

The subgenus *Monotarsobius* in the Iberian Peninsula with a description of a new pseudo-cryptic species from Northern Spain revealed by an integrative revision of *Lithobius crassipes* L. Koch, 1862 (Chilopoda, Lithobiomorpha, Lithobiidae)

Karin Voigtländer¹, Etienne Iorio², Peter Decker¹, Jörg Spelda³

1 Senckenberg Museum of Natural History Görlitz, Am Museum 1, 02826 Görlitz, Germany **2** Groupe d'Étude des Invertébrés Armoricaains, 5 rue du Général Leclerc, 44390 Nort-sur-Erdre, France **3** Bavarian State Collection of Zoology, Münchhausenstraße 21, 81247 Munich, Germany

Corresponding author: Karin Voigtländer (karin.voigtlaender@senckenberg.de)

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Abstract

The widespread European centipede species *Lithobius* (*Monotarsobius*) *crassipes* L. Koch, 1862 was revised using an integrative approach incorporating sequence data and morphology. The partial mitochondrial cytochrome *c* oxidase subunit I (COI) barcoding gene was amplified and sequenced for 21 individuals from northern Spain, France and Germany as well as for individuals of three other species of the subgenus *Monotarsobius* Verhoeff, 1905. The dataset was used for molecular phylogenetic analysis and genetic distance determination. In addition, *Monotarsobius* specimens from more than 100 localities in northern Spain, France, and Germany were morphologically investigated. Both morphological and molecular data indicate that specimens from the Navarre and Gipuzkoa provinces, northern Spain, represent a distinct pseudo-cryptic species, only differing in some minor characters from *L. crassipes*. The new species *L. (Monotarsobius) crassipesoides* **sp. n.** is described and compared to *L. crassipes* in detail using morphology and morphometric statistics for body, head, and antennae length, number of ocelli and coxal pores, as well as the starting leg for legpair spines Vmt and DaP. The Iberian and European records of *L. crassipes* are discussed. The subspecies *L. crassipes morenoi* Garcia Ruiz, 2014 from Southern Spain is elevated to species as *L. morenoi* **stat. n.** A checklist, distribution map and key to all five species of *Monotarsobius* of the Iberian Peninsula are presented.

Keywords

COI, taxonomy, new species, pseudo-cryptic diversity, key, checklist

Introduction

Currently 53 species and seven subspecies of the genus *Lithobius* Leach, 1814 are known from the Iberian Peninsula (Salinas 1990, Garcia Ruiz 2015, Iorio 2016, Iorio unpublished), of which 24 species and six subspecies are endemic to the region, which comprises continental Spain and Portugal. Of the 60 species-level taxa of Iberian *Lithobius* 48 species and six subspecies are in subgenus *Lithobius*, with four taxa in *Monotarsobius* Verhoeff, 1905 and two in subgenus *Sigibius* Chamberlin, 1913. *Monotarsobius* currently comprises the species *L. crassipes* L. Koch, 1862 and three other taxa endemic to Spain: *L. blascoi* Eason, 1991, *L. crassipes morenoi* Garcia Ruiz & Baena, 2014, and *L. osellai* Matic, 1968. This subgenus was reviewed by Serra (1982) for Iberia, together with a species from the Canary Islands and two species assigned to *Sigibius*. Beside the very few records of *L. blascoi*, *L. osellai* and *L. c. morenoi*, most *Monotarsobius* records are of *L. crassipes* (Meinert 1872, Attems 1952, Barace and Herrera 1980, Serra 1980, 1982).

Following a field trip to Navarre province in northern Spain in 2009 (see Material and methods), we noted that specimens of *L. crassipes* from the area differed slightly in morphology from other European *L. crassipes*. Fresh and museum material of *L. crassipes* from several localities in northern Spain, France and Germany was then studied in order to clearly delimit the new Spanish *L. crassipes*-like species, with integrated use of phylogenetic data, classical morphology and morphometric statistics. Here we also elevate *L. crassipes morenoi* to full species status and present an annotated list and updated key to species of *Monotarsobius* on the Iberian Peninsula. Finally, the implications on species distribution of *L. crassipes* on the Iberian Peninsula as well as in other parts of Europe are discussed.

Material and methods

Specimen collecting and preservation. Material of *Lithobius crassipesoides* sp. n. was hand-collected during a collecting trip in Navarre province (Spain) in 2009. Participants and collectors (collectively referred to as FT2009) were Karin Voigtländer, Hans Reip, Norman Lindner, Desmond Kime, Helen Read, Henrik Enghoff, Paul Richards, Steve Gregory, and Per Djursvoll.

Additional material (in ethanol or mounted at slides) was borrowed from the Museum of Zoology of the University of Navarra (MZNA).

Material of *Lithobius crassipes* from various regions in Germany in the Senckenberg Museum of Natural History Görlitz (SMNG) was also investigated, both old material and from recent collections by N. Lindner. The studied French *L. crassipes* were collected from various regions in France and are partly kept in the private collection of E. Iorio, a minor part being also kept in the Groupe d'Étude des Invertébrés Armoricaains

(GRETIA) collection in Nort-sur-Erdre, France. The French specimens used for DNA extraction came from the forest of the Gâvre (collected by E. Iorio), in the municipality of Le Gâvre in Loire-Atlantique department and are kept in the SMNG collection. All material is preserved in 70 % or 96 % ethanol (DNA vouchers) respectively. During the German Barcoding of Life project Myriapoda (Decker et al. 2017, Wesener et al. 2015, 2016) 22 specimens were collected for sequencing from various localities in Germany, but also from eastern France, Austria and Wales. The vouchers are deposited in the Zoologische Staatssammlung München (ZSM).

Sixty-four specimens of *L. crassipesoides* sp. n. from Spain were morphologically studied. For *L. crassipes* 55 specimens from 36 localities in Germany and 131 specimens from 60 localities in France were studied (see supplementary Table 1 for localities and collection numbers). Only adult specimens were used for morphological characters. Characters mentioned in the description of *L. crassipesoides* sp. n. are very similar or like in *L. crassipes*, unless stated otherwise. All specimens for molecular study were investigated for morphology prior to DNA extraction.

Illustrations. For scanning electron micrographs (SEM), samples were dehydrated through an ethanol series, dried in a desiccator overnight, and mounted on aluminum stubs before being sputter coated with gold-palladium. SEM images were taken using a JEOL JSM-6510LV microscope, and samples were removed from stubs and returned to alcohol upon examination.

Preserved specimens were imaged with a Leica M165 C or Leica DM5500B stereo microscope and DFC295 camera. Focus-stacked images were assembled from 10–25 source images using the software package Leica V4.5. All images of the z-stacks are available online at VIRMISCO (www.virmisco.org, Christian et al. 2017).

All figures were later edited using Adobe Photoshop CS4. Maps were created with ArcGIS 10.

DNA extraction and molecular analysis. At the SMNG, DNA was extracted from 2–4 legs each of six specimens of *L. crassipesoides* sp. n., three specimens of *L. crassipes* and one specimen of *L. forficatus* (Linnaeus, 1758) (Table 1). Total genomic DNA was extracted using the Qiagen DNAeasy Blood & Tissue kit following the standard protocol except that tissue was incubated for 48 h. All specimens were later deposited in the collections of the SMNG.

Polymerase chain reaction (PCR) was used for amplifying the COI barcode fragment using the primer pair LCO1490 and HCO2198 (Folmer et al. 1994). The following thermocycling profile was used to amplify fragments of COI: predenaturation at 95° C for 1 min, 35 cycles of 40 s at 94° C, 40 s at 51° C, and 1 min at 72° C, final extension step for 5 min at 72° C. All PCR mixes had a total volume of 10 µL and contained 1 µL template, 0.1 mM of each primer, 4 × 0.15mM dNTPs [Peqlab], 1 × PCR Buffer containing 2 mM MgCl₂ [Peqlab], and 0.2u Polymerase [Peqlab]. All fragments were sequenced in both directions by Biodiversity and Climate Laboratory Centre, Frankfurt, Germany.

As part of the GBOL project at ZSM, 11 specimens of *L. crassipes*, five specimens of *L. curtipes* C. L. Koch, 1847, and six *L. austriacus* (Verhoeff, 1937) were extracted

Table 1. Species, localities, GenBank accession numbers, and repository accession numbers for all specimens analyzed.

Species	Locality	GenBank Acc. No.	Voucher
Ingroup			
<i>L. crassipesoides</i> sp. n.	Spain, Navarra, Leitza, between area „Ustarleku“ and „Karobieta“	MF123704	SMNG VNR017128-8
<i>L. crassipesoides</i> sp. n.	Spain, Navarra, Leitza, between area „Ustarleku“ and „Karobieta“	MF123705	SMNG VNR017129-3
<i>L. crassipesoides</i> sp. n.	Spain, Navarra, Leitza, near road NA 4150	MF123706	SMNG VNR017131-3
<i>L. crassipesoides</i> sp. n.	Spain, Spain, Navarra, Leitza, near road NA 4150	MF123707	SMNG VNR017131-4
<i>L. crassipesoides</i> sp. n.	Spain, Navarra, Sierra de Aralar, S Errazkin	MF123708	SMNG VNR017135-4
<i>L. crassipesoides</i> sp. n.	Spain, Gipuzkoa, Onati, Aizkorri-Aratz	MF123709	SMNG VNR017139-5
<i>L. crassipes</i>	Germany, Baden-Württemberg, Bad Urach	KX458777	GBOL14972
<i>L. crassipes</i>	Germany, Bavaria, Höllental	MF123703	SMNG VNR17287-1
<i>L. crassipes</i>	Germany, Bavaria, Kelheim	JQ350449	BCZSMMYR00443
<i>L. crassipes</i>	Germany, Bavaria, Klausenhöhle	KX458796	GBOL11199
<i>L. crassipes</i>	Germany, Bavaria, Poppendorf	KX458752	GBOL12250
<i>L. crassipes</i>	Germany, Bavaria, Eichstätt	KX458625	GBOL14992
<i>L. crassipes</i>	Germany, Hesse, Göttingen	JQ801572.1	
<i>L. crassipes</i>	Germany, Lower Saxony, Soltau	KX458601	GBOL11898
<i>L. crassipes</i>	Germany, Saxony-Anhalt, Bollenkopf	MF123701	SMNG VNR17291-1
<i>L. crassipes</i>	Germany, Schleswig-Holstein, Bad Segeberg	KX458716	GBOL12308
<i>L. crassipes</i>	France, Haut-Rhin, Sewen	KX458631	GBOL11870
<i>L. crassipes</i>	France, Haut-Rhin, Thann	KX458674	GBOL11887
<i>L. crassipes</i>	France, Moselle, Ballon d'Alsace	KX458683	GBOL11895
<i>L. crassipes</i>	France, Loire-Atlantique, Le Gâvre	MF123710	SMNG VNR17281-1
<i>L. crassipes</i>	Great Britain, Wales, Newbridge	KX458753	GBOL11881
<i>L. curtipes</i>	Germany, Bavaria, Neuschönau	KX458647	GBOL12396
<i>L. curtipes</i>	Germany, Bavaria, Hengersdorf	KX458722	GBOL14991
<i>L. curtipes</i>	Germany, Saxony-Anhalt, Elbingerode	KX458653	GBOL11899
<i>L. curtipes</i>	Germany, Saxony-Anhalt, Elbingerode	KX458595	GBOL11875
<i>L. curtipes</i>	Great Britain, Wales, Groesfaen Woods	KX458652	GBOL11815
<i>L. austriacus</i>	Germany, Bavaria, Grafenau	KX458587	GBOL11194
<i>L. austriacus</i>	Germany, Bavaria, Grafenau	KX458687	GBOL14980
<i>L. austriacus</i>	Germany, Bavaria, Karlsfeld	KX458792	GBOL11829
<i>L. austriacus</i>	Germany, Bavaria, Spiegelau	KX458633	GBOL12311
<i>L. austriacus</i>	Germany, Saxony, Oybin	KX458666	GBOL12326
<i>L. austriacus</i>	Austria, Upper Austria, Sankt Wolfgang	JQ350447	BCZSMMYR00442
<i>L. forficatus</i>	Germany, Mecklenburg-Western Pomerania, Rügen	MF123702	SMNG VNR17150-2
Outgroup			
<i>E. cavernicolus</i>	Croatia	KF715050.1	CHP-416
<i>C. parisi</i>	Germany	KU497164.1	GBOL02712
<i>S. linearis</i>	Germany	KM491663.1	ZFMK-TIS-15771

and sequenced by the Canadian Centre for DNA Barcoding (CCDB, Guelph, Canada) using standardized, high-throughput DNA extraction, PCR amplification and bidirectional Sanger sequencing (<http://www.ccdb.ca/resources.php>). For PCR and sequencing, a primer cocktail (Hebert et al. 2004) was used. See also Wesener et al. (2015) and Wesener et al. (2016).

All 32 new sequences were deposited in GenBank (see Table 1 for accession numbers).

Alignment and phylogenetic analysis. All obtained sequences were checked via Blast searches (Altschul et al. 1997); no contaminations were discovered. The sequences were aligned by hand in ClustalX ver. 1.83 (Chenna et al. 2003). One sequence for *L. crassipes* (Eitzinger et al. 2013) was downloaded from GenBank. As outgroups sequences *Eupolybothrus cavernicolus* Komerički & Stoev, 2013 (Stoev et al. 2013), *Stenotaenia linearis* (C.L. Koch, 1835) (Wesener et al. 2015) and *Cryptops parisi* Brölemann, 1920 (Wesener et al. 2016) were downloaded from GenBank (see Table 1 for accession numbers). The final dataset for the phylogenetic analysis included 26 sequences and the alignments consisted of 657 bp (COI mtDNA). To find the best substitution model, Modeltest as implemented in MEGA 7 (Kumar et al. 2016) was utilised. The lowest Bayesian Information Criterion score (BIC) was obtained for the Tamura–Nei model plus gamma distribution with indifferent sites (Tamura and Nei 1993) (BIC 11667.16). Maximum likelihood analyses were conducted in MEGA7 (Kumar et al. 2016). The tree with the highest log-likelihood (−5445.7387) is shown. Initial tree(s) for the heuristic search were obtained by applying the neighbour-joining method to a matrix of pairwise distances estimated using the maximum composite likelihood approach. A discrete gamma distribution was used to model evolutionary rate differences among sites (five categories (+G, parameter = 1.0671)). The tree (Fig. 1) is drawn to scale, with branch lengths measured in the number of substitutions per site. The bootstrap consensus tree inferred from 1000 replicates (Felsenstein 1985) is here used as the best estimate of the phylogeny of the analysed taxa (Fig. 1). The final trees were edited using Adobe Illustrator CS4. Mean uncorrected pairwise distances between terminals (transformed into percentages) were determined using MEGA7 (Kumar et al. 2016).

Statistical analysis. The software package PAST version 3.14 (Hammer et al. 2001) was used for analysis.

Box and jitter plots: For each sample, the 25–75 percent quartiles are drawn using a box. The median is shown with a horizontal line inside the box. The minimal and maximal values are shown with short horizontal lines (“whiskers”). Each value is plotted as a dot. To show overlapping points more clearly, they have been displaced using a random “jitter” value controlled by a slider.

Usually nonparametric statistics have been used, while parametric statistics have been restricted to interval data. Prior to the parametric t-test normality was tested using three statistical tests for normal distribution: The Shapiro-Wilk test (Shapiro and Wilk 1965), the Jarque-Bera-Test (Jarque and Bera 1987) and the Anderson-Darling-Test with significance estimated according to Stephens (1986). For the Jarque-Bera-Test and Anderson-Darling-Test also a significance test has been included based on

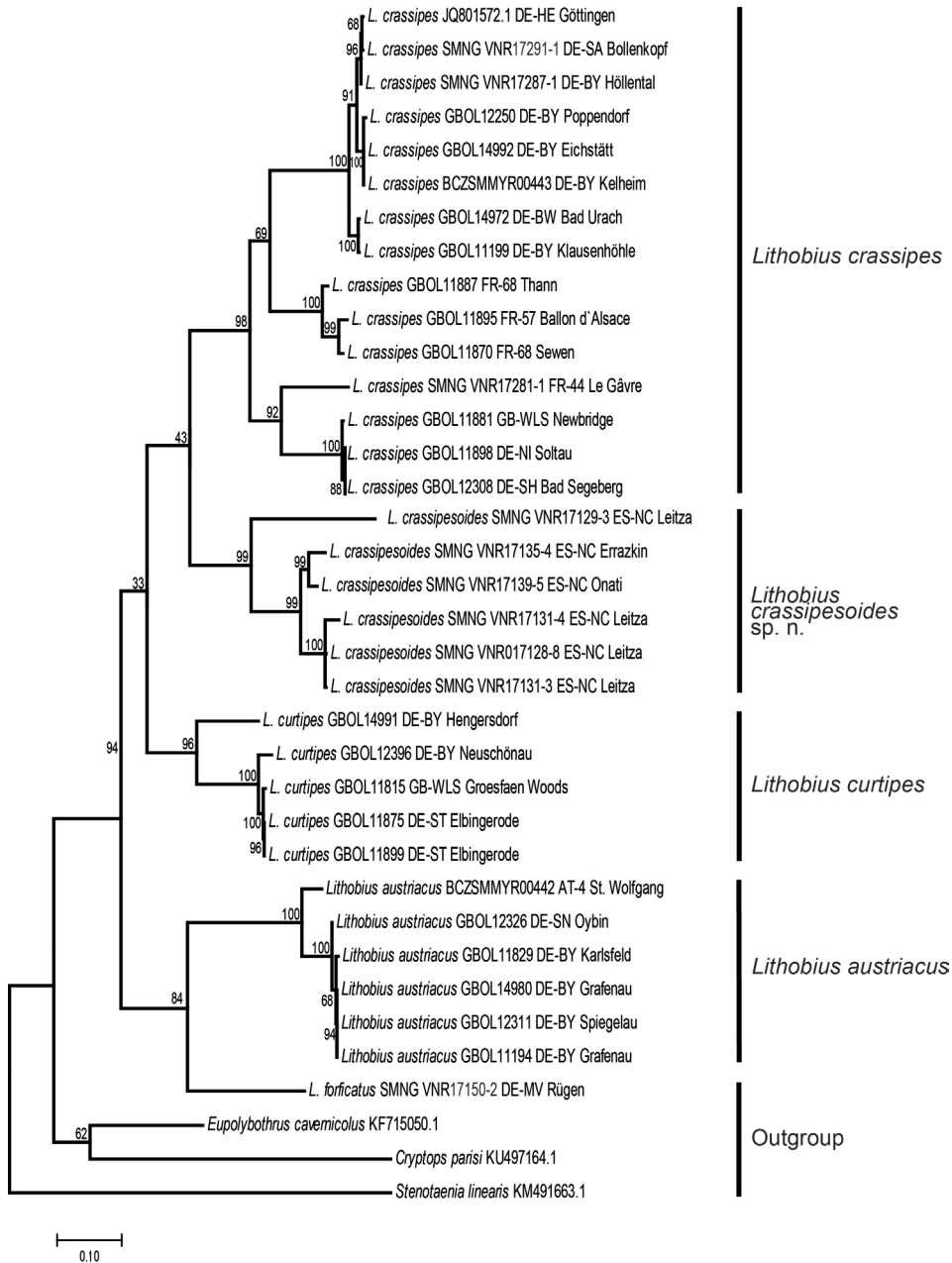


Figure 1. Results of the mitochondrial cytochrome c oxidase I (COI) analysis. Maximum likelihood tree, 1000 bootstrap replicates. Scale bar = substitutions per site.

Monte Carlo simulation, with 10,000 random values taken from a normal distribution has been included. If one of these normality tests rejected the null hypothesis of equal distribution only non-parametric statistics were used for the following tests.

In the xy graph of the canonical variate analysis (Figs 9–11) 95 % concentration ellipses have been plotted. Their calculation assumed normal distribution for the values of the discriminant factors. They estimate a region where 95 % of population points are expected to fall, i.e. they are not confidence regions for the mean.

The following characters have only been investigated in *L. crassipesoides* sp. n. from Spain and *L. crassipes* from Germany: the head length, the number of coxal pores on legpair 12–15 and the start of the ventral median spine on the trochanter.

Terminology. The terminology of external morphology follows Bonato et al. (2010).

The coloration as seen in alcohol material under a stereo microscope follows the colour terminology of Köhler (2012).

The following abbreviations are used in the text and figures:

SMNG	Senckenberg Museum of Natural History
ZSM	Zoologische Staatssammlung München
MZNA	Museum of Zoology of the University of Navarra
FT2009	participants in the Navarre field trip in 2009
AL	antennae length
BL	body length
HL	head length
LP	legpair
C	coxa
P	prefemur
F	femur
T	tibia
t	trochanter
Ts	tarsus
a	anterior spine
m	median spine
p	posterior spine
V	ventral
D	dorsal

Results

Molecular analysis

The monophyly of both *Lithobius crassipesoides* sp. n. and *L. crassipes* is well supported with bootstrap values of 99 and 98 respectively (Fig. 1), as well as *L. curtipes* (96) and *L. austriacus* (99). A sister clade of *L. crassipesoides* sp. n. and *L. crassipes* is not supported (43), while all other groupings within the two species are well supported (Fig. 1). Intraspecific uncorrected p-distances range up to 16.8 % within *L. crassipesoides* sp. n., 16.3 % in *L. crassipes*, 12.6 % in *L. curtipes*, and 6.7 % in *L. austriacus*. Interspecific

Table 2. Body length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France).

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>					
	Spain			France			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	62	69	131	27	25	52
Min	6.94	6.39	6.39	8.30	7.90	7.90	9.40	7.62	7.62
Max	11.02	10.74	11.02	13.20	13.10	13.20	12.40	12.10	12.40
Median	8.47	8.02	8.43	9.80	9.90	9.90	10.60	9.93	10.20
Mean	8.68	8.18	8.42	9.92	10.15	10.05	10.63	10.11	10.38
Stand. dev	1.04	1.04	1.06	1.06	1.31	1.20	0.90	1.12	1.04

Table 3. Normality test for body length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France). The p values below 0.05 are marked with bold letters.

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>					
	Spain			France			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	62	69	131	27	25	52
Shapiro-Wilk W									
p(normal)	0.387	0.729	0.690	0.015	0.015	0.000	0.089	0.467	0.416
Anderson-Darling A									
p(normal)	0.251	0.740	0.671	0.157	0.021	0.002	0.165	0.313	0.274
p(MCarlo)	0.261	0.761	0.687	0.165	0.020	0.002	0.167	0.319	0.289
Jarque-Bera JB									
p(normal)	0.794	0.718	0.637	0.019	0.146	0.010	0.405	0.796	0.897
p(MCarlo)	0.759	0.637	0.559	0.023	0.086	0.018	0.188	0.754	0.888

p-distances between *L. crassipesoides* sp. n. and *L. crassipes* range between 16.1 % and 21.2 %. Lowest interspecific distances between the other analysed *Monotarsobius* species are between *L. crassipes* and *L. curtipes* (16.6 %) and highest between *L. crassipes* and *L. crassipesoides* sp. n. (21.2 %). Uncorrected p-distances to the outgroup ranges from 18.3 % to 28.3 %.

Statistics of body length. A comparison of jitter box plots shows that the specimens of *L. crassipesoides* sp. n. from Spain are usually smaller than those of *L. crassipes* (Fig. 2). The basic descriptive statistic parameters are given in Table 2.

The performed tests for normality (Table 3) showed significant differences from a normal distribution within the specimens from France, while there had been no significant deviation between the two sexes in the specimens from Spain and Germany. Based on the significance of the French samples it seemed to be wise to use non-parametric tests solely.

