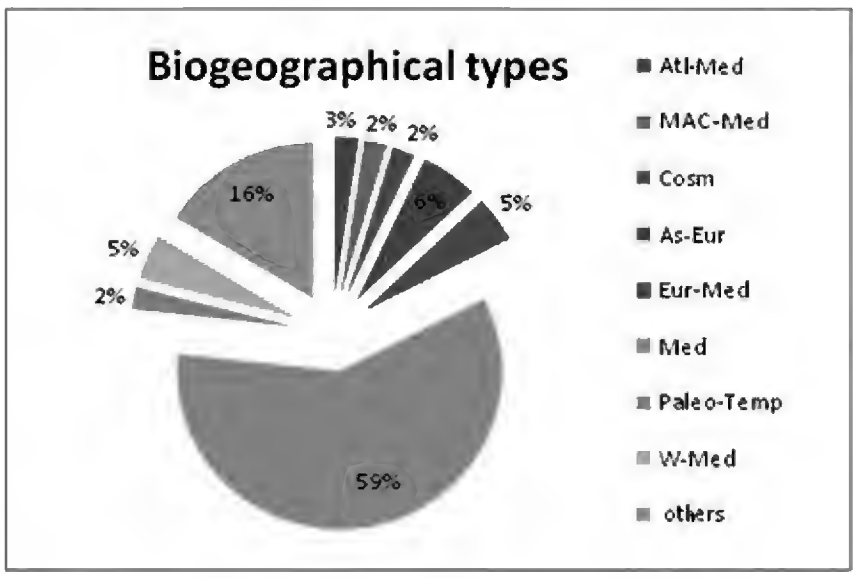

Figure 4. Biogeographic patterns of medicinal species from the study area.

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A new species of *Clytus* Laicharting, 1784 from Greece (Coleoptera Cerambycidae)

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ABSTRACT A new species of *Clytus* Laicharting, 1784 (Coleoptera Cerambycidae Cerambycinae Clytini) is described from Peloponnese, Greece. The new species is close to *Clytus tropicus* (Panzer, 1795) which is also reported as a new species for Italy.

KEY WORDS New species; Cerambycidae; *Clytus*; Greece.

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INTRODUCTION

Our colleagues and friends Mauro Malmusi (Modena, Italy), Lucio Saltini (Modena, Italy) and Massimiliano Trentini (Castelfranco Emilia, Modena, Italy) collected during the summer 2014 two specimens of a particular form of *Clytus* Laicharting, 1784 (Coleoptera Cerambycidae Cerambycinae Clytini) from Peloponnese (Greece). The same particular form of *Clytus* was collected by Ivo Jeniš, Oliver Ďulik (Nasobůrky, Czech Republic), Ivo Martinů (Olomouc, Czech Republic) from the same area.

These specimens are related to *Clytus tropicus* (Panzer, 1795) but they are easy to distinguish from many distinctive characters which we attribute to a new species that we describe below.

ACRONYMS. BBuC: Boris Bubenik collection, Frýdek Místek, Czech Republic. IJC: Ivo Jeniš collection, Náklo, Czech Republic. MMC: Mauro Malmusi collection, Modena, Italy. IMC: Ivo Martinů collection, Olomouc, Czech Republic. PRC: Pierpaolo Rapuzzi collection, Prepotto, Udine, Italy.

Clytus paradisiacus n. sp.
Figure 1

EXAMINED MATERIAL. Type material: Holotypus female, Greece: Arkadia, Paradisia, South of Megalopoli, 1-9.VI.2014, sugar traps, M. Malmusi, L. Saltini and M. Trentini legit (PCR); Paratypus 1 female, same data as holotypus (MMC); 1 female, Greece: Arkadia, Paradisia, South of Megalopoli, 13.VI.2004, I. Jeniš legit (IJC); 1 female, Greece: Arkadia, Dasochori, South of Megalopoli, ex larva, 5.V.2013, O. Ďulik legit (BBuC); 1 female, Greece: Arkadia, Vastas, South of Megalopoli, ex pupae, 14.V.2014, I. Martinů legit (IMC).