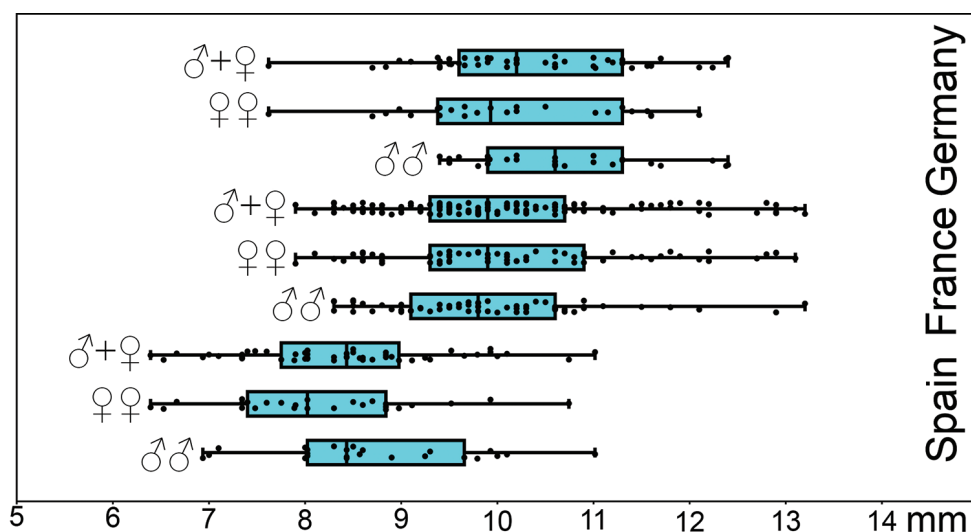


Figure 2. Body length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France).

Using the Mann-Whitney-U-Test for mean, no significant differences in body length have been found between males and females of *L. crassipesoides* sp. n. from Spain ($p=0.108$) and between *L. crassipes* from France (0.433) and Germany ($p=0.067$). Therefore, it was justified to pool the samples. These pooled samples showed, that specimens of *L. crassipesoides* sp. n. are significantly shorter than specimens of *L. crassipes* from France ($p<0.001$) and Germany ($p<0.001$), while the two samples of *L. crassipes* do not significantly differ ($p=0.081$).

Statistics of head length

A comparison of jitter box plots shows, that the specimens of *L. crassipesoides* sp. n. from Spain usually have shorter heads than those of *L. crassipes* from Germany (Fig. 3). The basic descriptive statistic parameters are given in Table 4.

The performed tests for normality (Table 5) showed significant differences from a normal distribution within the specimens from Germany in the Shapiro-Wilk W and Anderson-Darling A tests, while there had been no significant deviation between the two sexes in the specimens from Spain. Based on the significance of the German samples it seemed to be wise to use non-parametric tests solely.

Using the Mann-Whitney-U-Test, no significant differences in head length have been found between males and females of *L. crassipesoides* sp. n. ($p=0.105$) and *L. crassipes* from Germany (0.655). The pooled samples show that head length was significantly shorter in specimens of *L. crassipesoides* sp. n. than in specimens of *L. crassipes* from Germany ($p<0.001$).

Table 4. Basic statistics of head length (in mm) in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany).

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>		
	Spain			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	25	27	52
Min	0.72	0.6	0.6	0.8	0.8	0.8
Max	1.08	1.08	1.08	1.08	1.12	1.12
Median	0.86	0.8	0.84	0.92	0.9	0.92
Mean	0.85	0.81	0.83	0.93	0.92	0.92
Stand. dev	0.09	0.11	0.10	0.07	0.09	0.08

Table 5. Normality test for head length (in mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany). The p values below 0.05 are marked with bold letters.

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>		
	Spain			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	27	25	52
Shapiro-Wilk W						
p(normal)	0.105	0.572	0.241	0.040	0.022	0.002
Anderson-Darling A						
p(normal)	0.080	0.314	0.101	0.016	0.037	0.001
p(MCarlo)	0.076	0.316	0.100	0.015	0.035	0.001
Jarque-Bera JB						
p(normal)	0.585	0.705	0.675	0.563	0.236	0.130
p(MCarlo)	0.406	0.625	0.616	0.380	0.089	0.068

Statistics of antennae length. A comparison of jitter box plots shows, that the antennae of the specimens of *L. crassipesoides* sp. n. from Spain are usually smaller than those of *L. crassipes* (Fig. 4). The basic descriptive statistic parameters are given in Table 6.

The performed tests for normality (Table 7) showed low significant differences (p between 0.05 and 0.01) from a normal distribution only within pooled specimens from France and Spain, while there had been no significant deviation between the two sexes in the specimens from all countries and the pooled specimens from Germany. Based on the low significance of the French and Spanish samples it seemed to be wise to use non-parametric tests solely.

Using the Mann-Whitney-U-Test, only low significant differences in antennal length have been found between males and females of *L. crassipesoides* sp. n. from Spain (p=0.046) but not between *L. crassipes* from France (0.655) and Germany (p=0.555). The very low significance in specimens of *L. crassipesoides* sp. n. solely is interpreted

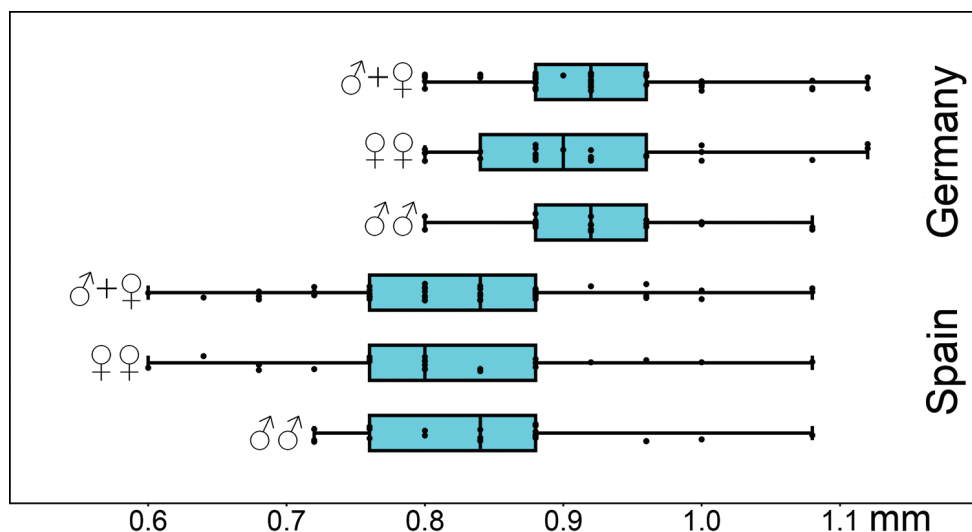


Figure 3. Head length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany).

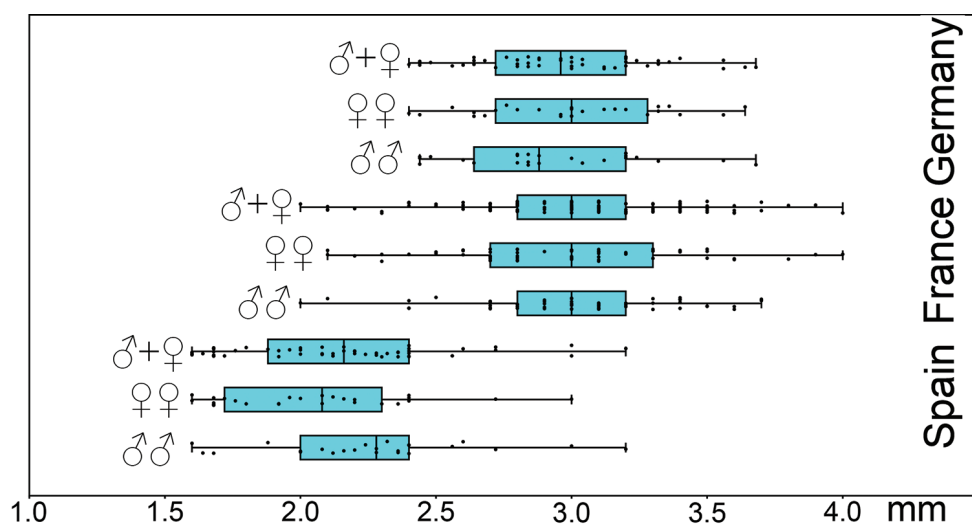


Figure 4. Antennae length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France).

as a stochastic effect and as there are no sex-specific differences in both of the *L. crassipes* samples they are pooled for comparison of the two species. These pooled samples showed that the antennae of specimens of *L. crassipesoides* sp. n. are significantly shorter than in specimens of *L. crassipes* from France ($p < 0.001$) and Germany ($p < 0.001$, while the two samples of *L. crassipes* do not significantly differ ($p = 0.632$).

Table 6. Antennae length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France).

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>					
	Spain			France			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	59	59	118	25	27	52
Min	1.60	1.60	1.60	2.00	2.10	2.00	2.44	2.40	2.40
Max	3.20	3.00	3.20	3.70	4.00	4.00	3.68	3.64	3.68
Median	2.28	2.04	2.16	3.00	3.00	3.00	2.88	3.00	2.98
Mean	2.27	2.05	2.16	3.01	2.98	3.00	2.94	2.99	2.97
Stand. dev	0.39	0.36	0.38	0.36	0.42	0.39	0.34	0.33	0.33

Table 7. Normality test for antennal length (mm) of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France). The p values below 0.05 are marked with bold letters.

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>					
	Spain			France			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	62	69	131	27	25	52
Shapiro-Wilk W									
p(normal)	0.486	0.079	0.034	0.083	0.700	0.195	0.307	0.869	0.327
Anderson-Darling A									
p(normal)	0.421	0.200	0.119	0.053	0.538	0.043	0.369	0.891	0.621
p(MCarlo)	0.424	0.203	0.116	0.054	0.554	0.042	0.378	0.896	0.645
Jarque-Bera JB									
p(normal)	0.726	0.299	0.291	0.253	0.932	0.804	0.739	0.737	0.569
p(MCarlo)	0.645	0.113	0.156	0.132	0.931	0.785	0.668	0.677	0.466

Statistics of number of ocelli. The number of ocelli was counted on each side of the head separately. For statistical evaluation, the average of the two sides has been used, as the separate measures are not independent samples (Lamprecht 1992). This approach also allows using ocelli numbers from a single side if the other was not countable.

A comparison of jitter box plots shows that the specimens of *L. crassipesoides* sp. n. from Spain usually have a lower number of ocelli than specimens of *L. crassipes* from France and Germany (Fig. 5). The basic descriptive statistic parameters are given in Table 8.

Using the Mann-Whitney-U-Test, no significant differences in the number of ocelli have been found between males and females of *L. crassipesoides* sp. n. from Spain (p=0.063) and *L. crassipes* from France (0.438) and Germany (p=0.074). The pooled samples show that the number of ocelli in specimens of *L. crassipesoides* sp. n. is significantly lower than in specimens of *L. crassipes* from France (p<0.001) and Germany (p<0.001, while the two samples of *L. crassipes* do not significantly differ (p=0.293).

Statistics of number of coxal pores. A comparison of jitter box plots shows that specimens of *L. crassipesoides* sp. n. usually have a lower number of coxal pores on leg-

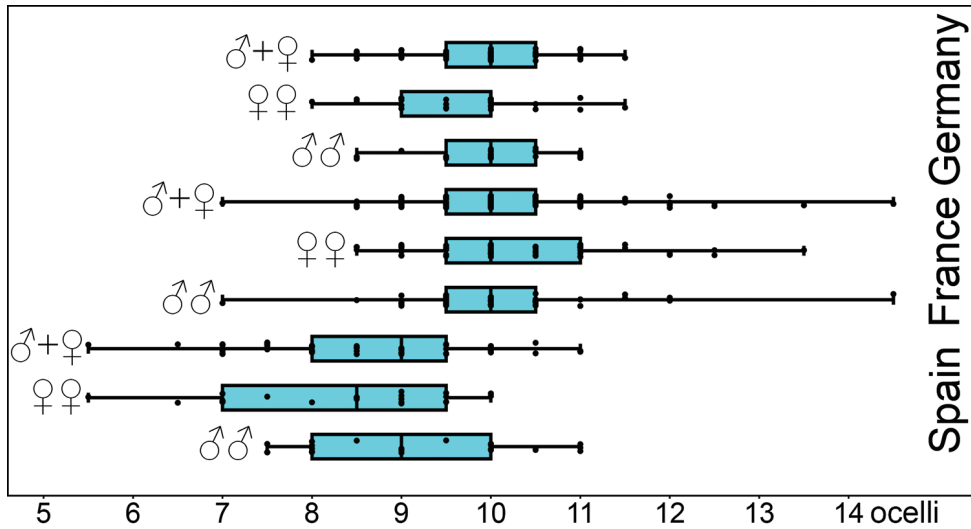


Figure 5. Number of ocelli in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France).

Table 8. Number of ocelli of males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France).

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>					
	Spain			France			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	23	24	47	59	66	125	25	27	52
Min	7.5	5.5	5.5	7	8.5	7	8.5	8	8
Max	11	10	11	14.5	13.5	14.5	11	11.5	11.5
Median	9	8.5	9	10	10	10	10	10	10
Mean	9.1	8.3	8.7	10.1	10.2	10.1	10.1	9.7	9.9
Stand. dev	1.2	1.2	1.3	1.0	1.0	1.0	0.7	0.8	0.8

pair 12 to 15 and that females usually have a higher number of coxal pores on them (Fig. 6). The basic descriptive statistic parameters are given in Table 9.

In Table 10 the differences in coxal pore numbers between males and females as well as between the different species have been tested using the Mann-Whitney-U-Test. This test showed that females usually have a higher number of coxal pores than males. This had been more obvious in specimens of *L. crassipes* from Germany (significant p values in all legs) and also more obvious on the coxopleura of legpair 14 and 15 (significant p values in both species). Therefore, comparisons have to be made sex specific. These sex specific tests showed significant differences in the number of coxal pores on legpair 15 solely in males, while in females it was exactly legpair 15 that showed no significant p value. Pooled samples showed significant p values for coxal pore numbers in all legs, but this comparison is of doubtful value as it represents an average of the sex specific differences.

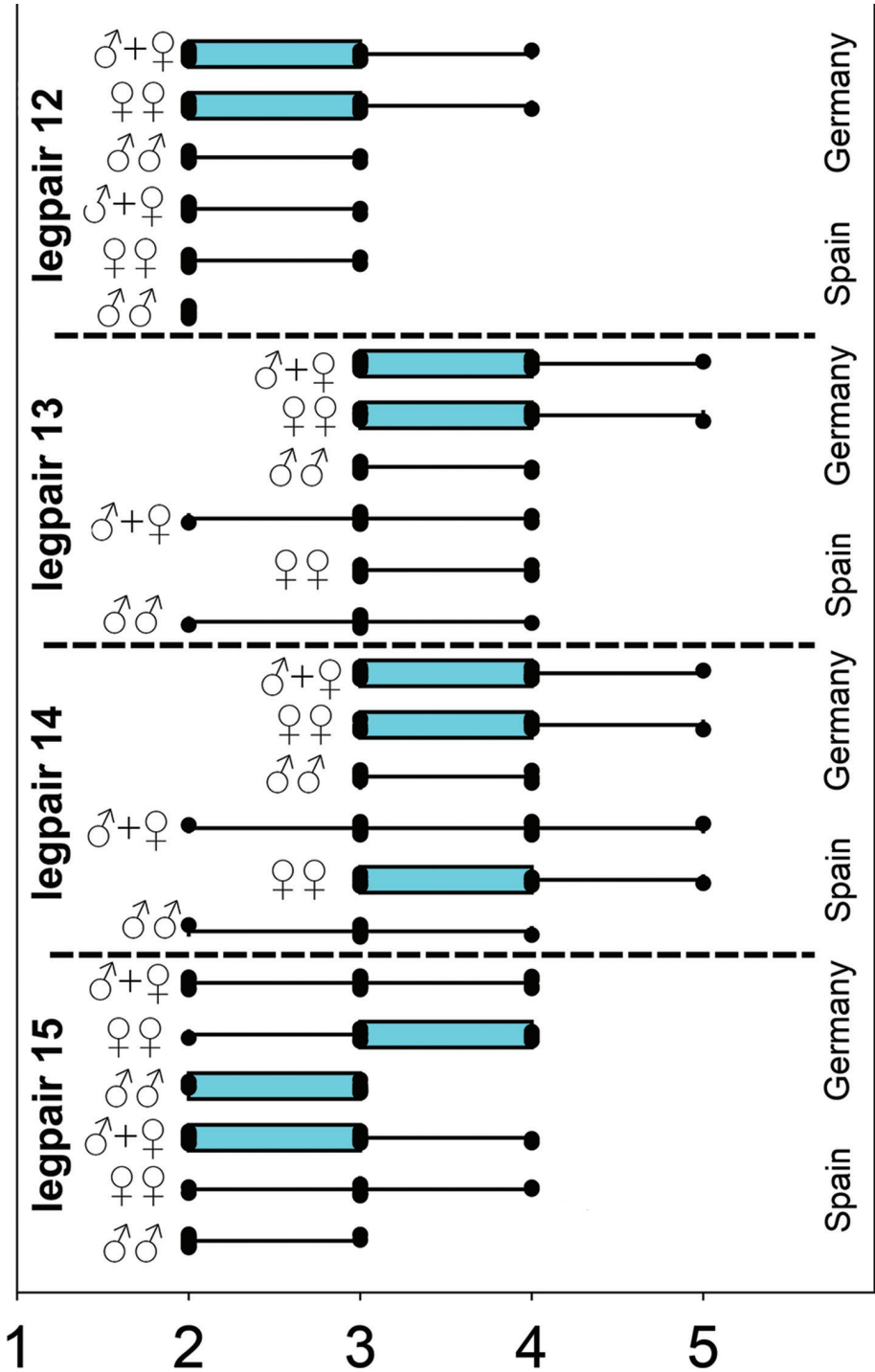


Figure 6. Number of coxal pores on legpair 12–15 in males and females of *Lithobius crassipes* sp. n. (Spain) and *L. crassipes* (Germany).

Table 9. Basic statistics of number of coxal pores on legpair 12–15 in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany).

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>		
	Spain			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
	legpair 12					
N	24	26	50	25	27	52
Min	2	2	2	2	2	2
Max	2	3	3	3	4	4
Median	2	2	2	2	2	2
Mean	2.00	2.08	2.04	2.12	2.41	2.27
Stand. dev	0.00	0.27	0.20	0.33	0.57	0.49
	legpair 13					
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	25	27	52
Min	2	3	2	3	3	3
Max	4	4	4	4	5	5
Median	3	3	3	3	3	3
Mean	3.00	3.12	3.06	3.08	3.48	3.29
Stand. dev	0.29	0.33	0.31	0.28	0.58	0.50
	legpair 14					
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	25	27	52
Min	2	3	2	3	3	3
Max	4	5	5	4	5	5
Median	3	3	3	3	4	3
Mean	3.00	3.42	3.22	3.20	3.74	3.48
Stand. dev	0.29	0.58	0.51	0.41	0.53	0.54
	legpair 15					
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	25	27	52
Min	2	2	2	2	2	2
Max	3	4	4	3	4	4
Median	2	3	3	3	3	3
Mean	2.08	3.00	2.56	2.60	3.22	2.92
Stand. dev	0.28	0.40	0.58	0.50	0.51	0.59

Statistics of legpair DaP spine. The start of the anterior dorsal spine (DaP) at the prefemur has sometimes been checked on both sides, sometimes on one side solely, depending on the availability of intact specimens with at least one leg being complete on one side at a given legpair position. Again, the average value has been used for the statistical calculation if both values had been available. Due to the high number of specimens with missing legs the number of samples was much lower than in the previously processed characters, see Table 11 for basic descriptive statistic parameters.

Table 10. Significance levels (p values) of differences in the numbers of coxal pores between males and females and pooled samples of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany). The p values below 0.05 are marked with bold letters.

	legpair 12	legpair 13	legpair 14	legpair 15
♂♂ (Spain) vs. ♀♀ (Spain)	0.179	0.197	0.002	< 0.001
♂♂ (Germany) vs. ♀♀ (Germany)	0.037	0.003	< 0.001	< 0.001
♂♂ (Spain) vs. ♂♂ (Germany)	0.087	0.343	0.06	< 0.001
♀♀ (Spain) vs. ♀♀ (Germany)	0.01	0.008	0.041	0.083
♂+♀ (Spain) vs. ♂+♀ (Germany)	0.002	0.007	0.014	0.002

Table 11. Legpair where anterior dorsal spine of prefemur (DaP) starts in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France). Abbreviation: n. p. = not present.

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>					
	Spain			France			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	36	34	70	25	26	51
Min	14	12	12	7,5	8	7.5	7	8	7
Max	15	n. p.	n. p.	11.5	11.5	11.5	11	13	13
Median	15	15	15	10	9.75	10	9	9	9
Mean	14.7	14.4	14.5	10.0	9.8	9.9	9.0	9.8	9.4
Stand. dev	0.5	1.0	0.8	0.9	0.7	0.8	1.2	1.4	1.4

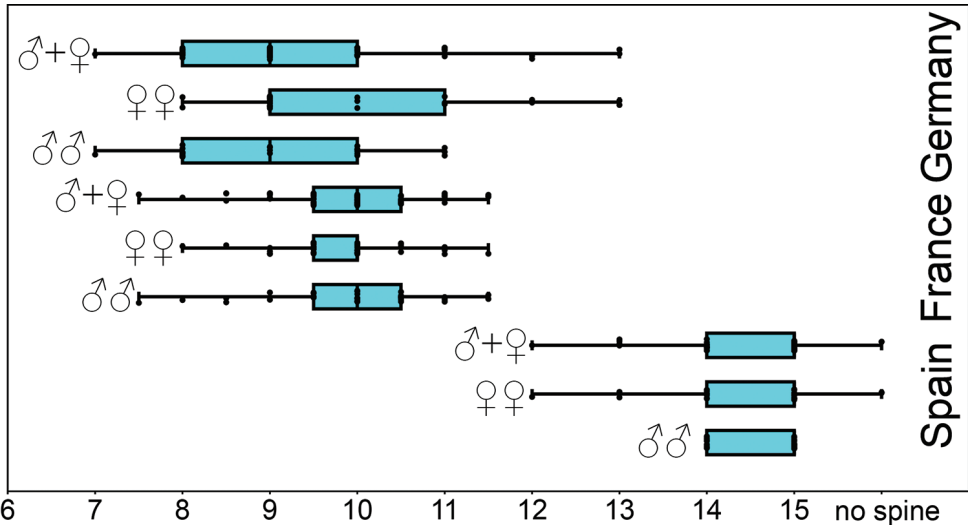


Figure 7. Start of the anterior dorsal spine of prefemur in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany and France). The DaP spine has been recorded on each leg of each specimen in French material: this explains the 0.5 graduation in this case (DaP being sometimes present on one side only).

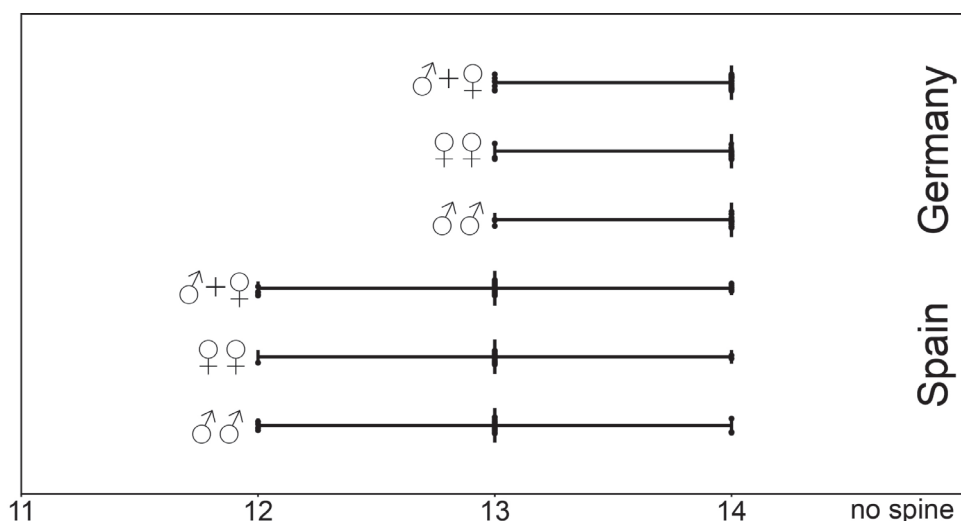


Figure 8. Legpair where the median ventral trochanter spine starts in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany).

A comparison of jitter box plots shows that the spine DaP usually starts later in specimens of *L. crassipesoides* sp. n. from Spain than in specimens of *L. crassipes* (Fig. 7), with an overlap at legpair 12 and 13 in females solely.

Using the Mann-Whitney-U-Test, no significant differences in the starting position of spine DaP have been found between males and females of *L. crassipesoides* sp. n. from Spain ($p=0.209$) and *L. crassipes* from France ($p=0.340$), while there was a low significance between males and females from Germany ($p=0.024$). The pooled samples show that spine DaP starts significantly later in specimens of *L. crassipesoides* sp. n. than in specimens of *L. crassipes* from France ($p<0.001$) and Germany ($p<0.001$). However, the two samples of *L. crassipes* differ significantly ($p=0.001$).

Statistics of median ventral spine at the trochanter

The start of the median ventral spine at the trochanter (Vmt) has sometimes been checked on one side solely. The basic descriptive statistic parameters are given in Table 12.

A comparison of jitter box plots shows that the spine Vmt usually starts earlier in specimens of *L. crassipesoides* sp. n. from Spain than in specimens of *L. crassipes* (Fig. 8), with an overlap at legpair 13.

Using the Mann-Whitney-U-Test, no significant differences in the starting position of spine Vmt have been found between males and females of *L. crassipesoides* sp. n. ($p=0.777$) and *L. crassipes* from Germany ($p=0.771$). The pooled samples show that spine Vmt appeared significantly earlier in specimens of *L. crassipesoides* sp. n. than in specimens of *L. crassipes* from Germany ($p<0.001$).

Table 12. Basic statistics of legpair where median ventral trochanter spine (Vmt) starts in males and females of *Lithobius crassipesoides* sp. n. (Spain) and *L. crassipes* (Germany).

	<i>Lithobius crassipesoides</i>			<i>Lithobius crassipes</i>		
	Spain			Germany		
	♂♂	♀♀	♂+♀	♂♂	♀♀	♂+♀
N	24	26	50	25	27	52
Min	12	12	12	13	13	13
Max	14	14	14	14	14	14
Median	13	13	13	14	14	14
Mean	13.0	13.0	13.0	13.9	13.9	13.9
Stand. dev	0.6	0.3	0.5	0.3	0.4	0.3

Canonical variate analysis

A canonical variate analysis (CVA, linear discriminant analysis with several groups) has been performed to improve the separation of the two species. As complete datasets are necessary for such a comparison only samples from Germany could be used to represent *L. crassipes*. All morphometric characters evaluated above have been used and sex specific groups have been defined. Additionally, the ratios of body length and antenna length to head length have been included.

The CVA (Fig. 9) allowed a complete separation of all specimens, as shown by the convex hulls. Also, the 95 % concentration ellipses show a complete separation, although there was one female of *L. crassipes* (SMNG VNR 15170-2 b) that fell outside the concentration ellipse.

Although differences between the sexes are clearly visible, even CVA does not allow separating them completely. Three discriminant factors have been extracted, explaining 85.8 %, 12.1 % and 2.1 % of the observed variance.

The factor loadings of discriminant function one show that the start of spine DaP and the body length have the highest separating power for the two species (Table 13). Ocelli number, start of spine Vmt and antennal length are also of value. Discriminant factor one could be interpreted as a “size factor”. It is remarkable that head length and both ratios are of negligible influence. They are just redundant expressions of the size factor, which is best represented by body length.

Discriminant factor two could be interpreted as a “sex factor”, with the highest factor loading on the number of coxal pores on legpair 15. Ocelli number and start of DaP are also of importance, while the numbers of coxal pores on the other legs are redundant characters.

Factor three is of no practical value and explains only a negligible part of the variance (Fig. 10).

Based on these interpretations a reduced model could be defined, which has a lower separating power but requires less measuring. Fig. 11 shows the first two discriminant factors. The parameters of the reduced model are given in Table 14.

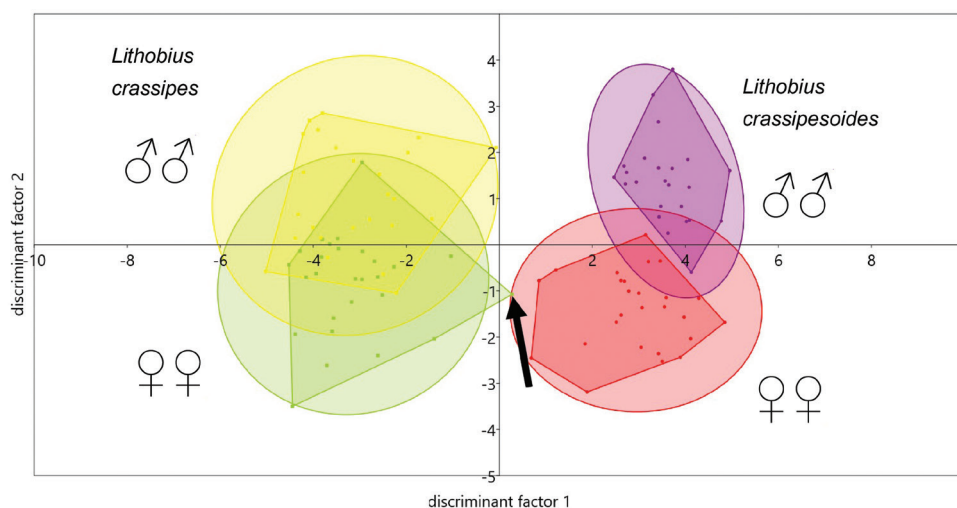


Figure 9. Canonical variate analysis of morphometric data showing factors one and two, using all morphometric characters of *Lithobius crassipesoides* sp. n. from Spain and *L. crassipes* from Germany. The specimen SMNG VNR15170-2 b with an extraordinary position within the CVA is marked with an arrow.

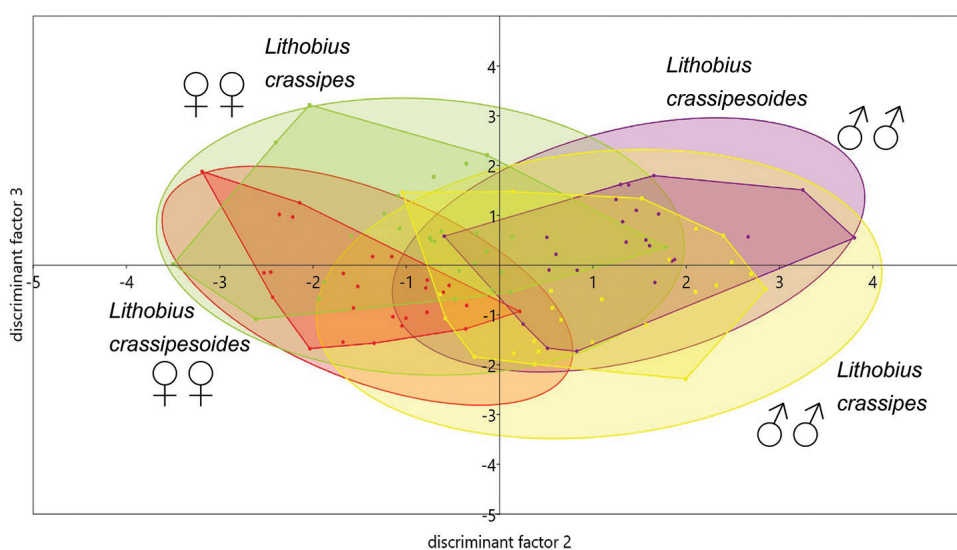


Figure 10. Canonical variate analysis of morphometric data showing factors two and three, using all morphometric characters of *Lithobius crassipesoides* sp. n. from Spain and *L. crassipes* from Germany.

Discussion

Molecular and morphological comparison of *L. crassipesoides* sp. n. and *L. crassipes*

Both molecular analysis (Fig. 1) and morphology support the hypothesis that the northern Spanish *L. crassipes*-like specimens represent a species genetically and morphologically distinct from *L. crassipes*. The two species are morphologically similar and

Table 13. Eigenvalues and factor loading of the three extracted discriminant factors for the complete model. Highest factor loadings marked in bold letters and top values in larger fonts.

	Axis 1	Axis 2	Axis 3
Eigenvalue	10.6	1.49	0.26
Explanation of variance	85.8 %	12.1 %	2.1 %
Body length	-0.303	0.080	0.579
Antennae length	-0.125	0.063	0.147
Head length	-0.014	0.015	0.015
AL/HL	-0.097	0.026	0.132
BL/AL	0.067	-0.071	-0.004
Coxal pores LP 15	-0.064	-0.316	0.012
Coxal pores LP 14	-0.044	-0.187	0.157
Coxal pores LP 13	-0.037	-0.090	0.197
Coxal pores LP 12	-0.037	-0.062	0.145
Ocelli	-0.170	0.262	0.120
DaP	0.804	-0.202	0.400
Vmt	-0.132	0.017	-0.001

Table 14. Eigenvalues and factor loading of the three extracted discriminant factors in a reduced model. Highest factor loadings marked in bold letters.

	Axis 1	Axis 2	Axis 3
Eigenvalue	9.84	1.23	0.13
Explanation of variance	87.9 %	11.0 %	1.1 %
Body length	-0.313	-0.080	0.904
Antennae length	-0.130	-0.063	0.235
Coxal pore LP15	-0.063	0.352	0.099
Ocelli	-0.179	-0.278	0.167
DaP	0.838	0.145	0.393
Vmt	-0.138	-0.008	0.033

probably closely related, but can be distinguished as both males and females. While *L. crassipes* is widely distributed in Europe, *L. crassipesoides* sp. n. is currently only known from northern Spain (Fig. 17).

Statistical analysis

The main weakness of the morphometric statistical evaluation is the fact that the measured specimens are not identical with the sequenced specimens. This means that the possibility of having other cryptic species among the material cannot be excluded. The rejection of the normal distribution in the French samples in body length, in the German

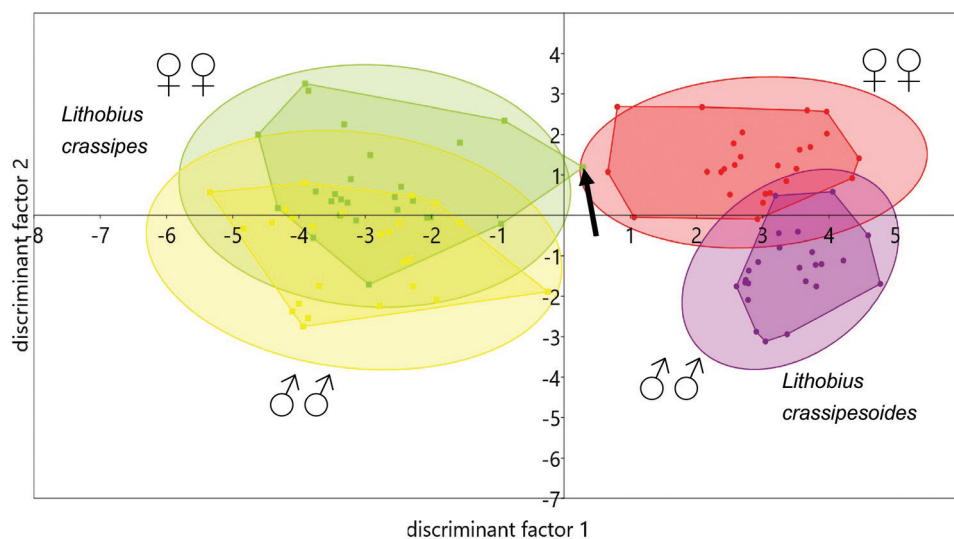


Figure 11. Canonical variate analysis of morphometric data of *Lithobius crassipesoides* sp. n. from Spain and *L. crassipes* from Germany, showing factors one and two. Only characters with high separating power have been included. The specimen SMNG VNR15170-2 b with an extraordinary position within the CVA is marked with an arrow.

samples in head length and in samples from Spain and France in antennae length might be interpreted as a hint for more cryptic lineages.

Canonical variate analysis

The moderate dropping of the eigenvalue of axis1 from 10.6 to 9.84 (7 %) and of axis2 from 1.49 to 1.23 (1.5 %) shows that no crucial variables have been removed when generating the reduced model. This is also visible by comparison of Fig. 9 versus Fig. 11, as the overlapping of the convex hulls changes only at a small extent. To check if the measures antennae length and head length represent discriminating power beside a size factor, their quotients had also been included in the complete model of the CVA. As visible in Table 13 head length shows only a low, negligible factor loading of -0.014, while antennae length shows a distinctly higher loading of -0.125 and the quotients AL/HL and BL/AL show lower loadings, but these are still higher than the loading of HL solely. Also a model without AL and HL was calculated, but the factor loadings of AL/HL and BL/AL did not change their values. This means that in contrast to HL AL has a discriminant value beside a size factor, and that using AL solely in a model would be the best choice.

As seen in Fig. 10 axis3 shows no clear separation for any group. This is also reflected by the low eigenvalue, explaining only 2.1 % of the overall variability in the complete and 1.1 % in the reduced model. Furthermore axis1 and axis3 show the highest factor loadings on the same variables, marked in bold letters in Table 14. For that reason it is justified to omit axis3 in further considerations.

***Lithobius crassipes* on the Iberian Peninsula and elsewhere in Europe**

Currently, all records of *L. crassipes* on the Iberian Peninsula as well as in other parts of Europe need to be carefully checked against *L. crassipesoides* sp. n., which could also be dispersed by human transport (Decker et al. 2017, Stoev et al. 2010). In the southern part of Spain more pseudo-cryptic species of the *Lithobius crassipes*-group may also exist. *L. crassipes* is formally known from the Pyrénées-Atlantiques department (French Basque country) (Iorio 2014, 2016), which is adjacent to the Spanish Navarre province. However, as mentioned above, *L. crassipesoides* sp. n. occurs only a few hundred meters or few kilometers from the French border and can be assumed to occur at least in the most western region of the French Pyrenees.

Interestingly, some authors have previously given details on morphology of Spanish *L. crassipes*. Serra (1980) described specimens of *L. crassipes* from the province of Almería as follows: 6–11 mm body length, 6–11 ocelli in 2 or 3 rows, a DaP spine on legpair 10 (or even sometimes on legpair 7) to legpair 15. Perhaps his description included specimens of both *L. crassipes* and *L. crassipesoides* sp. n. Finally, Serra (1982) mentioned the same details as above for some *L. crassipes* from the provinces Asturias and Almería but only gave the plectrotaxy of legpair 15, not the preceding legpairs.

Here we give a brief review of historic descriptions of *L. crassipes* for characters which have been found to be useful. Descriptions of *L. crassipes* elsewhere in Western Europe quoted a body length of 9–12 mm (Iorio 2008, 2010, Iorio and Labroche 2015) or 9–13 mm (Meinert 1872), up to 13.5 mm (Barber 2009); Koch (1862) gave the body length in “lines” (= lignes in French, an old measurement unit), thus his 4–4.5 lines may correspond to 9.02–10.15 mm. Manfredi (1957), in her description of *L. crassipes stictonotus* Manfredi, 1957 from southern Italy, a synonym of typical *L. crassipes* according to Bonato et al. (2016), has recorded 11.5–14 mm. Only Brölemann (1930) mentioned a small size, with 6.5–10 mm. Also, the number of ocelli ranged from 8 to 11 in two rows (Brölemann 1930), 10 to 11 in three rows (Koch 1862), 8 to 12 in two or three rows (Meinert 1872, Iorio 2008, 2010) or 9 to 13 in two or three rows (Barber 2009). Manfredi (1957) gave 12 or 13 ocelli for *L. crassipes stictonotus*. The DaP spine starts at legpair 10 (or even on legpair 7 to 9) to legpair 15 according to Brölemann (1930) and Eason (1964). Brölemann (1930) noted that the DaP spine is only sometimes present on legpair 15. Despite several hundred of specimens of *L. crassipes* having been examined from France and Germany (this study and unpublished data), no specimen with an absence of a DaP on legpair 15 was observed. Brölemann (1930) may have had specimens of *L. crassipesoides* among his material.

In Sweden, western specimens of *L. crassipes* seems to differ from the south-eastern Swedish *L. crassipes* (including also those from Denmark) as underlined by Andersson (1981). In the west, a DaP spine is only present on the last one, two or three legpairs, or a DaP may even be absent. In the south-east, *L. crassipes* have a DaP spine at least from legpair 12 to 15, but usually on more legs, 88 % from legpair 10 to 15, and it can even start on legpair 5 (Andersson 1981). The western Swedish specimens have a body length of 8–10 mm, and 8–10 ocelli; the south-eastern specimens are 9–11 mm long

with 9–12 ocelli (Andersson 1981). Andersson et al. (2005) also record both forms, but without any supplementary information. We note that the south-eastern Swedish and the Danish specimens correspond well with our *L. crassipes* from France and Germany.

Taxonomy

Order Lithobiomorpha

Family Lithobiidae Newport, 1844

Genus *Lithobius* Leach, 1814

Subgenus *Monotarsobius* Verhoeff, 1905

Species of the subgenus *Monotarsobius* are characterized by short antennae and, in its modern conception, very frequently with 20 antennal articles for most members in Western Europe; the wider amplitude in this area being usually 17–23 articles, very rarely 24–25 in exception as in Spanish *L. blascoi* Eason, 1991. *Monotarsobius* always has 2 + 2 forcipular teeth, no posterior projections on tergites and tarsal articulation is missing on the first 12 or 13 legpairs (Verhoeff 1905, 1937, Brölemann 1930, Eason 1964, 1982, 1991, 1992, Serra 1980, Iorio 2008, 2010, Barber 2009).

Lithobius crassipesoides sp. n.

<http://zoobank.org/EFB3B6F5-F82D-42AF-B1FC-6C656C0D18B7>

Figures 1–17, Tables 1–16

Lithobius crassipes – Barace and Herrera 1980: 4 (listed), 5 (records, redescription), figs 3–5. – Barace and Herrera 1982: 117 (records). – Salinas 1990: 2 (in checklist for Navarre), 59 (record), mapa 19 (map).

Diagnosis. Small member (body length 6.4–11 mm) of the subgenus *Monotarsobius*. Antennae with 20 articles, short, 2.6 times longer than head, 1/4 of body length. 5–11 ocelli, mostly 8 or 9, in two or three rows with one larger posterior ocellus. Legs with species-specific plectrotaxy; legpair 14 and 15 thickened in both sexes, much more so in males; legpair 15 without accessory apical claw, in males with a depression in the posterior half of tibia. Female gonopod claw tridentate.

L. crassipesoides sp. n. differs generally from other Iberian members of *Monotarsobius* in the presence of a depression in the posterior half of the legpair 15 tibia. It differs from *L. osellai* and *L. morenoi* in having more than one row of ocelli; from *L. blascoi* in having only 20 antennal articles; and from *L. crassipes* in smaller body length, shorter antennae, lower number of ocelli, the DaP spine starting posteriorly from legpair (12) 13, and the different location and size of the male depression on legpair 15 tibia.

Etymology. Derived from the morphological similarity to *Lithobius crassipes*.

Material examined. *Holotype.* Spain: Navarre province: Leitza, Ariz Mendiak, between area “Ustarleku” and “Karobieta”, above side stream to Gorritzaran; loamy and calcareous soil, 43.0778°N, 1.8775°W, 615 m a.s.l., 20 April 2009, leg. FT2009, grove of *Castanea*, pollard trees on the slope with *Ranunculus ficaria*, *Daphne*, *Helleborus*, *Salvia*, *Rubus*, *Lathrea*; under leaves and bark of rotten trunk, 1 ♂ (SMNG VNR14744-4 d).

Paratype. Spain: Navarre province: Same data as holotype, 1 ♂ (SMNG VNR16739-1 b), 1 ♀ (SMNG VNR14744-4 b), 1 ♀ (SMNG VNR14752-1 c); Spain: Gipuzkoa province, Sierra de Aralar, Beasain, road from Lazkao to Etxarri-Aranaz, Pass Puerto de Lizarrusti, forest of *Fagus* on the slope, under stones and in leaf litter, 42.9614°N, 2.0983°W, 690 m a.s.l., 21 April 2009, leg. FT2009, 1 ♂: (SMNG VNR14764-3).

Other material examined. **Spain: Navarre province:** Leitza, Ariz Mendiak, between area “Ustarleku” and “Karobieta”, above side stream to Gorritzaran; loamy and calcareous soil, 43.0778°N, 1.8775°W, 615 m a.s.l., 20 April 2009, leg. FT2009, grove of *Castanea*, pollard trees on the slope with *Ranunculus ficaria*, *Daphne*, *Helleborus*, *Salvia*, *Rubus*, *Lathrea*; under leaves and bark of rotten trunk, 2 ♂♂, 3 ♀♀, 1 juv. ♂ (SMNG VNR14744-4), 1 ♂, 1 juv. ♂ (SMNG VNR16739-1), 1 ♀ (SMNG VNR14746-5), 1 ♀ (SMNG VNR17128-8); 100 meters down to a meadow along the way, 1 ♀ (SMNG VNR17126-4); *Alnus* wood along stream, under bark of standing dead wood, 2 ♀♀, 1 juv. ♀ (SMNG VNR14752-1); with *Carpinus betulus*, *Corylus*, *Fagus*, *Sambucus*, 1 ♀ (SMNG VNR17129-3). – Leitza, Ariz Mendiak, between area “Ustarleku” and “Karobieta”, next to road NA 4150 to Goizueta; on a slope with *Fagus*, *Corylus*, under a dead, mossy tree trunk, 43.09092°N, 1.86613°W, 593 m a.s.l., 20 April 2009, leg. FT2009, 2 ♀♀ (SMNG VNR17131-3). – Sierra de Aralar, south of Errazkin, north of area “Axkarateko Malkorra”, young *Fagus* and old big *Quercus*, *Ilex*, *Ruscus*, *Hedera helix*, in leaf litter, 42.9972°N, 1.9703°W, 630 m a.s.l., 21 April 2009, leg. FT2009, 2 juv. ♂♂ (SMNG VNR14757-6), 1 ♂, 1 ♀ (SMNG VNR14758-3; SMNG VNR14813-1), 1 ♂, 1 ♀ (SMNG VNR17133-9). – Sierra de Aralar, south Baraibar, on road NA-7510 to Santuario de San Miguel, at area “Izáin”, karst area with deep grykes and bare limestone rocks, *Fagus* woodland and some *Crataegus* bushes, in leaf litter, partly sieved out, 42.9714°N, 1.9384°W, 790 m a.s.l., 22 April 2009, leg. FT2009, 1 ♀ (SMNG VNR14770-12), 1 ♀ (SMNG VNR14771-6). – Sierra de San Miguel, mountain point Artxueta at radio mast, karst area with bare limestone rocks, grove of low growing *Fagus*, in litter and under bark, 42.9525°N, 1.9668°W, 1300 m a.s.l., 22 April 2009, leg. FT2009, 3 ♂♂, 1 ♀ (SMNG VNR14773-1). – Sierra de Urbasa, road NA-718 from Olazi / Olazagutía to Estella, at the end of the hairpin curves, under the bark of a very large old beech with a lot of moos; limestone, 42.86031°N, 2.18055°W, 888 m a.s.l., 23 April 2009, leg. FT2009, 1 ♂, 1 ♀ (SMNG VNR17135-4). – Sierra de Urbasa, 1 km east of road junction to road NA-7182 at site “Bentakaita”, *Fagus* forest with *Prunus*, *Corydalis*, *Mercurialis*, *Erythronium*; in leaf litter, 42.8540°N, 2.1595°W, 890 m a.s.l., 23 April 2009, leg. FT2009, 1 ♂ (SMNG VNR16734-1), 1 ♂ (SMNG VNR17136-4). – Urroz, hayedo [beech forest], 25 September 1995, leg. Javier Sáenz de Cabezón, 1 ♀ (MZNA MZ-19951125 a). – Imbuluzqueta, tocón [stub], 21 February 1993, 2 ♂♂, 4 ♀♀ (MZNA MZ-19931121a). – Eguaras, Vedado