DESCRIPTION OF THE HOLOTYPE. Length 17 mm.; width 3 mm. Body black except for the base of elytra, antennae and part of the legs. Body with yellow stripes. Head deeply punctate. Frons square, with a middle small carina between eyes. Antennal tubercles prominent. Only few yellow hairs just around the eyes on frons. The whole surface of the head is densely and deeply punctate. Pronotum as long as wide; sides rounded, the largest portion just before the middle. Pronotum

deeply punctate with several dark erect setae denser on the sides. Pronotum with four yellow spots, two on the base and two on the apex. On the middle of pronotum, on external sides, there are two small depressions; sides rounded. Scutellum small, triangular and covered with yellow pubescence. Elytra long, the basal quarter with light brown integuments, the apical three quarters black. The yellow pattern is made by short and recumbent setae. The drawing consists of four yellow bands. The first one is an elongate spot on each elytra, briefly arched behind the shoulders. The second one is a complete "U" shaped band on each elytra. This band starts from the lateral margin and reaches the suture, the basal yellow spot is positioned inside the concavity made by this band. The third band is behind the middle of the elytra, transverse, slightly protracted towards the base. The fourth band is very small, only a thin spot before the apex on each elytra. Few semi-erect short setae in the light portion of the elytra; these setae are yellow and black. Apex rounded. Elytral punctuation very dense and relatively thin, density and size of the punctures similar on the whole elytral surface. Legs very long, especially the hind legs. All the legs are yellow, only the club of all femurs darker. Antennae short, not reaching the middle of elytra, yellow, darker towards the apex. Third antennal segment longer than fourth and next segments progressively shorter towards the apex.

VARIABILITY. The lenght of the paratypes females is between 16 and 18 mm.; the paratypes are completely missing the apical yellow spot; the clubs of femora are darker and the apex of antennae is slightly dark as well. Male unknown.

ETYMOLOGY. The name of the new species originates from the collecting locality of the specimens known (Paradisia, Arkadia, Greece).