de, *Quercus coccifera*, 10 January 1980, leg. R. Jordana, 1 juv. ♀ (MZNA VE1041AS). – Irati, suelo de hayedo [floor of beech forest], 17 September 1982, leg. J. Barace, 1 ♀ (MZNA MZ-19820917, Salinas 1990). – Velate, hayedo [beech forest], 25 September 1995, leg. Javier Sáenz de Cabezón, 1 ♂ (MZNA MZ-19951125). – Lagos de Urroz, hayedo [beech forest], 25 September 1995, leg. Javier Sáenz de Cabezón, 1 ♀ (MZNA MZ-19951125 a). – Tirapegui, tocón [stub], 21 February 1993, 3 ♂♂, 1 ♀ (MZNA MZ-19931121 b). – Aquerreta, corteza [bark], 15 January 1994, 1 ♂, 6 ♀♀ (MZNA MZ-19940119a). – Quinto Real, 29 June 1977, 1 juv. ♀ (MZNA MZ-19770629d, Barace and Herrera 1980). – Quinto Real, carretera [road], 11 May 1977, leg. R. Jordana, 1 ♀ (MZNA MZ-19770511d, Barace and Herrera 1980). – Quinto Real, tocón [stub], 4 August 1977, leg. Vierna, 4 ♂♂ (MZNA MZ-19770804e, Barace and Herrera 1982). – Quinto Real, carretera [road], 11 May 1977, 1 ♂ (MZNA MZ-19770511d, Barace and Herrera 1980). – Quinto Real, pinar [pine forest], 14 September 1977, 1 ♂ (MZNA MZ-19770914, Barace and Herrera 1980). – Quinto Real, 24 November 1976, leg. Labiano, 1 ♂ (MZNA MZ-19761124a, Barace and Herrera 1980). – Quinto Real, 29 June 1977, leg. Monreal, 1 ♂ (MZNA MZ-19770629d, Barace and Herrera 1980). – Quinto Real, pinar [pine forest], 14 September 1977, 1 ♀ (MZNA MZ-19770914, Barace and Herrera 1980). – Quinto Real, pinar [pine forest], 14 September 1977, 1 ♀ (MZNA MZ-19770914, Barace and Herrera 1980). – Quinto Real, corteza de haya [bark of beech], 3 September 1977, leg. J. Barace, 1 ♂ (MZNA MZ-19770903 d, Barace and Herrera 1980). – Quinto Real, pinar [pine forest], 14 September 1977, 1 ♂ (MZNA MZ-19770914, Barace and Herrera 1982). – Quinto Real, corteza [bark], 29 June 1977, 1 ♂ (MZNA MZ-19770629 e, Barace and Herrera 1980). – Quinto Real, corteza [bark], 29 June 1977, 1 (juv.?) ♀ (MZNA MZ-19770629 e, Barace and Herrera 1980). – Quinto Real, tocón [stub], 4 August 1977, 1 ♀ (MZNA MZ-19770804 f, Barace and Herrera 1980). – Quinto Real, tocón [stub], 16 March 1977, leg. Labiano, 1 ♀ (MZNA MZ-19770316 b, Barace and Herrera 1980). **Spain: Gipuzkoa province:** Sierra de Aralar, Beasain, road from Lazkao to Etxarri-Aranaz, west of the Pass Puerto de Lizarrusti, forest of *Fagus*, in leaf litter, 42.9572°N, 2.1122°W, 550 m a.s.l., 21 April 2009, leg. FT2009, 1 ♂ (SMNG VNR14763-9), 1 juv. ♂ (SMNG VNR14763-11). – Natural Park Aizkorri-Aratz, near Onati; close to the monastery Arantzazu, beechwood in limestone with *Ilex*, *Fagus*, *Rubus fruticosus*, *Hedera*, *Larix*, *Helleborus*, under bark of a dead tree trunk, 42.97766°N, 2.38989°W, 850 m a.s.l., 24 April 2009, leg. FT2009, 1 ♀ (SMNG VNR17139-5). – Natural Park Aizkorri-Aratz, Sierra de Urquilla, Montes de Alzania, south of mountain chain Aikorririko Mendikatea, south west of Mountain Aitzgorri, northwest Zumarraundi, high plain Alizania, north of Portua Zarra, karst plain with small growing trees of *Fagus* and open grasslands, 42.9354°N, 2.3298°W, 1160 m a.s.l., 24 April 2009, leg. FT2009, 1 ♂, 1 ♀, 1 juv. ♂, 1 juv. ♀ (SMNG VNR14786-3), 1 ♂, 1 ♀ (SMNG VNR14828-3), 1 ♂ (SMNG VNR14791-5). – Natural Park Aizkorri-Aratz, Sierra de Urquilla, near Zumaraundi, deep doline with creek discharge near cave entry; much leaf litter; sieved from *Fagus* leaves 42.9241°N, 2.3224°W, 980 m a.s.l., 24 April 2009, leg. FT2009, 1 juv. ♂ (SMNG VNR14793-5).



Figure 12. Adult males, dorsal view **A** *Lithobius crassipesoides* sp. n. (SMNG VNR14828) **B** *L. crassipes* (SMNG VNR15171). Scale bars: 2 mm (**A, B**).

Description. *Habitus.* Slightly fusiform, widest around tergite 10 (Fig. 12A).

Colour. General body colouration varies from pale and light buff (most individuals), through yellow ochre to tawny olive (Fig. 12A). Mostly last third of the body and usually also the head a little darker. Head light yellow ochre, sometimes darker in front and around the ocellar area. Last antennal articles yellowish. Some or all tergites more or less darker on posterior margin. Most specimens are paler than *L. crassipes*.

Length. 6.4–11.0 mm (Fig. 2, Table 2).

Head. Head roundish, mostly as broad as long or little broader than long and head broader or as broad as T5. Head length 0.6–1.08 mm (Fig. 3, Table 4).

Antennae. 20 antennal articles, short and stout, 1.6–3.2 mm long, 2.6 times longer than head (Figs 4, 13A, Table 6).

Ocelli. 5 to 11 ocelli on each side of the head, mostly 8 or 9, rarely 5 or 11, arranged in two or three rows (Fig. 5, Table 8), posteriorly with one greater, longitudinally oval ocellus, clearly separated from the others. The most common arrangements ($n = 47$) are

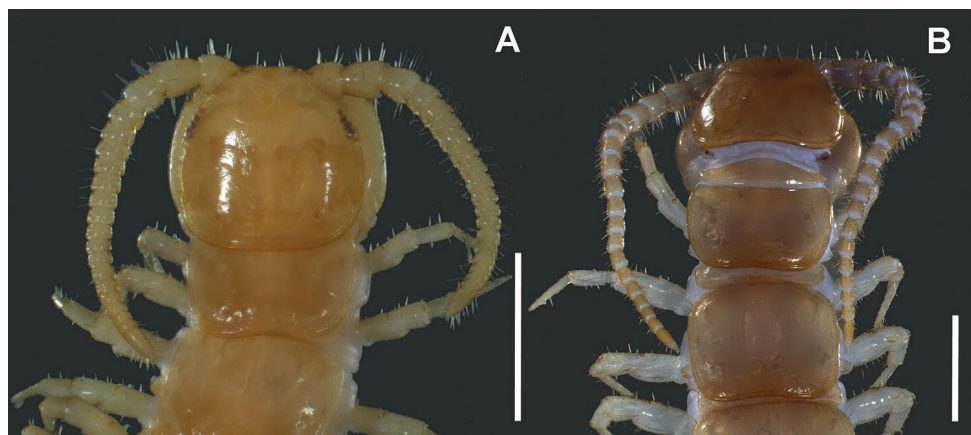


Figure 13. Adult males, anterior body, dorsal view **A** *Lithobius crassipesoides* sp. n. (SMNG VNR14828) **B** *L. crassipes* (SMNG VNR15171). Scale bars: 0.5 mm (**A, B**).

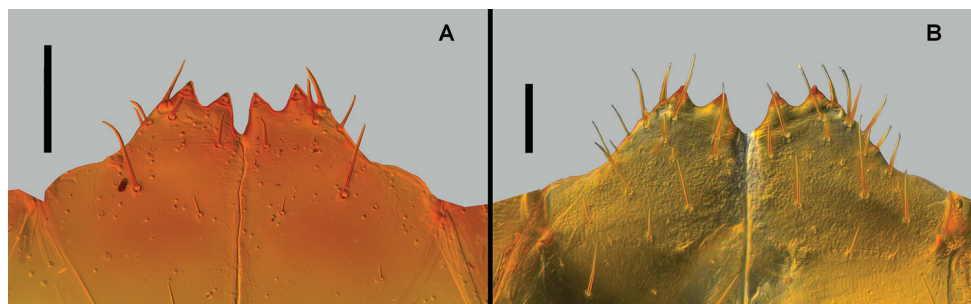


Figure 14. Coxosternum, ventral view **A** *Lithobius crassipesoides* sp. n. (MZNA 138944) **B** *L. crassipes* (SMNG VNR015171). Scale bars: 0.1 mm (**A, B**).

1 + 4, 3 (21 %), 1 + 4, 3, 1 (14 %) and 1 + 4, 3, 2 (14 %). There is no significant difference between males and females in number and arrangement. In 54 % the number of ocelli differs between right and left side in one or two ocelli.

Coxosternum. Anterior border with 2+2 teeth, upper part slender, acuminate, lateral borders without shoulders. Middle notch narrow to moderate width. Sometimes coxosternum slenderer and the middle notch narrower (Fig. 14A).

Tergites. Surface slightly rough, glossy. Posterior border of T1 feebly concave or straight, T3 to T5 feebly concave, T8 to T15 distinctly concave, T16 feebly to distinctly concave. Posterior angles of T9, T11 and T13 mostly obtuse or rounded with no trace of lobes or triangular projections.

Legs. Tarsus and metatarsus fused on legpair 1 to 11. On legpair 12 and 13 the tarsal-metatarsal articulation is indistinct. Penultimate and ultimate legpairs (14, 15) are densely covered with pores. Last two legpairs are thickened in both sexes, much more so in males. Without accessory apical claw on legpair 15.

Legpair 15 tibia of males with a more setiferous depression (fossa), which is distinct and well-developed in specimens in later developmental stages (Fig. 15A), in younger

Table 15. Coxal pores in *Lithobius crassipesoides* sp. n. and in German *L. crassipes*. Sequence from legpair 15–12.

	<i>Lithobius crassipesoides</i> sp. n.		<i>Lithobius crassipes</i> (Germany)	
	♂♂	♀♀	♂♂	♀♀
n	31	31	26	26
Variants of arrangements	7	7	5	14
Highest number	2432, 2342	4543	3443	4554
Common arrangements	2332 (71 %)	3332 (45 %)	2332 (42 %)	2332 (15 %)
		2332 (32 %)	3332 (39 %)	3443 (15 %)

Table 16. Plectrotaxy of *Lithobius crassipesoides* sp. n. (n = 11 ♂♂ and 11 ♀♀). In brackets spines absent in more than 50 % of individuals.

Legpair	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	(p)	am(p)	m	–	–	mp	a(p)	a
2	–	–	(p)	am(p)	(a)m	–	–	mp	ap	a(p)
3	–	–	(p)	am(p)	(a)m	–	–	mp	ap	a(p)
4	–	–	(p)	am(p)	(a)m	–	–	mp	ap	a(p)
5	–	–	(p)	am(p)	(a)m	–	–	mp	ap	a(p)
6	–	–	(p)	am(p)	(a)m	–	–	mp	ap	a(p)
7	–	–	(p)	am(p)	(a)m	–	–	mp	ap	a(p)
8	–	–	(p)	am(p)	am	–	–	mp	ap	a(p)
9	–	–	(p)	amp	am	–	–	mp	ap	ap
10	–	–	(mp)	amp	am	–	–	mp	(a)p	ap
11	–	–	(m)p	amp	am	–	–	mp	(a)p	ap
12	–	(m)	(a)mp	amp	am	(a)	–	(a)mp	p	(a)p
13	–	m	amp	amp	am	a	–	(a)mp	p	p
14	–	m	amp	amp	(a)m	a	–	(a)mp	p	(p)
15	–	m	amp	am(p)	–	a	–	amp	(p)	–

developmental stages only indicated. The depression starts more or less in the half of the tibia (55–75 % of tibia length) and reaches nearly up to the end of the tibia (88–93 % of tibia length) and has a relative length of about 30 to 40 % of tibia (n = 28).

Coxal pores. Round, 2–4 (sometimes 5) pores on each coxa (Fig. 6, Table 9). Mostly 2, 3, 3, 2 or 3, 3, 3, 2 (coxae 15–12) with the highest observed number of 4, 5, 4, 3 in a female (Table 15).

Plectrotaxy. The plectrotaxy of legs of *L. crassipesoides* sp. n. is given in Table 16. It differs from *L. crassipes* in the absence of a DaP spine up to legpair 11, DaP very rarely present on legpair 12, rarely present on legpair 13 to 14, while almost always present in *L. crassipes* on legpair 10 to 15, frequently on legpair 9, rarely also on legpair 7 and 8 or only on legpair 11 to 15 (Table 17).

Male gonopods. Uni-articulated.

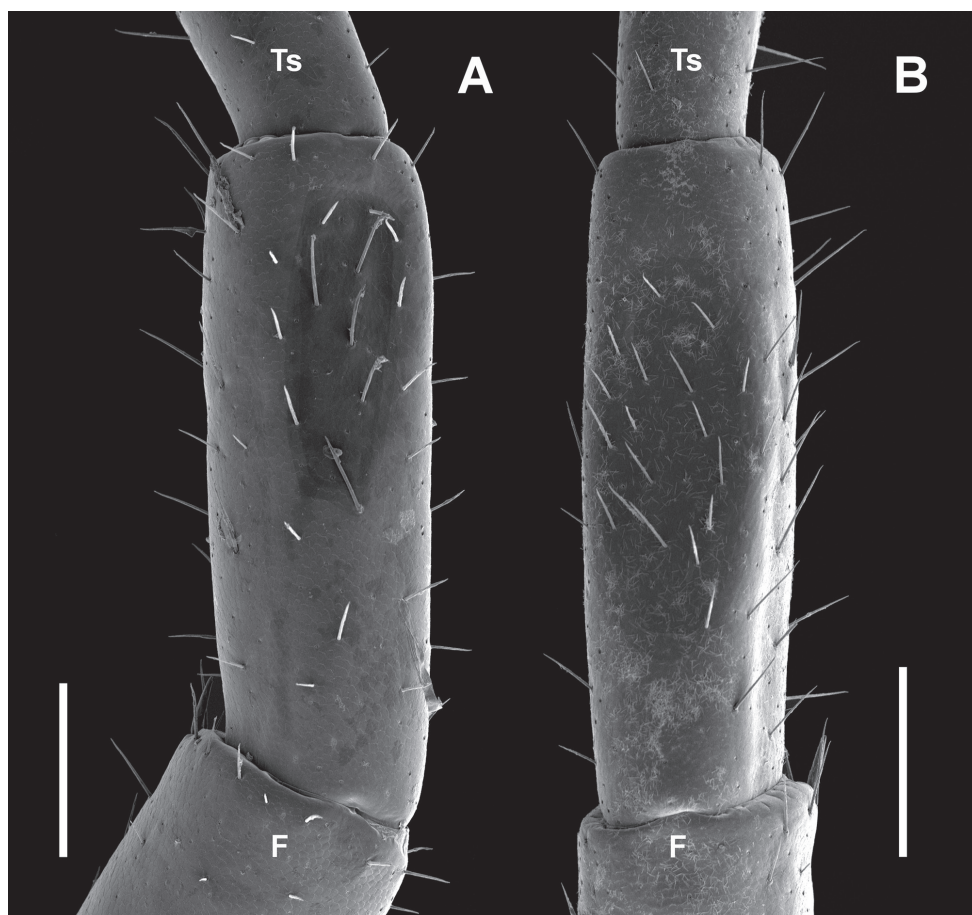


Figure 15. Tibia of male legpair 15, dorsal view **A** *Lithobius crassipesoides* sp. n. (SMNG VNR14773), right leg **B** *L. crassipes* (SMNG VNR10335), left leg. Abbreviations: F = femur; Ts = tarsus. Scale bars: 0.2 mm (**A, B**).

Female gonopods. Basal article with two conical spurs on each side, their apical edge serrated (Fig. 16A). With 5–9 ventrolateral setae with nearly the same length. No dorsomedial setae. One specimen (SMNG VNR14770) with two minute setae. Article II with 4–6 dorsolateral setae, stout, straight and fairly long, evenly distributed over the whole length of the article. Ventrolaterally with 4–6 setae without characteristic arrangement. Article III with 1 dorsolateral seta, 1 ventrolateral, 1 ventral and 2 ventromedial setae. Claw tridentated, dorsal denticle longer than the ventral denticle. At high magnification (SEM) with distinct pores of glandulae.

Distribution. So far only known from Navarre and Gipuzkoa provinces, northern Spain (Fig. 17). Some records are only a few kilometers from the French border. *L. crassipesoides* sp. n. is therefore expected also in the Western Pyrenees in France.

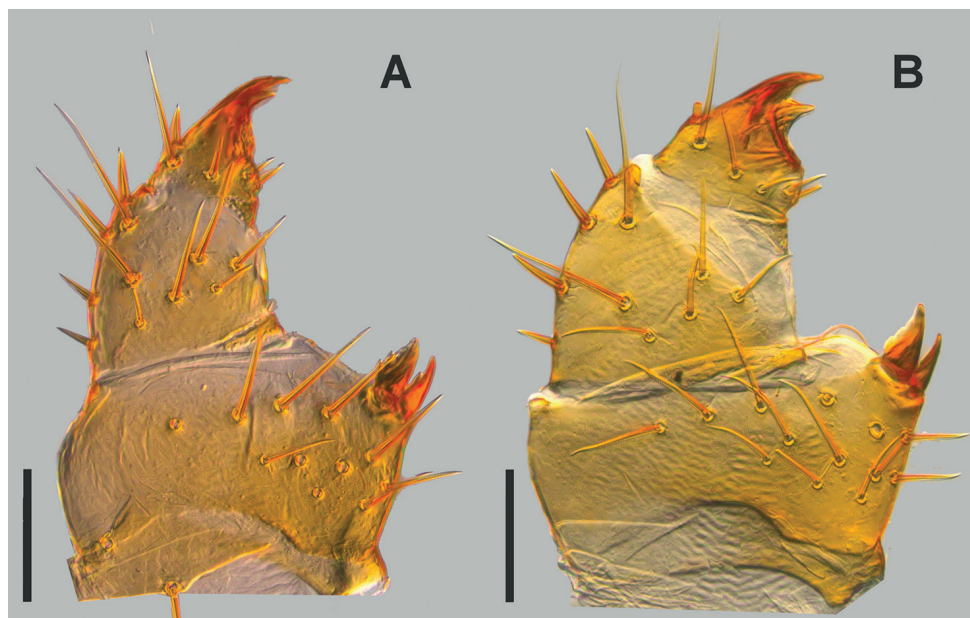


Figure 16. Left female gonopod, ventral view **A** *Lithobius crassipesoides* sp. n. (SMNG VNR14828) **B** *L. crassipes* (SMNG VNR15171). Scale bars: 0.1 mm (**A**, **B**).

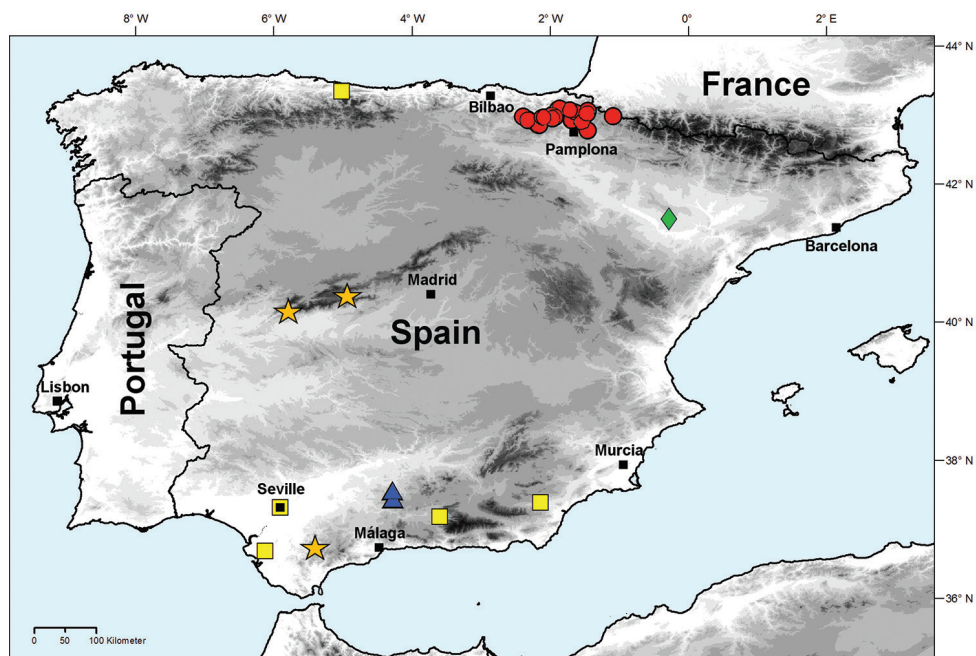


Figure 17. Distribution map of *Lithobius* (*Monotarsobius*) on the Iberian Peninsula: *Lithobius blascoi* = diamond; *L. crassipes* = square; *L. crassipesoides* sp. n. = circle; *L. morenoi* stat. n. = triangle; *L. osellai* = star.

Habitat. The species was mostly found in the leaf litter and under the bark of dead wood in mountain deciduous forests from 550 to 1300 m a.s.l.

Remarks. *L. crassipes* was recorded from the Navarre region from Irati (Salinas 1990) and several locations near Quinto Real (Barace and Herrera 1980, 1982). Barace and Herrera (1980) also gave a brief description of 12 males and eight females. Most of the material studied by Barace and Herrera (1980, 1982) and Salinas (1990) was available for re-examination at MZNA (38 specimens) and was confirmed to be *L. crassipesoides* sp. n. Therefore, all records of Barace and Herrera (1980, 1982) and Salinas (1990) of *L. crassipes* are hereby assigned to *L. crassipesoides* sp. n. Finally, as mentioned above, the description of Serra (1980) for *L. crassipes* is possibly composite and perhaps partially concerns *L. crassipesoides* sp. n.

***Lithobius (Monotarsobius) crassipes* L. Koch, 1862**

Figs 1–17, Tables 1–15, 17

Lithobius crassipes L. Koch 1862: 71–72, table II 31

Lithobius crassipes – Meinert 1872: 341 (record). – Attems 1927: 238 (record). – Attems 1952: 346 (record). – Demange 1958: 39 (in key). – Serra 1980: 294–297 (record, description). – Serra 1982: 45–47, figs a–c (record, description), 49 (in key). – Garcia Ruiz 2015: 9 (in checklist for Spain).

Description. *Habitus.* Slightly fusiform, widest around tergite 10 (Fig. 12B).

Colour. General body colouration varies from pale horn colour to cream colour and to yellow ochre (Fig. 12B) or rarely with very light reddish tint.

Length. 7.6–13.2 mm (Fig. 2, Table 2).

Head. Head roundish, mostly as broad as long or little broader than long and head broader or as broad as T5. Head length 0.8–1.12 mm (Fig. 3, Table 4).

Antennae. 20 antennal articles, short and stout, 2–4 mm long, 3.2 times longer than head, length (Figs 4, 13B, Table 6).

Ocelli. The German specimens have 8–12, the French 7–15 ocelli on each side of the head, mostly 9–11 (Fig. 5, Table 8), posteriorly with one greater, longitudinally oval ocellus, clearly separated from the others. In 90 % of all specimens (n = 174) they are arranged in three rows with a single larger ocellus posteriorly. The most common arrangements are in Germany (n = 52) 1+432 (43 %), 1+431 (11 %), 1+433 (10 %) and in France (n = 125) 1+432 (47 %), 1+431 (19 %), 1+442 (15 %). In nearly 60 % of individuals (both Germany and France) the number differs between right and left side of head, mostly only in one ocellus.

Coxosternum. Anterior border with 2+2 teeth, upper part slender, acuminate, lateral borders without shoulders. Middle notch narrow to moderate width. Sometimes coxosternum broader and the middle notch broader (Fig. 14B).

Tergites. Surface slightly rough, glossy. Posterior border of T1 feebly concave or straight, T3 to T5 feebly concave, T8 to T15 distinctly concave, T16 feebly to dis-

Table 17. Plectrotaxy of German *Lithobius crassipes* (n = 11 ♂♂ and 11 ♀♀). In brackets spines absent in more than 50 % of individuals.

Legpair	Ventral					Dorsal				
	C	t	P	F	T	C	t	P	F	T
1	–	–	–	am	m	–	–	mp	a(p)	a
2	–	–	–	am	(a)m	–	–	mp	ap	a(p)
3	–	–	–	am	(a)m	–	–	mp	ap	a(p)
4	–	–	–	am(p)	(a)m	–	–	mp	ap	ap
5	–	–	–	am(p)	(a)m	–	–	mp	ap	ap
6	–	–	–	am(p)	am	–	–	mp	ap	ap
7	–	–	–	am(p)	am	–	–	(a)mp	ap	ap
8	–	–	–	am(p)	am	–	–	(a)mp	ap	ap
9	–	–	(mp)	amp	am	–	–	amp	ap	ap
10	–	–	m(p)	amp	am	–	–	amp	ap	ap
11	–	–	mp	amp	am	–	–	amp	ap	ap
12	–	–	(a)mp	amp	am	(a)	–	amp	p	p
13	–	(m)	amp	amp	am	a	–	amp	p	p
14	–	m	amp	amp	m	a	–	amp	p	(p)
15	–	m	amp	am	–	a	–	amp	(p)	–

tinctly concave. Posterior angles of T9, T11 and T13 mostly obtuse or rounded with no trace of lobes or projections.

Legs. Tarsus and metatarsus fused on legpair 1 to 11. On legpair 12 and 13 the tarsal-metatarsal articulation is indistinct. Penultimate and ultimate legpairs (14, 15) are densely covered with pores. Last two legpairs are thickened in both sexes, much more so in males. Without accessory apical claw on legpair 15.

Legpair 15 tibia of males with a more setiferous depression (fossa), which is distinct and well-developed in specimens in later developmental stages (Fig. 15B), in younger developmental stages only indicated. The depression starts in the first third of the tibia (20–40 % of tibia length) and reaches nearly up to the end of the tibia (80–90 % of tibia length) and has a relative length of about 40 to 50 % of tibia (n = 85).

Coxal pores. Round, 2–4 (sometimes 5) pores on each coxa (Fig. 6, Table 9). Mostly 2, 3, 3, 2 or 3, 3, 2 (coxae 15–12) with the highest observed number of 4, 5, 5, 4 in a female (Table 15).

Plectrotaxy. The plectrotaxy of legs of *L. crassipes* is given in Table 17.

Male gonopods. Uni-articulated.

Female gonopods. Basal article with two conical spurs on each side, their apical edge serrated (Fig. 16B). With 6–13 (mostly 8) ventrolateral setae with nearly the same length. No dorsomedial setae. Article II with 3–4 (mostly 3) dorsolateral setae, stout, straight and fairly long, evenly distributed over the whole length of the article. Ventrolaterally with 4–6 (mostly 6) setae without characteristic arrangement. Article III with 1 dorsolateral seta, 1 ventrolateral, 1 ventral and 2 ventromedial setae. Claw tridentated, dorsal denticle longer than the ventral denticle. At high magnification (SEM) with distinct pores of glandulae.

Distribution. Widespread in Europe. The species has been recorded from several more or less precise Spanish localities (Fig. 17): Granada (Meinert 1872, Attems 1927); Cerro del Mirador, Sevilla (Attems 1952); Av. del Roquer, Chiribel, Albex, Almería (Serra 1980, 1982); Mestas de Con, Asturias (Serra 1982).

All current records of *L. crassipes* on the Iberian Peninsula are doubtful and need further verification (see discussion above). Some records from the literature have been assigned here to *L. crassipesoides* sp. n. or *L. morenoi*.

***Lithobius (Monotarsobius) morenoi* Garcia Ruiz & Baena, 2014, stat. n.**

Fig. 17

Lithobius crassipes morenoi Garcia Ruiz and Baena, 2014: 58–61, fig. 1, tables I–II.

Lithobius crassipes morenoi – Serra 1982: (record). – Garcia Ruiz and Baena 2014: 61 (discussion). – Garcia Ruiz 2015: 9 (in checklist for Spain).

Distribution. Known from two caves (Sima LQ-14, Abuchite, Luque; Sima de la Sierrazuela/Sima Fuente del Francés, Carcabuey) in Andalusia and from Jerez de la Frontera (Cádiz), Spain (Fig. 17).

Remarks. This subspecies was described by Garcia Ruiz and Baena (2014) based on specimens from two caves in the Cordoba province in Andalusia. It clearly differs from *L. crassipes crassipes* in the low number of ocelli (only three), the enlarged Tömösváry's organ, and the absence of some spines, particularly of Vmt, VaF, and DaH on legpair 15. Garcia Ruiz and Baena (2014) also discuss the record of *L. crassipes* by Serra (1982) coming from Cv. de las Motillas, Jerez de la Frontera (Cádiz), which was also considered by them as probably representing *L. crassipes morenoi*. The specimens of Serra (1982) have the same morphological peculiarities regarding number of ocelli (three), Tömösváry's organ and modification of male legpair 15 tibia as the subspecies *L. c. morenoi*. All records from *L. c. morenoi* are from the same geographical area in Andalusia, localized near the cities of Seville and Cordoba. Therefore, we are elevating *L. c. morenoi* species status and assigning the Jerez de la Frontera records of *L. crassipes* to *L. morenoi* stat. n.

***Lithobius (Monotarsobius) blascoi* Eason, 1991**

Fig. 17

Lithobius blascoi Eason 1991: 179–183, figs. 1–6, table 1

Lithobius blascoi – Garcia Ruiz and Baena 2014: 56 (listed). – Garcia Ruiz 2015: 9 (in checklist for Spain).

Distribution. So far only known from the type locality Pina de Ebro near Zaragoza, Spain (Fig. 17).

***Lithobius (Monotarsobius) osellai* Matic, 1968**

Fig. 17

Lithobius osellai Matic 1968: 123–125, fig. 4*Lithobius osellai* – Serra 1982: 47 (record, description), 49 (in key). – Garcia Ruiz and Baena 2014: 56 (listed). – Garcia Ruiz 2015: 9 (in checklist Spain).*Lithobius* cf. *osellai* – Voigtländer and Reip 2013: 235, tab. 1, figs 27–30 (record, description).

Distribution. In Spain (Fig. 17) known from two localities in the Sierra de Gredos, in central Spain (Matic 1968, Serra 1982), and one uncertain record from the Sierra de Grazalema, Andalusia (Voigtländer and Reip 2013). There is also one doubtful record from Malta (Kime 2003).

Key to the species of *Lithobius (Monotarsobius)* of the Iberian Peninsula

Key is valid for adult specimens only.

- | | | |
|---|--|--------------------------------------|
| 1 | 3 or 4 ocelli arranged in one row only..... | 2 |
| – | 6–13 ocelli arranged in two or three rows | 3 |
| 2 | Ventral plectrotaxy of LP15 = --, m, amp, -m-, ---. VaP present from LP13 to LP15, VpF from LP8 to LP14, VaT from LP7 to LP13 and DaP from LP10 to LP15. Male LP15 tibia with a weak depression on the dorsal side..... | |
| | <i>L. morenoi</i> Garcia Ruiz & Baena, 2014 stat. n. | |
| – | Ventral plectrotaxy of LP15 = --, m, -mp, -m-, -m-. No VaP, VpF, VaT and DaP spines on legs | <i>L. osellai</i> Matic, 1968 |
| 3 | Antennae with 22 to 23 (rarely 24, unusually 25) articles. 6–7 ocelli arranged in two rows (usually 1 + 3, 3). Angular shoulders on each side of the lateral teeth on the forcipular coxosternite. No VaP, VaF, VpF, DaP nor DpT spines on legs. Male with a dorsal wart near the extremity of the LP15 femur and a weak sulcus in the distal two thirds of LP15 tibia..... | |
| | <i>L. blascoi</i> Eason, 1991 | |
| – | Antennae with usually 20 articles (18–21). 6–13 ocelli arranged in two or three rows. No angular shoulders on each side of the lateral forcipular teeth. VaP at least exist on LP15, VaF at least from LP12 to LP15, VpF at least from LP13 to LP14, DaP at least on LP15 (or very rarely lacking), DpT at least on LP12 and/or LP13. Male with a depression on dorsal side of LP15 tibia..... | 4 |
| 4 | Body usually 6–11 mm long. Usually, DaP starts on LP14 or on LP15, exceptionally from LP12, rarely from LP13 or totally lacking. Male dorsal depression of LP15 tibia shorter; starts in the posterior half of LP15 tibia (Fig. 15A) | |
| | <i>L. crassipesoides</i> Voigtländer, Iorio, Decker & Spelda, sp. n. | |

- Body 8.5–12 mm long (extreme values 7.9 and 13.2). Usually, DaP starts from LP7 to LP11 until LP15, very rarely from LP12 or LP13. Male dorsal depression of LP15 tibia longer, starts in the first third of LP15 tibia (Fig. 15B) ***L. crassipes* L. Koch, 1862**

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Supplementary material I

Full data of investigated specimens of *Lithobius crassipes*

Authors: Karin Voigtländer, Etienne Iorio, Peter Decker

Data type: Occurrence and collection

Explanation note: Information on locality, date, collector, collection, sex of investigated specimens of *Lithobius crassipes*.

Copyright notice: This dataset is made available under the Open Database License (<http://opendatacommons.org/licenses/odbl/1.0/>). The Open Database License (ODbL) is a license agreement intended to allow users to freely share, modify, and use this Dataset while maintaining this same freedom for others, provided that the original source and author(s) are credited.

Link: <https://doi.org/10.3897/zookeys.681.12942.suppl1>

A review of the *Cercyon* Leach (Coleoptera, Hydrophilidae, Sphaeridiinae) of the Greater Antilles

Emmanuel Arriaga-Varela^{1,2}, Matthias Seidel^{1,2}, Albert Deler-Hernández¹,
Viktor Senderov^{3,4}, Martin Fikáček^{1,2}

1 Department of Zoology, Faculty of Science, Charles University, Prague, Viničná 7, CZ-128 44 Praha 2, Czech Republic **2** Department of Entomology, National Museum, Cirkusová 1, CZ-193 00 Praha, Czech Republic **3** Pensoft Publishers, Prof. Georgi Zlatarski Street 12, 1700 Sofia, Bulgaria **4** Institute of Biodiversity and Ecosystems Research, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria

Corresponding author: Emmanuel Arriaga-Varela (arriagavarelae@natur.cuni.cz)

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Abstract

The representatives of the genus *Cercyon* Leach occurring in the Greater Antilles are reviewed. Ten species are recorded, of which five are described here as new: *C. gimmeli* **sp. n.** (Dominican Republic), *C. armatipenis* **sp. n.** (Dominican Republic), *C. taino* **sp. n.** (Dominican Republic), *C. sklodowskiae* **sp. n.** (Jamaica) and *C. spiniventris* **sp. n.** (Dominican Republic). Diagnoses and detailed distributional data are also provided for *C. floridanus* Horn, 1890 (distributed in southeastern United States of America and Cayman Islands), *C. insularis* Chevrolat, 1863 (endemic to the Antilles), *C. praetextatus* (Say, 1825) (widely distributed in the New World incl. Greater Antilles), *C. quisquilius* (Linnaeus, 1761) (an adventive species of Palearctic origin) and *C. nigriceps* (Marshall, 1802) (an adventive species probably of Oriental origin). *Cercyon armatipenis*, *C. gimmeli*, *C. taino* form a group of closely related species only distinguishable by male genitalia and DNA sequences. A key to the Great Antillean *Cercyon* is provided and important diagnostic characters are illustrated. The larvae of *C. insularis* and *C. taino* were associated with adults using COI barcode sequences, illustrated and diagnosed. Full occurrence data, additional images and COI barcode sequences were submitted to open access on-line depositories in an effort to provide access to complete data.

Keywords

Megasternini, morphology, taxonomy, new species, Caribbean, COI, DNA barcode, larva, biodiversity informatics

Introduction

Until very recently, water scavenger beetles (Hydrophilidae) from the Greater Antilles in the Caribbean Region were largely neglected and systematic or faunistic studies were scarce. For instance, 46 of 56 hydrophilid species recorded from Cuba were described in the 18th and 19th centuries (Peck 2005). Nevertheless, recent taxonomic studies have brought to light many new species and new country records in this region e.g. in genera *Berosus* Leach (Deler-Hernández et al. 2013a), *Enochrus* Thomson (Deler-Hernández and Delgado 2010; Short 2005), *Oosternum* Sharp (Deler-Hernández et al. 2014), *Phaenonotum* Sharp (Deler-Hernández et al. 2013b) and *Tropisternus* Solier (Spangler and Short 2008). However, many other groups still await a comprehensive treatment, which includes *Cercyon*, the most speciose genus within the subfamily Sphaeridiinae. As with most members of the subfamily, *Cercyon* species have predominantly terrestrial habits, and are frequently associated with decaying plant material and feces. Approximately 260 species have been described from all zoogeographical zones (Short and Fikáček 2011), of which 24 have been recorded from Central and South America (Hansen 1999; Fikáček 2006). The number of described species seems highly underestimated in the Neotropical Region, due to the lack of recent taxonomic work. The most comprehensive identification resource for Central American fauna still remains the iconic *Biologia Centrali-Americana* (Sharp 1882, 1887). The situation is also aggravated by the presence of introduced Old World synanthropic species, which are difficult to recognize and are sometimes confused with native species (Fikáček 2009).

Six species of *Cercyon* have been recorded from the Greater Antilles: the Cuban-endemic *C. insularis* Chevrolat whose identity has remained unclear (Hansen 1999; Peck 2005), two species widely distributed in the New World (*Cercyon variegatus* Sharp, *Cercyon praetextatus* (Say); Leng and Mutchler 1917; Smetana 1984; Fikáček 2009), one species native to southeastern United States of America (*Cercyon floridanus* Horn; Thomas et al. 2013) and two widely distributed adventive species (*Cercyon nigriceps* Marsham, *Cercyon quisquilius* (Linnaeus); Leng and Mutchler 1917; Fikáček 2009). Our recent field work and examination of museum material revealed that additional species occur in the area, which provided the impetus for this study. In order to provide a review that will constitute a reliable reference for future studies on the genus *Cercyon* and the tribe Megasternini, we complemented the traditional taxonomic account with COI sequences (i.e., “DNA barcodes”), complete occurrence data, and full set of high-resolution photographs, all deposited in online freely available platforms.

Material and methods

Examined specimens and depositories. A total of 848 specimens of *Cercyon* from the Greater Antilles were examined, including the type specimens of *Cercyon insularis* Chevrolat and *C. variegatus* Sharp. Label data are only reproduced verbatim for type specimens; each individual label is separated by double slash “//”; notes on the label data or

additional information are written between square brackets []. All holotypes are marked with red label bearing the following text: “HOLOTYPE, *Cercyon* [name of the species] sp. n., Arriaga-Varela, Seidel, Deler-Hernández and Fikáček des. 2016”. All paratype specimens are marked by yellow label bearing the following text: “PARATYPE, *Cercyon* [name of the species] sp. n., Arriaga-Varela, Seidel, Deler-Hernández and Fikáček des. 2016”. A georeferenced dataset of the studied specimens is available as Excel spreadsheet in Suppl. material 1. The file only includes specimens identified to species. The distribution maps (Figs 15–16) were constructed from the GPS data extracted from the Excel spreadsheet and mapped using the R script (see Suppl. material 4).

The examined specimens are deposited in the following collections:

BCPC	Bruno Clarkson private collection, Rio de Janeiro, Brazil;
BMNH	Natural History Museum, London, United Kingdom (M.V.L. Barclay);
CMN	Canadian Museum of Nature, Ottawa, Canada (R. Anderson, F. Génier);
CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada (P. Bouchard);
CNIN	Colección Nacional de Insectos, Instituto de Biología, Universidad Nacional Autónoma México, Mexico City, Mexico (S. Zaragoza);
FSCA	Florida State Collection of Arthropods, Gainesville, USA (P. Skelley);
HNHM	Hungarian National History Museum, Budapest, Hungary (O. Merkl, G. Szél);
MNHNSD	Museo Nacional de Historia Natural, Santo Domingo, Dominican Republic (C. Suriel);
MNHN	Muséum National d’Histoire Naturelle, Paris, France (A. Mantilleri);
NHMW	Naturhistorisches Museum, Wien, Austria (M. A. Jäch);
NMPC	National Museum, Prague, Czech Republic (M. Fikáček);
SBNM	Santa Barbara Museum of Natural History, Santa Barbara, USA (M. L. Gimmel);
SBPC	Stewart Peck Personal Collection, Ottawa, Canada;
UPRM	University of Puerto Rico, Mayagüez, Puerto Rico (A. Segarra);
ZMUC	Zoological Museum, Natural History Museum of Denmark, Copenhagen, Denmark (A. Solodovnikov).

Morphological studies. Specimens were dissected, with genitalia embedded in a drop of alcohol-soluble Euparal resin on a piece of glass glued to a small piece of cardboard attached below the respective specimen. All species are diagnosed and illustrated, and new species are described in detail.

Habitus photographs were taken using a Canon D-550 digital camera with attached Canon MP-E65mm f/2.8 1–5 macro lens. Pictures of genitalia were taken using a Canon D1100 digital camera attached to an Olympus BX41 compound microscope; pictures of different focus were combined in Helicon Focus software. Scanning electron micrographs were taken using Hitachi S-3700N environmental electron microscope at the Department of Paleontology, National Museum in Prague. Pictures used for plates

were adapted in Adobe Photoshop CS6. All original pictures including additional views not presented in this paper are published and freely available on Flickr in order to serve for further morphological studies.

DNA barcoding. Most of the examined specimens were collected during recent expeditions to Cuba, Dominican Republic and Puerto Rico. Samples were preserved in 96% ethanol and stored at -20 °C. DNA was extracted from complete specimens using a QiaGen Blood and Tissue DNA extraction kit following the manufacturer's instructions. The highly variable 5' region of the mitochondrial cytochrome c oxidase subunit I gene (COI) was amplified using LCO1490 (5'-GGTCAACAAATCATAAAGATATTGG-3') and HCO2198 (5'-TAAACTTCAGGGTGACCAAAAAATCA-3') primers (Folmer et al. 1994). Each 10 µl PCR reaction contained 6.7 µl H₂O, 0.4 µl of MgCl₂ (25 mM), 0.2 µl of dNTPs (10 mM), 0.3 µl of each forward and reverse primer (10 µM), 0.1 µl of Taq polymerase (5 u/µl), 1.0 µl of 10x Taq buffer, and 1.0 µl of DNA template. The PCR conditions consisted of 3 min at 94 °C + 35 cycles of 30 s at 94 °C, 45 s at 48 °C and 1 min at 72 °C + 8 min at 72 °C. 5 µl of each PCR product were purified by adding 0.5µl (20 u) Exonuclease I (Exo1) and 1µl (1 u) Thermosensitive Alkaline Phosphatase (FastAP) (Thermo Fisher Scientific) and incubating the mixture for 15 min at 37°C, followed by 15 min at 80°C. The Sanger sequencing was performed by BIOCEV (Vestec, Czech Republic) on a capillary DNA sequencer. Sequences were edited with Geneious 9.1.4. We did not attempt DNA extraction and sequencing of old museum specimens, which is why we only provide sequences for six of the ten species occurring in Greater Antilles.

Analyses of molecular data. In order to identify the larvae collected along with adult specimens, a maximum likelihood analysis of obtained COI sequences was performed. We combined the newly generated sequences of freshly collected adults and larvae, and combined them with additional sequences of two introduced species (*C. quisquilius* and *C. nigriceps* from Europe and Canada) from the Barcode of Life Data Systems (BOLD; <http://www.boldsystems.org>). Sequences were aligned using the ClustalW algorithm in Geneious 9.1.4. The final alignment had a length of 610 bp and was tested for the best nucleotide substitution model using MEGA7 (Kumar et al. 2016). A phylogenetic analysis using the maximum likelihood algorithm and 1000 bootstrap replicates was performed in the same software.

Open access to complete data

This taxonomic paper includes only a part of the data accumulated in the course of our study. Part of the primary data (e.g., unedited photographs, the complete set of unedited SEM micrographs, DNA sequences, spreadsheet-formatted species distribution data) are not included here. To make all primary data accessible, we deposited them to open access on-line depositories as specified below. For more details about biodiversity data publishing, see e.g. the policies and guidelines implemented for Pensoft Publishers (Penev et al. 2011).

Complete primary data. Complete primary data were submitted as a .zip file to the Zenodo depository (<https://zenodo.org/>) under the doi 10.5281/zenodo.580260.

Species distribution data. The distribution data on all specimens examined are presented in unstructured text format directly in the paper. The conversion of these data into a structured, computable format (as XML, so called parsing) is difficult, and no algorithm exists for parsing occurrence records (see Sautter and Böhm 2014 for the analogous problem of parsing literature references).

The text-formatted distribution data published here are, however, based on a structured Excel spreadsheet following the Darwin Core (henceforth DwC) format for biodiversity data described by Wiecezorek et al (2012). DwC defines how the data should be structured (i.e. which columns may be included in the table, how they should be called and which part of the data they should include). In some cases DwC also specifies the format of the entries (e.g., how date should be formatted). Details are available through the website of the Biodiversity Information Standards (TDWG; <http://rs.tdwg.org/dwc/terms/>). Being a formal biodiversity standard, DwC is nowadays used by a wide spectrum of on-line biodiversity portals, e.g. by the Global Biodiversity Information Facility (GBIF), Encyclopedia of Life, and the Atlas of Living Australia. This is the reason why we selected it. The Excel file is attached here as Suppl. material 1, it is included in the .zip file submitted to Zenodo, and was used for the GBIF submission.

The Publication of distribution data to GBIF is possible through the institution or organization, which is a member or partner of GBIF (direct submissions from individual users are not possible) using the Integrated Publishing Toolkit (IPT). IPT allows to upload the distribution data from the DwC-formatted Excel spreadsheet, specify the metadata about the dataset, and publish the data to the GBIF portal. We submitted our data through Pensoft as an organization associated with GBIF using the Pensoft IPT Data Hosting Centre (<http://ipt.pensoft.net/>).

DNA data and voucher information. The cytochrome oxidase I barcode sequences and the data about the voucher specimens were submitted to the Barcode of Life Data Systems (BOLD; <http://www.boldsystems.org/>) using the user web interface available after registration. The submission requires first the submission of the specimen data using the Excel-based spreadsheet following the Specimen Data Submission Protocol (http://www.boldsystems.org/index.php/resources/handbook?chapter=3_submissions.html§ion=data_submissions). To prevent the re-typing of the specimen data again, we wrote an R script converting the data from DwC to the format required for BOLD submissions (see Suppl. material 3). Once specimen data are submitted, all other information (voucher photos, DNA sequences, DNA trace files) can be submitted, using the identification code (SampleID) to connect the data to the respective voucher specimen. We submitted the sequences under Process ID GANTC001-16 and GANTC002-17 to GANTC015-17 in BOLD.

Original photo-documentation. The original photo-documentation includes the unedited high-resolution versions of photos and SEM micrographs that we used in this

publication, plus many photos and SEM micrographs that were taken for comparative purposes but are not published here. We submitted all these files to Zenodo as a part of the .zip file containing all our primary data. Since the images are not easy to see in this way, we also submitted all photos to Flickr photo hosting service where they can be easily displayed; they are available at <https://www.flickr.com/photos/142655814@N07/collections/72157678126129411/>.

Taxonomy

Cercyon Leach, 1817

Cercyon Leach, 1817: 95. - Type species: *Dermestes melanocephalus* Linnaeus (designated by Thomson 1859: 19).

Diagnosis. *Cercyon* can be distinguished from other hydrophilid genera occurring in the Greater Antilles by the following combination of characters: antenna with compact club; prothorax with conspicuous antennal groove not reaching pronotal margin; medial part of prosternum not demarcated from lateral parts; metaventrite without arcuate lines in anterolateral corners; mesoventral plate fusiform, narrowing anteriorly and posteriorly, touching anterior margin of metaventrite in one point.

Cercyon species are very similar to the members of *Pelosoma*, a Neotropical genus that is recorded from the Lesser Antilles; *Pelosoma* differs from *Cercyon* by the mesoventral plate widely contacting the metaventrite (it only narrowly contacts it in *Cercyon*). Small species of *Cercyon* may resemble the members of *Oosternum*, which can be easily distinguished from *Cercyon* by possessing a metaventrite with an arcuate ridge delimiting its anterolateral corner, and in some species also by elevated median part of the prosternum.