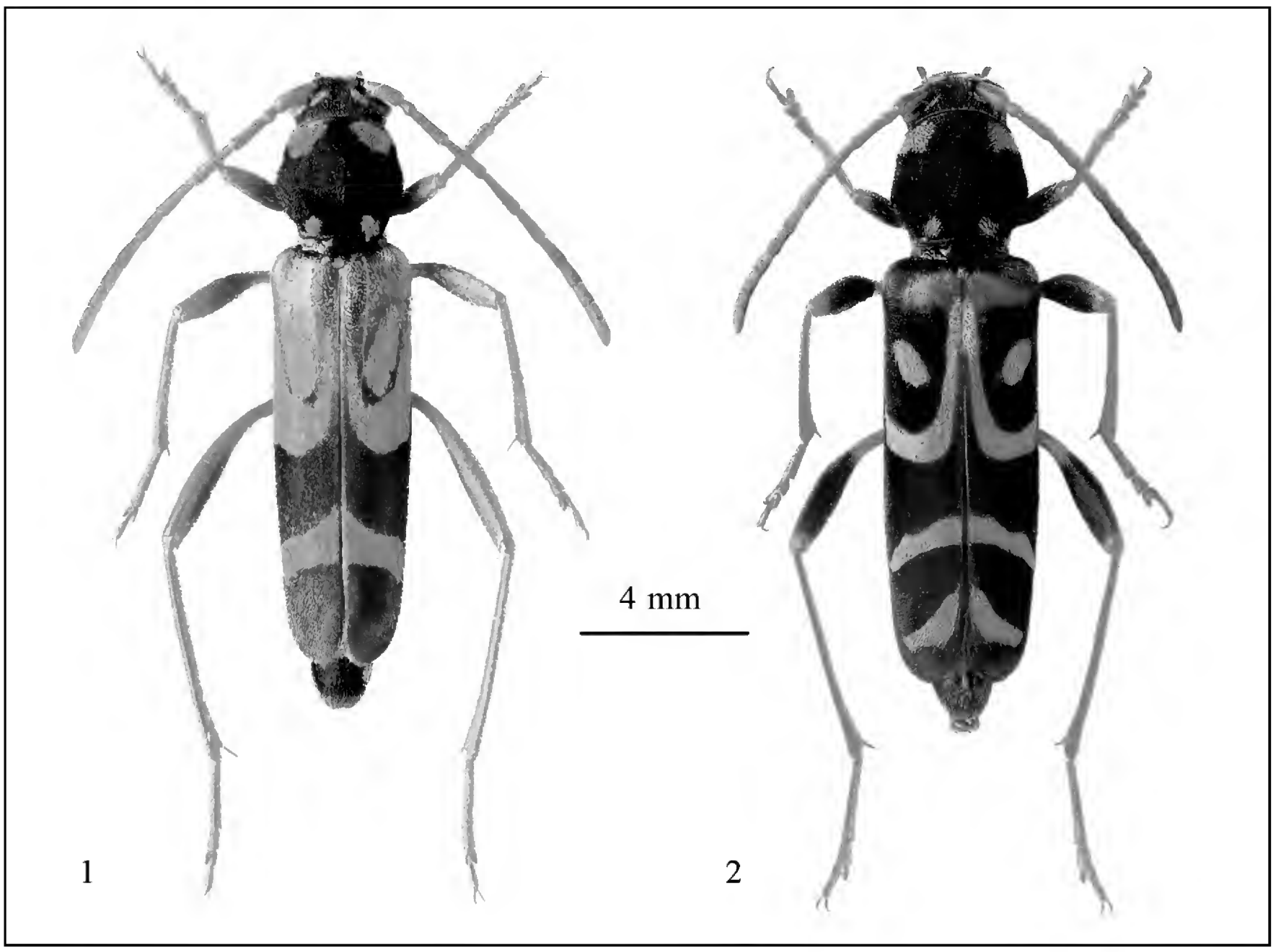

Figure 1. *Clytus paradisiacus* n. sp., paratypus female.
Figure 2. *Clytus tropicus* (Panzer, 1795), female (Czech, Republic).

DISTRIBUTION AND BIOLOGY. The new species is, at moment, known only of the collected locality in Greece, Peloponnese.

The specimens of *C. paradisiacus* n. sp. were reared from dead branches of *Quercus pubescens* Willd. (BBuC and IMC).

REMARKS. *Clytus paradisiacus* n. sp. is related to *Clytus tropicus* (Panzer, 1795) (Fig. 2) but is easy to distinguish by the third antennal segment that is clearly longer than fourth, equal in *C. tropicus*. The pattern is different and helps for the identification of the new species. The first fourth of elytral length is light brown, completely black or at the most only a narrow portion of the base is brown in *C. tropicus*. The yellow spot on each elytra is longer and more oblique in the new species than in *C. tropicus*. The first arched band is "U" shaped in *C. paradisiacus* n. sp. instead of "J" shaped in *C. tropicus*. The post-median band is less arched and wider than in *C. tropicus* where it very often connects with the pre-apical transverse band. The latter is completely missing or at least remains only a small spot in the new species. Antennal tubercles are more prominent and acute in the new species.

Clytus tropicus is known from Middle Europe and South East Europe from the Balkan Peninsula to Bulgaria and Southern Russia (Löbl & Smetana, 2010). Recentely it was discovered in Italy as well (Lazio, Roma province, Bosco di Manziana, VI.2014, D. Patacchiola legit (Rome, Italy); it is a new record for Italy (Sama, 2005).

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