Key to the Greater Antilles species of *Cercyon*

- 1 Small species, body length 1.0–2.1 mm. Metaventrite with complete femoral lines (Fig. 13d).....***Cercyon nigriceps* (Marsham)**
- Larger species, body length 2.3–4.1 mm. Metaventrite without femoral lines (Figs 7d, 8g, 9c, h, 10g, 11g, 12g, 13b, f).....**2**
- 2 Mesoventral plate very wide, 1.9× as long as wide (Fig. 7d). Mesoventral plate and pentagonal raised part of the metaventrite with large, deep, semicircular punctures (Fig. 7d) ***Cercyon floridanus* Horn**
- Mesoventral plate moderately to very narrow, 3.3–5.9× as long as wide (Figs 8f, 9c, h, 10f, 11f, 12f, 13b, e). Mesoventral plate and pentagonal raised part of the metaventrite with small and shallow punctures (Figs 8g, 9c, h, 10g, 11g, 12g, 13b, f).....**3**
- 3 Mesoventral plate wide, 3.3× as long as wide (Fig. 13a). Dorsal coloration black, with large yellow spot at elytral apex; lateral margin of elytra narrowly

- yellow, the yellow stripe not widened in humeral area (Fig. 2g–i).....
 ***Cercyon praetextatus* (Say)**
- Mesovenal plate narrow, 5.7–6.3× as long as wide as long as wide (Figs 8f, 9c, h, 10g, 11g, 12g, 13e). Dorsal coloration variable, if elytra is black with a large yellowish spot at apex, then the yellow coloration at the lateral margin of elytra expands to humeral area..... **4**
- 4 Metaventrite with raised pentagonal area markedly wide at midlength, 0.6× as long as wide (Fig. 13f) ***Cercyon quisquilius* (Linnaeus)**
- Metaventrite with raised pentagonal area rather narrow at midlength, 0.9–1.2× as long as wide (Figs 8g, 9c, h, 10g, 11g) **5**
- 5 Dorsal surface of head black, with reddish-brown spot(s) at vertex. Pronotum (Fig. 4a) yellowish to dark reddish, with a large median spot and smaller spot on each side, often fused together into one large tri-lobate spot. Elytra brown with black humeral spots extending to anterior margin and suture. Prosternum with median ridge not projected ventrally at anterior margin (Fig. 12c).....
 ***Cercyon insularis* Chevrolat**
- Dorsal surface of head including vertex black, anterolateral margins of clypeus yellowish. Pronotum either black with yellowish to reddish lateral margins (Figs 1a–i, g, 2a–c), or uniformly light brown (Fig. 3a–i). Elytra either more or less uniformly brown, or black with yellowish to reddish lateral and apical parts..... **6**
- 6 Pronotum uniformly light brown, elytra more or less uniformly greyish-brown (Fig. 3a). First abdominal ventrite of females (Fig. 11h) with longitudinal carina prolonged into an acute spiniform setose process; longitudinal carina of male first abdominal ventrite not projected. Raised area of metaventrite comparatively wide, 0.8× as long as wide (Fig. 11g).....
 ***Cercyon spiniventris* sp. n.**
- Pronotum and elytra black with pale contrasting markings (Figs 1a, c, d, f, g, i, 2a, c): pronotum black with creamy-white or reddish lateral margins; elytra black with creamy-white to reddish humeral spot, lateral margins and apical third. First abdominal ventrite of both sexes not projecting beyond posterior margin (Figs 8h, 10h). Raised area of metaventrite rather narrow, 1.1–1.2× longer than wide (Figs 8g, 9c, h) **7**
- 7 Prosternum with median ridge forming a small rounded to weakly pointed process (Fig. 10c). Raised median area of metaventrite reaching anterior margin of metaventrite (Fig. 10g). Anterior margin of mentum emarginate medially (Fig. 10a). Apex of fifth abdominal ventrite with a triangular bulged projection in females (Fig. 10i), not modified in males. Jamaica
 ***Cercyon sklodowskiae* sp. n.**
- Prosternum with median ridge forming a large rounded knob (Figs 8c, 9g). Raised median area of metaventrite not reaching anterior margin of metaventrite (Figs 8g, 9c, h). Anterior margin of mentum not emarginate medially

- (Figs 8a, 9a, h). Apex of fifth abdominal ventrite rounded in both sexes. Hispaniola..... ***Cercyon gimmeli* species group...8**
- 8 Median lobe strongly acuminate at apex (Fig. 5f–g); parameres distinctly shorter than phallobase (Fig. 5e) ***Cercyon taino* sp. n.**
- Median lobe blunt at apex (Fig. 5c, k); parameres as long as or longer than phallobase (Fig. 5a, i)..... **9**
- 9 Median lobe wide basally, narrowing apically, with large gonopore and many spines in apical fifth (Fig. 5j–k); parameres ca. as long as phallobase (Fig. 5i).... ***C. armatipenis* sp. n.**
- Median lobe narrowly parallel-sided, with indistinct gonopore and without spines at apex (Fig. 5b–c); parameres distinctly longer than phallobase (Fig. 5a) ***C. gimmeli* sp. n.**

Species treatments

Cercyon gimmeli species group

This species group is composed of three very closely related species endemic to the island of Hispaniola. Specimens are indistinguishable on the basis of external morphology and can be only told apart by examination of male genitalia. At least in one locality, two species of this group were collected syntopically. For this reason, we refrain from using female specimens as paratypes unless the specimen was associated with males by DNA barcode, and female specimens are not listed in the text below neither in the DarwinCore spreadsheet submitted to GBIF for that reason. Below, we provide a diagnosis allowing to separate all species of the species group from other *Cercyon* species. Further on, we describe *Cercyon gimmeli* sp. n. in full, and provide only comparative diagnoses for the other two species, *C. armatipenis* sp. n. and *C. taino* sp. n.

Diagnosis of the *Cercyon gimmeli* species group. Members of the species group can be differentiated from other Greater-Antillean *Cercyon* by the following combination of characters: size 2.8–3.5 mm; dorsal surface of head black, with yellowish anterolateral margins of clypeus; pronotum black with sharply defined creamy-white areas at lateral margins; elytra black, with large, pale, rather sharply defined spot in posterior third of both elytra (Fig. 1); anterior margin of mentum not emarginated (Figs 8a, 9a, f); medial ridge of prosternum anteriorly forming a rounded knob (Figs 8c, 9g); mesoventral plate narrow, ca. 5.7× as long as wide (Figs 8f, 9c, h); metaventricle (Figs 8g, 9c, h) without femoral lines, with narrow raised pentagonal area, 1.1× as long as wide; first abdominal ventrite without spine-like process in both sexes (Fig. 8h); metatibia slightly bent outwards; apex of fifth abdominal ventrite without an apical triangularly bulged projection in both sexes (Fig. 8i).

By the dorsal coloration, the species of *C. gimmeli* group could be confused with *C. praetextatus* (Say), *C. floridanus* Horn and *C. sklodowskiae* sp. n. However, they can be easily distinguished from from *C. praetextatus* and *C. floridanus* Horn by the distinctly

narrower mesoventral plate (compare Fig. 8f with Figs 7d and 13a) and yellow coloration of lateral part of elytra expanding to humeral area at elytral base, and from *C. sklodowskiae* sp. n. by the bare median portion of mesoventrite not reaching anteriorly, bulged projection of the prosternum, metatibia slightly bent outwards, anterior margin of mentum not emarginated, and females without a triangularly bulging projection at apex of the fifth ventrite.

Distribution. The species group is endemic to Hispaniola and seems widespread on the island. No records are known from Haiti, likely due to collecting bias.

***Cercyon gimmeli* sp. n.**

<http://zoobank.org/DDB83C0C-AAF4-4BE7-BD49-E86443ADD650>

Figures 1a–c, 5a–d, 8a–i, 15a

DNA barcodes. GANTC002-17 to GANTC006-17

BIN ID. BOLD:ADF7790.

Figures on Flickr. www.flickr.com/photos/142655814@N07/albums/72157-671425298360

Type locality. Dominican Republic, Samaná Province, Monumento Natural Salto, El Limón 2.8 km SSW of El Limón, 19°16.56'S 69°26.47'W, 160 m a.s.l.

Type material. Holotype (male): “DOMINICAN REP.: Samaná, MN Salto El Limón 2.8 km SSW of El Limón; 19°16.56'S 69°26.47'W; 160 m; 2.ix.2014, Deler, Fikáček, Gimmel. DR29a // secondary vegetation and tiny remnants of forest among coffee plantations and pastures: in horse excrement” (NMPC) [DNA extract: MF1256.1]. **Paratypes: DOMINICAN REPUBLIC: Samaná:** same label data as the holotype (1 males, 1 female: NMPC; 1 male: BCPC; 1 male: CNC; 1 male: CNIN; 1 male: SBNM) [DNA extract: MF1256.2 in NMPC]. **La Vega:** “DOMINICAN REP.: La Vega, PN A. Bermúdez, 8 km W of Manabao, 19°4.05'N, 70°51.98'W, 1140 m, 22–26.viii.2014, Deler, Fikáček, Gimmel DR16 // montane broad-leaf forest: in cow and horse excrement” (2 males: NMPC). “DOMINICAN REPUBLIC: Pr. La Vega La Ciénaga de Manabao, Park Hdqt, 3-5-VII-1999, 3000 ft, R.E. Woodruff, blacklight” (1 male: FSCA). **Monseñor Nouel:** “DOMINICAN REP.: Msñ. Nouel, PN La Humeadora; 11.6km SSW, of Piedra Blanca; 18°44.92'N, 70°21.63'W; 636 m; 8.ix.2014, Deler, Fikáček, Gimmel DR41 // in horse excrement in moist broad-leaf forest in a valley of a small stony stream” (14 males, 2 females: NMPC; 1 male: BMNH; 1 male: CMN; 2 males: MNHNSD; 1 male: NHMW; 3 males: SBNM) [DNA extracts of both females: MF1217.1, MF1217.2 in NMPC]. **Barahona:** “DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 26-VI/7-VII-1992: Woodruff & Skelley, flight trap” (2 males: FSCA; 2 males: NMPC). “DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 26-VI/7-VII-1992: Woodruff, Skelley, Skillman. dung trap” (10 males: FSCA; 4 males: NMPC). “DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 20-VII/26-VI-1992: Woodruff & Skelley, human dung” (7 males: FSCA). “DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine:

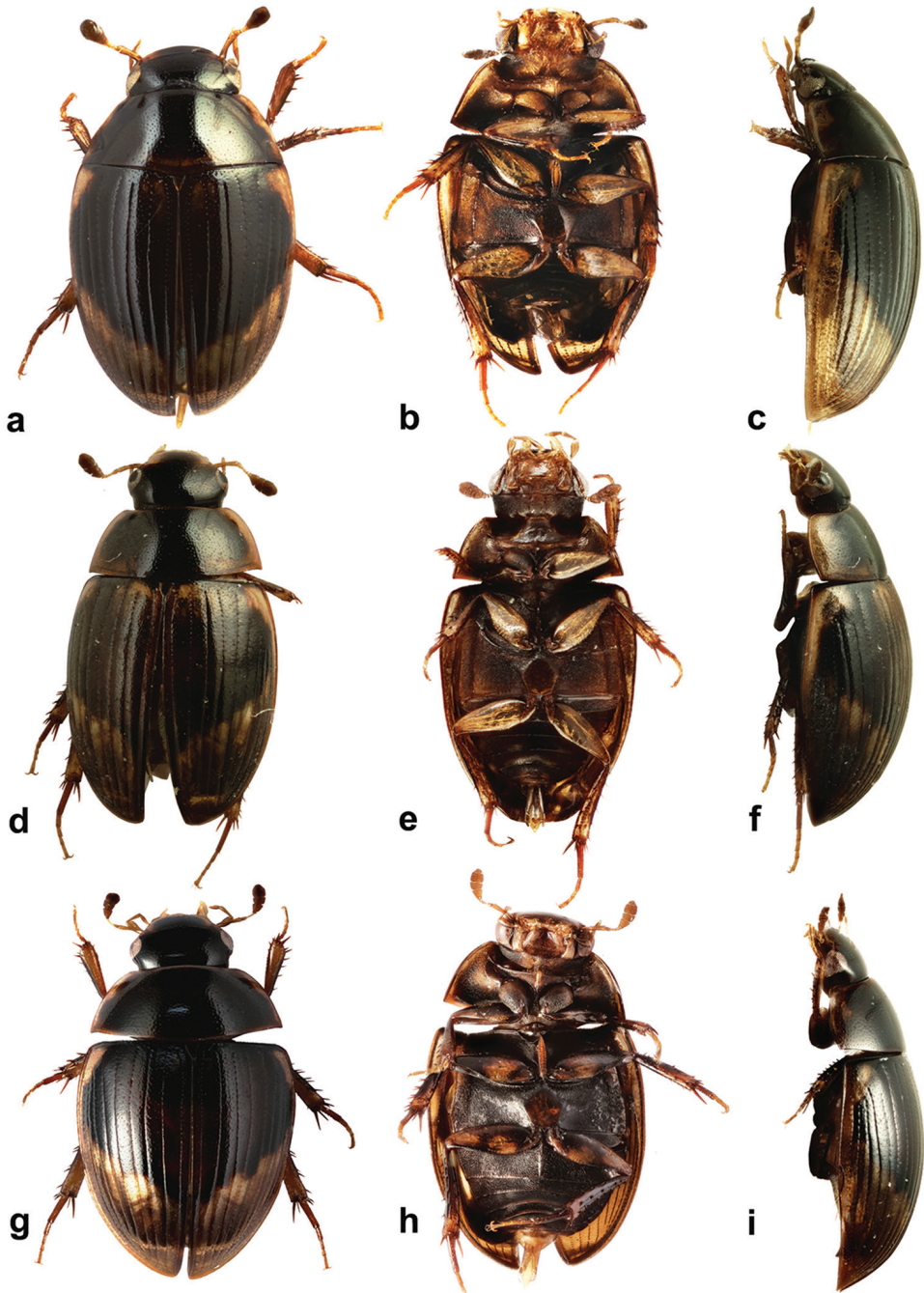


Figure 1. *Cercyon* spp. n. **a–c** *Cercyon gimmeli* sp. n. **d–f** *Cercyon armatipenis* sp. n. **g–i** *Cercyon taino* sp. n. **a, d, g** dorsal habitus **b, e, h** ventral habitus **c, f, i** lateral habitus.

26-VI/7-VII-1992: Woodruff, Skelley & Skillman, at light" (5 males: FSCA). "DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 20-VII/26-VI-1992: Woodruff & Skelley, at day" (2 males: FSCA). DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 20-VII/26-VI-1992: Woodruff & Skelley, at light" (5 males: FSCA). "DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 26-VI/7-VII-1992: Woodruff & Skelley, rat carrion" (1 male: FSCA). "DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 26-VI/7-VII-1992: Skelley, day catch, beating" (1 male: FSCA).

Diagnosis. Externally identical with other members of the *Cercyon gimmeli* species group, it may be only distinguished from them by the morphology of the aedeagus (Fig. 5a–d): parameres longer than the phallobase; median lobe without spines, narrowly parallel-sided, with rounded apex.

Description. *Body.* (Fig. 1a–c) 2.8–3.5 mm long (length of holotype: 3.25 mm); long oval, 1.8–1.9× as long as wide, widest at basal fourth of elytra; moderately convex, 3.2× as long as high, (height of holotype: 1.05 mm). *Coloration.* Dorsal surface of head black, clypeus with widely yellowish anterolateral margins. Antennae and ventral surface of head, including mouthparts, brown, antennal club dark-brown. Pronotum black, with a wide, rather sharply defined creamy-white area along lateral margins, broader at anterior half. Prosternum and hypomeron brown, gradually turning black in posterior half. Elytra dark brown to black, with large, pale, rather sharply defined apical spot covering posterior quarter of elytral interval 1, and gradually larger portion on subsequent intervals up to posterior three-quarters of interval 9; two lateralmost intervals completely pale; apical area slightly darker (yellowish brown) posteriorly, with bright yellowish stripe or spots at least along its anterior border; basal portion of elytra with a pair of pale elongated dots at sides of scutellar shield. Ventral surface of mesothorax blackish to pitchy black. Metepisternum brown. Metaventrite brown with dusk anteromedial part. Abdomen brown, ventrites sometimes with dusky marks on anterior margin. Legs yellow to brown ventrally, dorsally with black markings on femora.

Head. Clypeus with rather sparse and shallow punctation consisting of crescent-shaped setiferous punctures intermixed with denser, smaller and rather transverse non-setiferous punctures; interstices without microsculpture. Anterior margin of clypeus with a narrow bead. Frontoclypeal suture conspicuous as a zone without punctuation, vanished in middle. Frons with punctation similar to that on clypeus, punctures of same shape all over, slightly sparser on sides; interstices without microsculpture. Eyes rather small; interocular distance about 6× the width of one eye in dorsal view. Labrum membranous, nearly completely concealed under clypeus, only with narrowly exposed sinuate anterior margin. Mentum (Fig. 8a) subtrapezoid, widest at posterior fourth, about 2.1× wider than long, 1.3× wider at widest part than at anterior margin, concave in anterior half, with a shallow transverse impression anteromesally; surface glabrous, punctures rather small and shallow, almost vanishing anteromesally, interstices without microsculpture. Antenna with 9 antennomeres, scapus ca. 1.7× as long as antennomeres 2–6 combined; antennal club moderately elongate, about twice as long as wide, about as 1.1× as long as scapus; antennomere 9 acuminate at apex.

Prothorax. Pronotum transverse, widest at base $2.1\text{--}2.2\times$ wider than long; $1.8\times$ wider at base than between anterior angles, $1.8\times$ wider than head including eyes, as convex as elytra in lateral view. Punctuation moderately dense and shallow, consisting of crescent-shaped setiferous punctures intermixed with denser, smaller and rather transverse non-setiferous punctures; punctures slightly feebler on sides. Prosternum (Fig. 8b) strongly tectiform medially, medial ridge thickened in anterior half, forming a large rounded knob in lateral view (Fig. 8c). Antennal grooves distinct, with lateral margin curved, slightly feebler anteriorly.

Pterothorax. Scutellar shield $1.1\times$ as long as wide, sparsely punctured. Elytra widest at anterior fifth, $2.55\text{--}2.85\times$ as long as pronotum, $1.25\text{--}1.35\times$ as wide as pronotum; surface glabrous (Fig. 8d), with 10 series of punctures; series 6, 8 and 9 not reaching elytral base, serial punctures getting slightly larger laterally; intervals moderately convex; punctuation of interval 1 and odd intervals composed of crescent-shaped setiferous punctures intermixed with denser, smaller and rather transverse non-setiferous punctures; even intervals with non-setiferous punctures only; all interstices without microsculpture. Humeral bulge indistinct. Mesoventral plate (Fig. 8f) narrowly elongate, ca. $5.7\times$ as long as wide, widest at midlength, gradually and symmetrically narrowing posteriad and antieriad to pointed apices, posterior tip slightly overlapping over anterior portion of metaventrite; surface with few sparsely arranged coarse punctures. Metaventrite with narrow median raised pentagonal area (Fig. 8g), $1.1\times$ as long as wide at widest portion, glabrous, weakly and sparsely punctate, punctures with fine setae at least along margins of elevation, with bare area not reaching anterior margin; femoral lines absent; lateral parts of metaventrite densely covered by short pubescence.

Legs. Femora with sparse rather shallow punctures ventrally, interstices with weak microsculpture at bases, consisting of longitudinal lines; tibial grooves distinct. Tibiae with rather large lateral spines. Metatibiae moderately narrow and elongate, slightly bent outwards, $0.3\text{--}0.4\times$ as long as elytra, $5.3\times$ as long as wide. Metatarsus long, $0.9\times$ as long as metatibia, with few short but rather stout setae ventrally.

Abdomen with five ventrites, first abdominal ventrite about as long as second and third ventrites combined, with distinct median longitudinal carina (Fig. 8h) narrowing posteriad, not projecting posteriorly in both sexes; fifth ventrite (Fig. 8i) with acuminate and very weakly bulged apex in both sexes.

Male genitalia. Median projection of sternite 9 (Fig. 5d) very narrow, shorter than lateral struts, without subapical setae. Aedeagus: Phallobase (Fig. 5a) distinctly shorter than parameres, asymmetrically narrowing basally, base widely rounded. Parameres narrow throughout, slightly widened apically, subsinuate on outer face near apex, apex pointed, with a couple of setae. Median lobe (Fig. 5b) narrow throughout, indistinctly narrowing apically; apex (Fig. 5c) rounded with finely truncate tip, gonopore moderately large, situated subapically; basal portion with dorsal plate narrow and simply bifid basally. Median projection of sternite 9 (Fig. 5a) very narrow, shorter than lateral struts, without subapical setae.

Variability. In some specimens the pale spots at sides of the scutellar shield are longer, almost reaching the second fourth of elytral length.

Etymology. We are pleased to dedicate this species to Matthew L. Gimmel (Santa Barbara Museum of Natural History), who participated in the expedition to the Dominican Republic and collected part of the type series of this species.

Distribution. Dominican Republic: Barahona, La Vega, Monseñor Nouel, Samaná (Fig. 14a).

Biology. All specimens were collected in broad-leaf tropical forests and coffee plantations and pastures, mainly on cow and horse dung, but also on human dung, rat carrion, at black-light or at day by beating.

***Cercyon armatipenis* sp. n.**

<http://zoobank.org/B937F9C3-3948-4256-8879-37EF7A6ACCBC>

Figures 1d–f, 5i–l, 9a–d, 15a

DNA barcodes. GANTC013-17, GANTC014-17

BIN ID. BOLD:ADF5573

Figures on Flickr. www.flickr.com/photos/142655814@N07/albums/721576763-45486243

Type locality. Dominican Republic, Independencia Province, Parque Nacional Sierra de Neiba, 11.3 km NW of La Descubierta, 18°39.81'N, 71°46.17'W, 1650 m a.s.l.

Type material. Holotype (male): “DOMINICAN R.: Independencia, PN Sierra de Neiba, 11.3 km NW of La Descubierta; 1650 m, 18°39.81'N, 71°46.17'W; 18.viii.2014, Deler, Gimmel DR13 // disturbed montane cloud forest with many ferns and mosses: in cow excrement” (NMPC). **Paratypes: DOMINICAN REPUBLIC: Independencia:** same label data as the holotype (2 males: NMPC; 1 male: BMNH; 1 male: SBNM) [DNA extractions MF1264.5, MF1264.6 in NMPC].

Diagnosis. Externally identical with other members of the *Cercyon gimmelii* species group, it may be only distinguished from them by the morphology of the aedeagus (Fig. 5i–l): parameres as long as phallobase; median lobe moderately wide basally, narrowing apicad, with spines in apical fifth, apex finely truncate.

Description. Measurements. (Fig. 1d–f) 3.0–3.7 mm long (length of holotype: 3.45 mm); 1.8–1.9× as long as wide, 3.2× as long as high (height of holotype: 1.15 mm).

Conforming to the description of *C. gimmelii*, with the following differences: *Pterothorax*. Punctuation of even intervals consisting of small non-setiferous punctures, but here and there with infrequent crescent-shaped larger setiferous punctures; only lateral-most elytral interval completely pale.

Male genitalia. Median projection of sternite 9 (Fig. 5l) moderately wide, slightly widening apically, with few subapical setae. Phallobase (Fig. 5i) as long as parameres, asymmetrically narrowing basally, base narrowly rounded. Parameres wide basally,

gradually narrowing towards apex, sinuate on outer face near apex, apex rounded, with 3 apical and few subapical setae. Median lobe (Fig. 5j) wide basally, gradually narrowing towards apex; (Fig. 5k) apex finely truncate, with numerous backward-directed spines on dorsal and lateral surfaces; gonopore large, subapical; basal portion with dorsal plate simply bifid.

Etymology. The species name is derived from Latin words *armatus* (armed) and *penis* (penis), in reference to the diagnostic character of this species, i.e. the apex of the median lobe armed by small spines.

Distribution. Dominican Republic: Independencia (Fig. 15a).

Biology. Specimens were collected in cow dung in a cloud forest.

***Cercyon taino* sp. n.**

<http://zoobank.org/7EEF52BE-5EAE-412C-AE23-DD1AB8CA8C1A>

Figures 1g–i, 5e–h, 9f–i, 15b

DNA barcodes. GANTC007-17 to GANTC009-17

BIN ID. BOLD:ADF5574

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Type locality. Dominican Republic, Samaná Province, dam 2.5 km N of Samaná, 58 m a.s.l., 19°13.70'N, 69°19.85'W.

Type material. **Holotype** (male): “DOMINICAN REP.: Samaná, dam 2.5 km N of Samaná, 19°13.70'N, 69°19.85'W; 58 m, 5.ix.2014, Deler, Fikáček, Gimmel DR35 // in older cow excrements damped by recent rains at the grassy bank of a reservoir” (NMPC) [DNA extract: MF1735]. **Paratypes: DOMINICAN REP.: La Vega:** “DOMINICAN REP.: La Vega, PN Valle Nuevo, Salto Aguas Blancas; 18°50.60'N, 70°40.68'W; 1655 m; 25.viii.2014, Deler, Fikáček, Gimmel DR21 // Sifting of moist leaf litter in small remnants of montane forest in a small ravine with a spring and on slopes just above the small river” (5 males: NMPC); “DOMINICAN REP.: La Vega, PN A. Bermúdez, 10.3 km W of Manabao, 19°4.37'N, 70°53.26'W, 1270 m, 26.viii.2014, M. Fikáček lgt. (DR22) (2 males: NMPC). **Independencia:** “DOMINICAN R.: Independencia, PN Sierra de Neiba, 11.3 km NW of La Descubierta; 1650 m, 18°39.81'N, 71°46.17'W; 18.viii.2014, Deler, Gimmel DR13 // disturbed montane cloud forest with many ferns and mosses: in cow excrement” (1 male: NMPC; 1 male: BMNH; 1 male: SBNM) [DNA extract: MF 1264.1 in NMPC].

Diagnosis. Externally identical with other members of the *Cercyon gimmelii* species group, it may be only distinguished from them by the morphology of the aedeagus (Fig. 5e–g): parameres shorter than phallobase; median lobe without spines, narrowly parallel-sided, pointed at apex.

Description. *Measurements.* (Fig. 1g–i) 2.8–3.5 mm long (length of holotype: 3.35 mm); 1.8–1.9× as long as wide, 3.2× as long as high (height of holotype: 1.10 mm).

Conforming with description of *C. gimmeli*, with the following differences: *Pterothorax*. Punctuation of even intervals consisting of small non-setiferous punctures, but here and there with infrequent crescent-shaped larger setiferous punctures; only lateralmost elytral interval completely pale.

Male genitalia. Median projection of sternite 9 (Fig. 5h) moderately wide, slightly widening apically, with few subapical setae. Phallobase (Fig. 5e) longer than parameres, asymmetrically narrowing basally, base widely rounded. Parameres narrow throughout, slightly narrowing towards apex, weakly sinuate on outer face near apex, apex rounded, with one apical and one subapical seta. Median lobe (Fig. 5f) narrowly parallel-sided throughout, apically narrowing into pointed apex (Fig. 5g), apex without spines, gonopore minute, subapical; basal portion with dorsal plate simply bifid.

Etymology. The new species is named after the indigenous Taíno people inhabiting the Greater Antilles including Hispaniola before and at the time of the arrival of Europeans.

Distribution. Dominican Republic (Samaná, La Vega, Independencia) (Fig. 15b).

Biology. Examined specimens and the associated larvae (see below) were collected from leaf litter of montane forests and from cow dung.

***Cercyon sklodowskiae* sp. n.**

<http://zoobank.org/6679B59D-E7CE-4D95-8894-12C6084607A4>

Figures 2a–c, 5m–p, 10a–l, 15c

Figures in Flickr. www.flickr.com/photos/142655814@N07/albums/721576695-07211493

Type locality. Jamaica, Saint Thomas Parish, Corn Puss Gap, 6.44 km N of Bath. 640 m a.s.l.

Type material. **Holotype** (male): “JAM., St. Thomas, Corn Puu Gap [sic!, = Corn Puss Gap], 2100', 4mi. N, Bath, 3-8.VIII.1974, S. Peck, dung” (CNC). **Paratypes: JAMAICA: St. Thomas:** same data as the holotype (1 female: CNC; 1 female: NMPC); “JAM., St. Thomas, Corn Puss Gap, 2100”, 4mi. N, Bath, 3.viii.74, S. Peck, DT16-20” (1 male: CNC); “JAM., St. Thomas P. Portland Gap, 5500', 17.XII.72-1.I.73, S&J Peck, cloud for., dung&carriion tr.” (1 male, 1 female: CNC); “JAM., St. Thomas P, Portland Gap, 17.XII.72-1.II.73, S & J Peck (1 female: CNC); “JAM., St. Thomas, below Port. Gap, 1-5.VIII.1974, 4500”, S. Peck, dung trap 12” (1 female: CNC).

Diagnosis. *Cercyon sklodowskiae* sp. n. can be easily differentiated from other Greater-Antilles *Cercyon* species by the following combination of characters: body size 3.1–3.5 mm; dorsal surface of head black with yellowish anterolateral margins of clypeus; pronotum black with sharply defined yellowish areas at lateral margins (Fig. 2c); elytra (Fig. 2a) black, with large apical spot covering posterior third; medial ridge of prosternum anteriorly forming a small rounded to weakly pointed projection (Fig. 10c); mesoventral plate (Fig. 10f) narrow, ca. 5.8× as long as wide; metaventricle (Fig. 10g) without femoral lines, with narrow raised pentagonal area, 1.2× as long as wide;

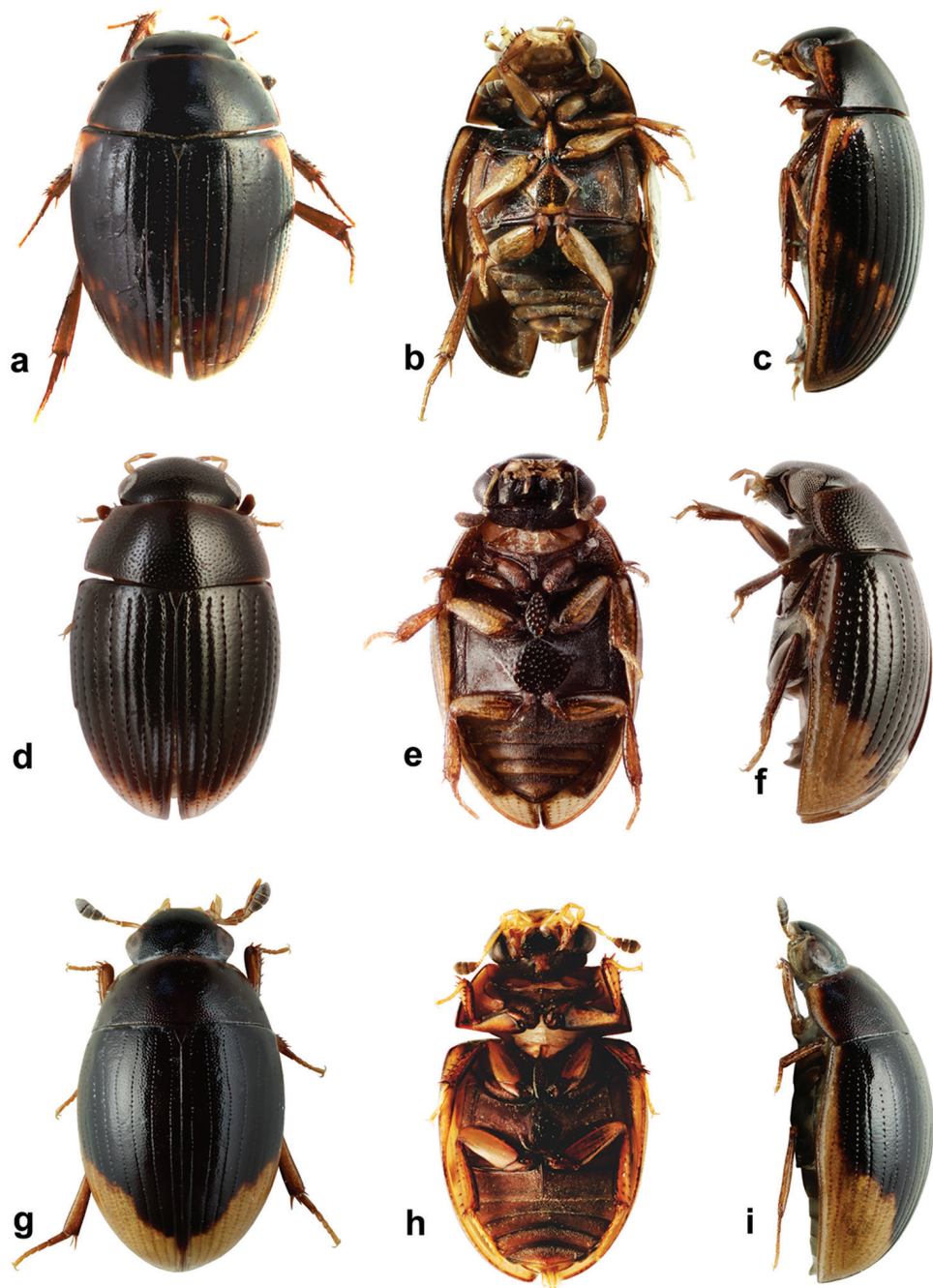


Figure 2. *Ceryon* spp. **a–c** *Ceryon sklodowskiae* sp. n. **d–f** *Ceryon floridanus* Horn **g–i** *Ceryon praetextatus* Say **a, d, g** dorsal habitus **b, e, h** ventral habitus **c, f, i** lateral habitus.

first abdominal ventrite without spiniform process in both sexes (Fig. 10h); apex of fifth abdominal ventrite with a triangular projection in females (Fig. 10i); aedeagus with very short parameres (Fig. 5m), median lobe (Fig. 5o) covered with spines in apical third.

C. sklodowskiae may be confused with *C. praetextatus* (Say) and *Cercyon floridanus* Horn and the members of *C. gimmeli* species group. It can be distinguished from *C. praetextatus* and *C. floridanus* by the head with widely yellowish clypeal margin and yellow coloration of elytra expanded basally (clypeus black and basal part of elytra only narrowly yellow in *C. praetextatus* and *C. floridanus*) and by much narrower mesoventral plate (5.8× as long as wide in *C. sklodowskiae*, 1.9× as long as wide in *C. floridanus* and 3.3× in *C. praetextatus*). It differs from members of *C. gimmeli* group by the mesoventral plate reaching anterior part of metaventrite (not reaching anterior margin in *C. gimmeli* group), only a small rounded process of median prosternal ridge (large rounded knob in *C. gimmeli* group), straight metatibia (slightly curved outside in *C. gimmeli* group), and last abdominal ventrite in females forming a triangular projection (without projection in *C. gimmeli* group). It differs from all these species by the morphology of male genitalia; by the apically spinose median lobe it resembles *C. armatipenis*, but differs from it by parameres much shorter than phallobase.

Description. *Body.* (Fig. 2a–c) 3.10–3.45 mm long (length of holotype: 3.29 mm); long oval, 1.8–1.9× as long as wide, widest at basal fourth of elytra; moderately convex, 2.8–3.0× as long as high, (height of holotype: 1.1 mm). *Coloration.* Dorsal surface of head blackish to pitchy black, clypeus with wide rather sharply defined yellowish area along anterolateral margins, slightly broader at sides. Ventral surface of head dark brown, almost black on sides. Antennae, mentum and mouthparts dark brown. Pronotum blackish to pitchy black, with narrowly brownish lateral margins, broader at anterolateral corners (Fig. 2c). Prosternum and hypomeron black, with darker anterolateral margins. Elytron (Fig. 2a) black, with large, pale, rather sharply defined apical spot covering posterior quarter of elytral interval 1 and gradually larger portion on subsequent intervals up to posterior three-quarters on interval 9, lateralmost interval completely yellowish to dark brown; apical spot slightly darker (yellowish-brown) posteriorly, with lighter brown spots at least along its anterior border. Ventral surface of mesothorax (Fig. 2b) blackish to pitchy black. Metepisternum dark brown. Metaventrite black with darker anteromedial part and anterior margins. Abdomen black, posteromedial margins and anterolateral corners of ventrites darker. Legs dark brown.

Head. Clypeus with moderately dense and shallow punctation consisting of crescent-shaped punctures intermixed with denser, slightly smaller and rather transverse punctures; interstices without microsculpture. Anterior margin of clypeus with a narrow bead. Frontoclypeal suture conspicuous as a zone without punctation, vanishing mesally. Frons with punctation similar to that on clypeus, punctures sparser on sides;

interstices without microsculpture. Eyes rather small; interocular distance about 6× the width of one eye in dorsal view. Labrum membranous, nearly completely concealed under clypeus, only with narrowly exposed sinuate anterior margin. Mentum (Fig. 10a) subtrapezoid, widest at posterior fourth, about 2.1× wider than long, 1.4× wider at widest part than at anterior margin, concave in anterior half, strongly emarginated anteromesally; surface glabrous, punctures rather small, shallow and sparse, almost vanishing anteromesally, interstices without microsculpture. Antenna with 9 antennomeres, scapus ca. 1.9× as long antennomeres 2–6 combined; antennal club moderately elongate, about twice as long as wide, about as 1.2× as long as scapus; antennomere 9 acuminate at apex.

Prothorax. Pronotum transverse, widest at base 2.1–2.2× wider than long; 1.6–1.7× wider at base than between front angles, 1.7× wider than head including eyes, as convex as the elytra in lateral view. Punctuation (Fig. 10b) moderately dense and shallow, consisting of crescent-shaped punctures intermixed with denser, slightly smaller and rather transverse punctures; punctures slightly feebler on sides. Prosternum strongly tectiform medially, medial ridge (Fig. 10c) weakly thickened anteriorly, forming a small rounded to slightly pointed process. Antennal grooves distinct, with lateral margin curved, slightly feebler anteriorly.

Pterothorax. Scutellar shield 1.25× as long as wide, sparsely punctured. Elytra widest at anterior fifth, 2.7–3.0× as long as pronotum, 1.2× as wide as pronotum, surface (Fig. 10d) glabrous, with 10 series of punctures; series 6, 8 and 9 not reaching elytral base, serial punctures of same size in all series; intervals moderately convex; interval punctuation composed by crescent-shaped punctures intermixed with denser, slightly smaller and rather transverse punctures in all intervals. Humeral bulge indistinct. Mesoventral plate (Fig. 10f) narrowly elongate, ca. 5.8× as long as wide, widest in anterior two-fifths, more strongly narrowing towards anterior apex which is pointed, posterior tip rounded, slightly overlapping over anterior portion of metaventrite; surface with a few sparse coarse punctures. Metaventrite (Fig. 10g) with narrow raised pentagonal area, 1.2× longer than wide, glabrous, weakly and sparsely punctate, punctures with fine setae at least along margins of the elevation; bare elevated area reaching anterior margin of metaventrite; punctures absent at two slightly elongate areas in the center; femoral lines absent; lateral parts of metaventrite densely covered by short pubescence.

Legs. Femora with sparse rather shallow punctures ventrally, interstices with weak microsculpture consisting of longitudinal lines; tibial grooves distinct. Tibiae with rather small lateral spines. Metatibiae moderately narrow and elongate, straight, 0.3–0.4× as long as elytra, 5.3× as long as wide. Metatarsus long, 0.9× as long as metatibia, with short rather stout setae ventrally.

Abdomen. With five ventrites, first abdominal ventrite (Fig. 10h) about as long as the second and third ventrites combined, with distinct median longitudinal carina narrowing posteriorly, not projecting posteriorly in both sexes; fifth ventrite with acuminate apex, weakly bulged in males and with a triangularly bulged apical projection in females (Fig. 10i).

Genitalia. Sternite 9 (Fig. 5p) asymmetrical basally, median process narrow, ca. as long as lateral struts, acuminate at apex, without subapical setae. Phallobase (Fig. 5m) almost twice as long as parameres, asymmetrically narrowing at base, base narrowly rounded and hooked. Parameres continuously narrowing apically, apex pointed, with two minute setae. Median lobe (Fig. 5n) widest in apical third, slightly narrowing towards base, continuously narrowing in apical third; apex (Fig. 5o) acuminate with rounded tip, apical part with numerous spines directed backwards; gonopore moderately large, subapical; basal portion with dorsal plate narrow and simply bifid basally.

Etymology. We dedicate this species to the eminent physicist and chemist Marie Skłodowska-Curie, on whose honor the Marie Skłodowska-Curie actions program of the European Union, funding this research, is named.

Distribution. Jamaica: Saint Thomas (Fig. 15b).

Biology. The specimens were collected on dung and using dung and carrion-baited traps in cloud forests.

Cercyon floridanus Horn, 1890

Figures 2d–f, 7a–d, 16a

Cercyon floridanus Horn, 1890: 303.

Cercyon floridanus Smetana (Thomas et al. 2013: 33 *lapsus calami*)

Figures in Flickr. www.flickr.com/photos/142655814@N07/albums/72157676249-653654

Type locality. Florida (without specific locality).

Greater Antillean specimens studied. **CAYMAN ISLANDS: Grand Cayman:** blacklight trap, vi.1992, leg. blacklight trap (1 male; FSCA), blacklight trap, vi.1992, lgt. P. Fitzgerald (1: FSCA); Queen Elizabeth Botanic Garden, blacklight trap, 28.v.2009, leg. Thomas, Turnbow & Ball (1: FSCA); Georgetown, blacklight, 30.iii.1973. E.J. Gerberg (1: FSCA).

Published Greater Antillean records. **GRAND CAYMAN:** 3 km W Colliers, 19°21'N, 81°07'W (Thomas et al. 2013).

Diagnosis. Body size 2.35–2.70 mm; dorsal surface of head (Fig. 2d) completely black, pronotum black sometimes with undefined piceous areas at lateral margins; elytra black (Figs 2d, f), with large rather sharply-defined yellowish to reddish-yellow lateroapical areas reaching apex lateralmost interval, medial ridge of prosternum anteriorly very weakly projected ventrally; mesoventral plate (Fig. 7d) very wide, ca. 1.9× as long as wide; metaventrite (Fig. 7d) without femoral lines, with broad raised pentagonal area (about 0.67× as long as wide) with large, deep and semicircular punctures; first abdominal ventrite without spiniform process in both sexes; apex of fifth ventrite without triangularly bulged projection at apex in both sexes; aedeagus (Fig. 7a) with parameres slightly shorter than phallobase, sinuately widened and bearing long setae at

apex; median lobe widest at midlength, narrowing to very finely truncate apex, without spines. For complete description see Smetana (1978).

Cercyon floridanus is part of the *C. tristis* group according to Smetana (1978). It resembles members of the *C. gimmeli* species group, *C. sklodowskiae* sp. n. and *C. praetextatus*. Besides of the features of the aedeagus (Fig. 7a–c), it can be easily distinguished from them by the distinctly by the smaller size (2.35–2.70 mm), wider mesoventral plate (1.9× as long as wide in *C. floridanus*, 3.3–5.8× as long as wide in the other species). Besides that, females of *C. floridanus* lack the triangular projection on the apex of the fifth abdominal ventrite (present in *C. sklodowskiae*), has a very small process of mid-prosternal ridge (large in *C. gimmeli* species group), and almost straight metatibia (curved in *C. gimmeli* species group).

Distribution. *Cercyon floridanus* is distributed in the southeastern USA, mainly in Florida, but rare records are also known from Georgia, Louisiana and Mississippi (Smetana 1978). In the Greater Antilles it is only known from Cayman Islands, from where it was first reported by Thomas et al. (2013) under the name “*C. floridanus*” Smetana” (Fig. 16a).

Cercyon praetextatus (Say, 1825)

Figures 2g–i, 6a–d, 13a–b, 15c

Sphaeridium praetextatum Say, 1825: 190.

Cercyon praetextatum (Say): Melsheimer, 1853: 37.

For complete synonymy see Smetana (1978: 84) and Hansen (1999: 286).

Figures in Flickr. www.flickr.com/photos/142655814@N07/albums/72157669492-876764

Type locality. USA, “Cambridge” (based on neotype designated by Smetana 1978).

Greater Antillean specimens studied. **CUBA: Santiago de Cuba:** Dos Caminos, farm field, MV lights, 20.18043°N, 75.77806°W, 165 m, 23.iii.2013, leg. A. Smith & A. Deler-Hernández (1 spec.: NMPC). **Cienfuegos:** Cumanayagua municipality, JBC [= Jardín Botánico de Cienfuegos], Soledad, 22°7'18.44"N, 80°19'35.26"W, 3.x.2012, leg. A. Deler-Hernández (1 spec.: NMPC). **CAYMAN ISLANDS: Grand Cayman:** black-light trap, 17.v.1992, leg. P. Fitzgerald (1 spec.: FSCA). **DOMINICAN REPUBLIC: La Vega Prov.:** Jarabacoa, 440 m a.s.l., riverside, UV light, 24.vii.-2.viii.1995, leg. S. & J. Peck (3 spec.: CMN). La Ciénega de Manabao, Park Headquarters, 915 m a.s.l. black-light, 3-5.vii.1999, leg. R.E. Woodruff (1 spec.: FSCA).

Published Greater Antillean records. **CUBA: Habana Province:** Laguna de Ariguanabo (Spangler 1981). **JAMAICA:** without precise locality (Smetana 1978).

Diagnosis. Body size 2.7–4.1 mm; dorsal surface of head (Fig. 2g) black, with a pair of small reddish-brown spots on vertex, sometimes fused to one spot; pronotum black with sharply defined yellowish to reddish areas at anterolateral corners, some-

times extending to complete lateral margins; elytra black, with large sharply-defined yellowish to reddish-yellow lateroapical area reaching about apical fourth, laterally reaching elytral base in lateralmost interval, yellow spot not extended to humeral area basally; medial ridge of prosternum anteriorly forming a small rounded to slightly pointed process; mesoventral plate (Fig. 13a) wide, ca. $3.3\times$ as long as wide; metaventricle (Fig. 13b) without femoral lines, with narrow raised pentagonal area (ca. as long as wide); first abdominal ventrite without spiniform process in both sexes; apex of fifth ventrite without triangularly bulged projection at apex in both sexes; aedeagus (Fig. 6a–c) with parameres almost twice as long as phallobase, sinuately widened and bearing long setae at apex; median lobe widest at midlength, narrowing to pointed apex, without spines. For complete description see Smetana (1978).

This species was assigned to the *C. marinus* group according to Smetana (1978). By the coloration of pronotum and elytra (Fig. 2g, i), *C. praetextatus* may be confused with members of the *C. gimmeli* species group and with *C. sklodowskiae* sp. n. Besides of the features of the aedeagus (Fig. 6a–c), it can be easily distinguished from them by the distinctly wider mesoventral plate ($3.3\times$ as long as wide in *C. praetextatus*, $5.7\text{--}5.8\times$ as long as wide in the other species) and the yellow stripe along lateral margin of elytra not expanding basally. Besides of that, females of *C. praetextatus* lack the triangular projection on the apex of the fifth abdominal ventrite (present in *C. sklodowskiae*), has a very small process of mid-prosternal ridge (large in *C. gimmeli* species group), and almost straight metatibia (curved in *C. gimmeli* species group).

Distribution. *Cercyon praetextatus* is widely distributed in North America (southern Canada, USA, Mexico; Smetana 1978; Ryndevich 2004) and reaches to Central America (Guatemala, Costa Rica; Smetana 1978) and to the Caribbean (Cayman Islands, Cuba, Dominican Republic, Jamaica, Smetana 1978, Spangler 1981, this paper); it has also been introduced to Argentina (Fikáček 2009). We report it here from Dominican Republic (La Vega Province) and the Cayman Islands for the first time (Fig. 15c).

Biology. This species seems to prefer wet environments, living primarily on many kind of organic debris, like decomposing plant remnants, carrion and dung (Smetana 1978). In Cuba and the Dominican Republic this species has been attracted to light.

***Cercyon spiniventris* sp. n.**

<http://zoobank.org/B172C05C-D9C0-4863-AF24-EB754A45BFC6>

Figures 3a–c, 6e–h, 11a–i, 16a

DNA barcode. GANTC010-17

BIN ID. BOLD:ADF5572

Figures in Flickr: www.flickr.com/photos/142655814@N07/albums/7215767-1689463811

Type locality. Dominican Republic, Monseñor Nouel Province, Parque Nacional La Humeadora; 11.6 km SSW of Piedra Blanca, 636 m a.s.l., $18^{\circ}44.92'N$, $70^{\circ}21.63'W$.

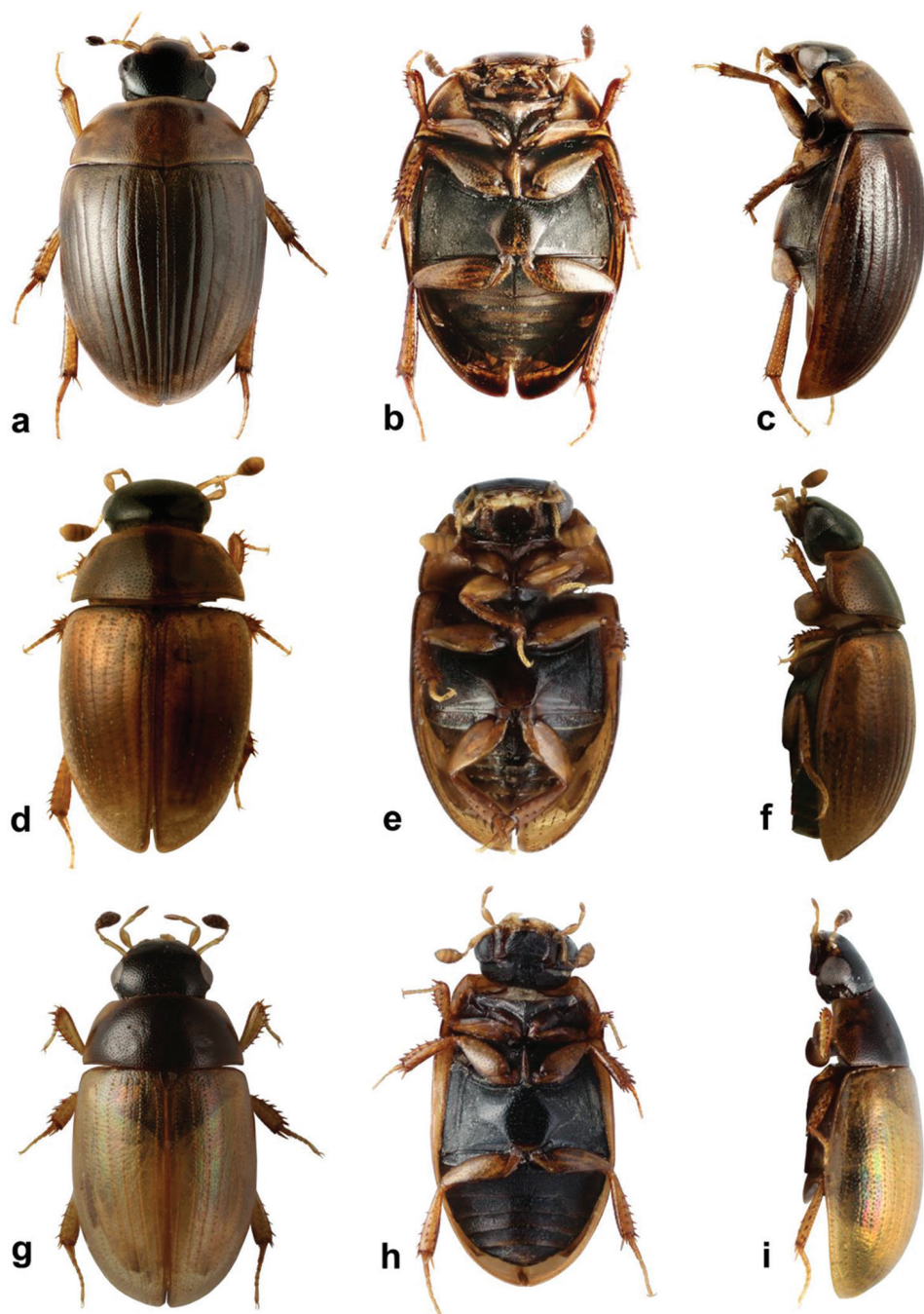


Figure 3. *Cercyon* spp. **a–c** *Cercyon spiniventris* sp. n. **d–f** *Cercyon nigriceps* Marsham **g–i** *Cercyon quisquilius* Linnaeus **a, d, g** dorsal habitus **b, e, h** ventral habitus **c, f, i** lateral habitus.

Type material. Holotype (male): “DOMINICAN REP.: Msñ. Nouel, PN La Huameadora; 11.6km SSW, of Piedra Blanca; 18°44.92'N, 70°21.63'W; 636 m; 8.ix.2014, Deler, Fikáček, Gimmel DR41 // in horse excrement in moist broad-leaf forest in a valley of a small stony stream” (NMPC) [DNA extract: MF1216.1]. **Paratypes: DOMINICAN REPUBLIC: Barahona:** “DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 26-VI/7-VII-1992: Woodruff, Skelley, Skillman. dung trap (1 males: FSCA). “DOMINICAN REP.: Prov. Barahona. nr. Filipinas, Larimar Mine: 26-VI/7-VII-1992: Woodruff & Skelley, rat carrion” (2 females: FSCA). **Monseñor Nouel:** same data as the holotype (7 males, 3 females, 12 spec.: NMPC; 2 males: BCPC; 2 males: BMNH; 2 males: CNC; 3 males: CNIN; 3 males: NHMW; 4 males, 1 female: SBNM; 3 males: SBP; 2 ZMUC). **Duarte:** “DOMINICAN REP.: Duarte. 9.1 km SW of El Factor, slope above La Factoria; 19°15.30'N, 69°56.52'W; 255 m; 4.ix.2014. Deler, Fikáček, Gimmel DR32 // area with cocoa plantations and small remnants of forests at very steep slopes: in horse excrement” (2 males: NMPC). **Independencia:** “DOMINICAN R.: Independencia, PN Sierra de Neiba, 11.3 km NW of La Descubierta; 1650 m, 18°39.81'N, 71°46.17'W; 18.viii.2014, Deler, Gimmel DR13 // disturbed montane cloud forest with many ferns and mosses: in cow excrement” (2 males, 4 females, 1 spec.: NMPC). **La Vega:** “DOMINICAN REP.: La Vega, PN A. Bermúdez, 8 km W of Manabao, 19°4.05'N, 70°51.98'W, 1140 m, 22-26. viii.2014, Deler, Fikáček, Gimmel DR16 // montane broad-leaf forest: in cow and horse excrement” (12 males, 15 females: NMPC; 1 male: BMNH; 1 male: CNIN; 2 males: FSCA; 1 male: MNHNSD; 3 males, 2 females: SBNM) [DNA extraction of one male: MF1753 in NMPC]; “DOM. REP; La Vega Prov., 10km NE Jarabacoa, Hotel Montana, forest, 18.VII-4.VIII.95, 550m, FIT, S.+J. Peck, 95-30” (2 females: CMN); “DOM. REP; La Vega Prov., PN. A. Bermudez, Cienaga, 19.VII-2.VIII.95, 1000m, trop.evgrn.for., FIT, S.+J. Peck, 95-32” (2 females: CMN); “DOM. REP; La Vega Prov., PN. A. Bermudez, Cienaga, 19.VII-2.VIII.95, 1020m, trop.evgrn.for., FIT, S.+J. Peck, 95-34” (1 male: CMN); “DOM. REP; La Vega Prov., PN. A. Bermudez, Cienaga, 21.-24.VII.95, 1000m, for. carrion trap, S.+J. Peck, 95-38” (1 female: CMN). **Samaná:** “DOMINICAN REP.: Samaná, MN Salto El Limón 2.8 km SSW of El Limón; 19°16.56'S 69°26.47'W; 160 m; 2.ix.2014, Deler, Fikáček, Gimmel. DR29a // secondary vegetation and tiny remnants of forest among coffee plantations and pastures: in horse excrement” (3 males, 3 females: NMPC).

Diagnosis. Body size 3.4–4.1 mm; dorsal surface of head black with yellowish anterolateral margins of clypeus (Fig. 3a); pronotum homogeneously light brown, elytra greyish-brown; medial ridge of prosternum anteriorly with a small rounded process (Fig. 11c); mesoventral plate narrow, ca. 5.9× as long as wide; metaventrite (Fig. 11f) without femoral lines; raised pentagonal area of metaventrite moderately wide, 0.9× as long as wide; first abdominal ventrite with an spiniform process in females (Fig. 11h), without process in males; apex of fifth abdominal ventrite without apical triangular projection in both sexes (Fig. 11i); aedeagus with parameres about as long as phallobase (Fig. 6e), median lobe narrowly parallel-sided, acute at apex, without spines.

Cercyon spiniventris somewhat resembles *C. nigriceps* by the dorsal coloration pattern (predominantly black head and rather homogeneously brown pronotum and elytra); it can be easily distinguished from *C. nigriceps* by much larger body size (3.4–4.1 mm in *C. spiniventris*, 1.0–2.1 mm in *C. nigriceps*) and by the lack of femoral lines on the metaventrite (present in *C. nigriceps*). *Cercyon spiniventris* is unique among Caribbean *Cercyon* species by a presence of a long spiniform process in the first abdominal ventrite of females.

Description. *Body* (Fig. 3a–c). 3.4–4.0 mm long (length of holotype: 3.5 mm); moderately short-oval, 1.8–1.9× as long as wide, widest at basal fourth of elytra; moderately convex, 2.9–3.0× as long as high (height of holotype: 1.15 mm). *Coloration.* Dorsal surface of head blackish to pitchy black, clypeus with wide rather sharply defined yellowish area along anterolateral margins, broader at sides. Antennae and ventral surface of head black, mentum with posterior half yellowish brown, mouthparts and antenna yellowish brown, antennal club dark-brown. Pronotum light brown. Prosternum yellowish-brown with posterior half black, hypomeron brown with large black marks on posterior third, and close to the yellowish-brown lateral margins. Elytra dark greyish-brown, with lateral and anterior margins, apex and epipleura slightly paler. Ventral surface of mesothorax blackish to pitch-black, with procoxal rests and mesoventral plate brown. Metepisternum black. Metaventrite black with paler raised anteromedial part. Abdomen black, posteromedial margins and anterolateral corners of ventrites brownish. Legs brown, femora dorsally black.

Head. Clypeus with dense and moderately deep punctation consisting of crescent-shaped setiferous punctures intermixed with denser, smaller and rather transverse non-setiferous punctures; interstices without microsculpture. Anterior margin of clypeus with a narrow bead. Frontoclypeal suture conspicuous as a zone without punctuation, vanished mesally. Frons with punctation similar to that on clypeus, punctures of same shape all over; interstices without microsculpture. Eyes rather small; interocular distance about 5.4× the width of one eye in dorsal view. Labrum membranous, nearly completely concealed under clypeus, only with narrowly exposed sinuate anterior margin. Mentum (Fig. 11a) subtrapezoid, widest at posterior fourth, about 2× wider than long, 1.5× wider at widest part than at anterior margin, weakly concave in anterior half; surface glabrous, punctures large and deep, becoming coarser anteromesally, interstices on anterior half with transverse depressions near each puncture. Antenna with 9 antennomeres, scapus ca. 1.8× as long as antennomeres 2–6 combined; antennal club moderately elongate, about twice as long as wide, about as 1.2× as long as scapus; antennomere 9 acuminate at apex.

Prothorax. Pronotum transverse, widest at base 2.1–2.3× wider than long; 1.7× wider at base than between anterior angles, 1.8× wider than head including eyes, as convex as elytra in lateral view. Punctation rather dense and moderately deep, consisting of crescent-shaped setiferous punctures intermixed with denser, smaller and rather transverse non-setiferous punctures; punctures slightly feebler on sides. Prosternum (Fig. 11b–c) strongly tectiform medially, medial ridge very weakly thickened ante-

riad, forming a small rounded process. Antennal grooves distinct, with lateral margin curved, feebler anteriad.

Pterothorax. Scutellar shield about as long as wide, moderately densely punctured. Elytra widest at anterior fifth, $2.7\text{--}2.9\times$ as long as pronotum, $1.1\text{--}1.2\times$ as wide as pronotum, surface (Fig. 10d) glabrous, with 10 series of punctures; series 6, 8 and 9 not reaching elytral base, serial punctures of same size in all series; intervals moderately convex; interval punctation composed of crescent-shaped setiferous punctures intermixed with denser, smaller and rather transverse non-setiferous punctures; setiferous punctures present on all intervals; interstices without microsculpture. Humeral bulge indistinct. Mesoventral plate (Fig. 11f) narrowly elongate, ca. $5.9\times$ as long as wide, widest at midlength, gradually and symmetrically narrowing to pointed apices, posterior tip slightly overlapping over anterior part of metaventrite; surface with coarse punctures. Metaventrite (Fig. 11g) without femoral lines, raised pentagonal area wide, $0.8\times$ as long as wide at widest portion, glabrous, rather weakly and sparsely punctate, punctures with fine setae at least along margins of elevation, punctures absent at two slightly elongate areas in the center, bare area not reaching anterior margin of metaventrite mesally; lateral parts of metaventrite densely covered by short pubescence.

Legs. Femora with sparse rather shallow punctures ventrally, interstices with weak granulose microsculpture; tibial grooves distinct. Tibiae with moderately large lateral spines. Metatibiae moderately narrow and elongate, slightly bent outwards, $0.4\times$ as long as elytra, $6.0\times$ as long as wide. Metatarsus moderately long, $0.7\text{--}0.8\times$ as long as metatibia, with short rather stout setae ventrally.

Abdomen with five ventrites, first abdominal ventrite longer than second and third ventrites combined, with long setae in medial third, median longitudinal carina present, slightly narrowing posteriad, not projecting posteriorly in males, projecting posteriad as a short spine in females (Fig. 11h); ventrite 5 with acuminate apex in both sexes.

Genitalia. Median projection of sternite 9 (Fig. 6h) rounded apically, without subapical setae, median portion narrowing posteriorly, shorter than lateral struts. Phallobase (Fig. 6e) about as long as parameres, asymmetrically narrowing basally, base acuminate and slightly hooked. Parameres weakly narrowing apically, subsinuate near apex, apex pointed apically. Median lobe (Fig. 6f) narrow, parallel-sided throughout, apex acuminate, gonopore moderately large, situated subapically; basal portion with dorsal horseshoe-shaped plate, base bifid. throughout, apex acuminate, gonopore moderately large, situated subapically; basal portion with dorsal horseshoe-shaped plate, base bifid.

Etymology. The name of this species is derived from Latin words *spina* (spine) and *venter* (underside), in reference to the spine-like process on the first abdominal ventrite of females.

Distribution. Dominican Republic: Duarte, Independencia, La Vega, Monseñor Nouel, Samaná (Fig. 16a).

Bionomics. Most of the specimens were collected in cow and horse dung in tropical forest and surrounding pastures.

***Cercyon nigriceps* (Marshall, 1802)**

Figures 3d–f, 6i–k, 13c–d

Dermestes nigriceps Marshall, 1802: 72.*Cercyon nigriceps* Stephens (1829: 151).

= *Dermestes atricapillus* Marshall, 1802: 72 (synonymized by Gemminger and Harold 1868: 498; precedence of *C. nigriceps* over *C. atricapillus* determined by Stephens 1939: 97, see also Hansen 1999: 284).

= *Sphaeridium centrimaculatum* Sturm, 1807: 23 (synonymized by Gemminger and Harold 1868: 498).

= *Cercyon striatus* Sharp, 1882: 108 (synonymized by Fikáček 2009: 354).

= *Cercyon panamensis* Hansen, 1999: 286 (replacement name of *C. striatus* Sharp; synonymized by Fikáček 2009: 354).

For complete synonymy see Smetana (1978) and Hansen (1999).

DNA barcode. GANTC015-17**BIN ID.** BOLD:AAO0116

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Type locality. “Britannia” [= Great Britain, without specified locality].

Specimens examined. **CAYMAN ISLANDS:** **Cayman Brac:** black-light trap, 06.vi.2008, lgt. R.H. Turnbow & B.K. Dozier (3 spec.: FSCA); Agricultural Exp. Sta. S. Of Songbird Dr., black-light trap, 04.vii.2013, leg. M.C. Thomas (3 spec.: FSCA); **CUBA:** **Cienfuegos:** Cumanayagua municipality, 22°7'18.44"N, 80°19'35.26"W, 722 m, 21.v.2013 (1 spec.: NMPC). **Guantánamo:** El Yunque, 0.5–1.0 km W of Campismo Popular, 20°20.1'N, 74°33.6'W, 40–50 m. 10.vi.2012, leg. Deler-Hernández & Fikáček (MF01) (8 spec.: NMPC). **Holguín:** Mayarí municipality, Feltón, 20°43'7.92"N, 75°37'59.19"W, 23.iii.2013, leg. Deler-Hernández (28: NMPC). **Santiago de Cuba:** El Vivero, 1.6 km E of Dos Caminos, 20°10.8'N, 75°46.4'W, 150 m, 20–21.vi.2012, leg. Deler-Hernández & Fikáček (MF18) (54 spec.: NMPC) [DNA extract: MF604]; San Luis Municipality, Dos Caminos, 20°10'57.82"N, 75°46'40.84"W, leg. Deler-Hernández (16 spec.: NMPC). **Artemisa:** Cañon de Santa Cruz, Río de Santa Cruz, 22°45'1.29"N 83°08'56.36"W, 199 m a.s.l., 16.vii.2016, leg. A. Deler-Hernández (8 spec.: NMPC) [DNA extraction: MF1750]. **DOMINICAN REPUBLIC:** **Samaná:** Samaná, dam 2.5 km N of Samaná, in older cow excrements dampened by recent rains at the grassy bank of a reservoir, 19°13.70'N, 69°19.85'W, 58 m a.s.l., 5.ix.2014, leg. Deler, Fikáček & Gimmel (DR35) (3 spec.: NMPC); MN Salto El Limón 2.8 km SSW of El Limón, secondary vegetation and tiny remnants of forests among coffee plantations and pastures, cow excrements, 19°16.56'N, 69°26.47'W, 2.ix.2014, leg. Deler-Hernández, Fikáček & Gimmel (DR29a) (1 spec.: NMPC). **La Altagracia:** Nisibon, Black-light trap, 03.v.1978, lgt. R.E. Woodruff & G.B. Fairchild (2 spec.: FSCA); **La Vega:** 7.0 km W of Manabao, side of a stony stream in a valley with scattered houses and plantations surrounded by montane forest, in cow excrement, 19°04.56'N, 70°51.46'W, 1185 m

a.s.l., 23.viii.2014, leg. Deler-Hernández, Fikáček & Gimmel (1 spec.: NMPC). **Monseñor Nouel:** PN La Humeadora; 11.6 km SSW, of Piedra Blanca, in horse excrement in moist broad-leaf forest in a valley of a small stony stream, 18°44.92'N, 70°21.63'W, 636 m a.s.l., 8.ix.2014, leg. Deler, Fikáček & Gimmel (DR41) (2 spec.: NMPC). **Monte Cristi:** 8.2 km. N Villa Elisa, 01.vi.1994, leg. R. Turnbow (1 spec.: FSCA). **San Pedro de Macoris:** Juan Dolio, at light, 10.-18.xii.2005, leg. Fendl (15 spec.: NMPC). **HAITI: Artibonite:** Montrouis, black-light trap, 05.vii.1977, leg. J.H. Frank (2 spec.: FSCA). **PUERTO RICO: Naguabo:** El Yunque National Forest (southern part), 3.45 km N of Río Blanco at road PR191, in horse excrements on exposed small pasture on the slope of El Yunque massive, 18°14.8'N, 65°47.9'W, 170 m a.s.l., 24.vi.2016, leg. Deler-Hernández, Fikáček & Seidel (PR2a) (17 spec. NMPC) [DNA extraction of one specimen: MF1732]; El Yunque National Forest (southern part), 4.9 km N of Río Blanco, margin of the rainforest in an area with many flowering *Etlíngera elatior* plants, FIT, 18°15.8'N, 65°47.3'W, 495 m a.s.l., 24.vi.-2.vii.2016, leg. Fikáček & Seidel (PR11) (1 spec.: NMPC). **Arecibo:** small settlement in Bosque Estatal Río Abajo, small settlement in the middle of the lowland forest, horse excrement, 18°19.7'N, 66°42.1'W, 340 m a.s.l., 27.vi.2016, leg. Deler-Hernández, Fikáček & Seidel (PR15) (13 spec.: NMPC). **Cabo Rojo:** Boquerón, black light, 18°13.11'N, 67°10.96'W, 5-6.x.2011, leg. A. Segarra (7 spec.: UPRM). **Rio Grande:** El Verde Biological Station, at light, 26.v.1994, leg. R. Turnbow (2 spec.: FSCA). **Lesser Antilles: ANTIGUA:** Christian valley, blacklight trap, 19.viii.1991, leg. FAO insect survey (1 spec.: SBP); same locality and collector, 26.vii.1991 (1 spec.: SBP); same locality and collector, 29.x.1991 (3 spec.: SBP); same locality and collector, 14.-15.ix.1991 (1 spec.: SBP). **GRENADA:** St. Andrew, Mirabeu Agriculture Lab, light trap, 9.iv.1990, leg. J. Telesford (1 spec.: SBP). **SAINT LUCIA:** Vieux Fort, horse dung sifting, 13°43.9'N 60°53.9'W, 3 m a.s.l., 12.vii.2007, S & J. Peck (07-60) (2 spec.: SBP); Mon Repos, Fox Grove Inn, UV light, 13°51.8'N, 60°54.4'W, 90 m a.s.l., 8.-18.vii.2007, leg. S. & J. Peck (07-50) (1 spec.: SBP). Soufriere, Rechette Pt. 11.VII.1980, leg. L.S. Mahunka (59 spec.: HNHM). **SAINT VINCENT & THE GRENADINES: St. Vincent:** Emerald Valley Hotel E of Layou, horse dung, 13°12.0'N, 61°14.8'W, 20 m a.s.l., 24.viii.2006, S. & J. Peck (06-120) (3 spec.: SBP); same locality, UV light at forest edge, 27.-29.viii.2006, leg. S. & J. Peck (06-123) (1 spec.: SBP). **Union Island:** Chatham Bay, Water Rock Reserve, UV traps in tall forest, 12°36.18'N, 61°26.59'W, 125 m a.s.l., 16.viii.2009, leg. S. Peck (09-64) (2 spec.: SBP); Campbell Miss Irene Reserve, high canopy thorn forest, 12°35.44'N, 61°27.34'W, 85 m a.s.l., 18.viii.2009, leg. S. Peck (09-66) (1 spec.: SBP).

Published records from the Caribbean. CUBA: Matanzas: Cárdenas (as *C. centrimaculatum*, Gundlach 1891); without precise locality (as *C. centrimaculatum*, de la Sagra 1857). **JAMAICA:** without precise locality (Leng and Mutchler 1917). **Trelawny:** Good Hope; Duncans (Fikáček 2009). **DOMINICAN REPUBLIC: Pedernales:** 4 km W of Oviedo (Fikáček 2009). **GUADELOUPE:** without precise locality (Leng and Mutchler 1914); Peck et al. 2014). **MONTserrat:** without precise locality (Peck et al. 2014).

Diagnosis. Body size 1.0–2.1 mm; dorsal surface of head black; pronotum (Fig. 3d) reddish brown, rarely with a vaguely darker central area; elytra uniformly reddish-

brown, rarely with a vaguely darker central area; mesoventral plate (Fig. 13c) narrow, ca. 6× as long as wide; metaventrite (Fig. 13d) with complete femoral lines; first abdominal ventrite without spiniform process of both sexes; apex of fifth ventrite without a triangularly bulged projection in both sexes; aedeagus with parameres twice as long as phallobase (Fig. 6i), median lobe (Fig. 6j) continuously acuminate, with long narrowly acute apex, without spines.

This species was assigned to *C. nigriceps* group (= *C. atricapillus* group) by Smetana (1978). *Cercyon nigriceps* can be distinguished from other species in the region by its small size and the presence of complete femoral lines on the metaventrite. It may be confused with representatives of the genus *Oosternum* by the small body size and coloration, but differs from them by presence of femoral lines (absent in *Oosternum*), absence of anterolateral ridge on mesoventrite (present in all *Oosternum*) and by very narrow mesoventral plate (1.7–2.8× as long as wide in *Oosternum*, see Deler-Hernández et al. 2014).

Distribution. This is an adventive species currently distributed in all zoogeographical regions. In Greater Antilles widespread in all islands: Cayman Islands, Cuba (Artemisa, Cienfuegos, Guantánamo, Holguín, Matanzas, Santiago de Cuba; Gundlach 1891), Dominican Republic (La Altagracias, La Vega, Monte Cristi, Samaná, San Pedro de Macoris; this paper), Haiti (Artibonite, this paper), Jamaica (Trelawny; Fikáček 2009) and Puerto Rico (Naguabo, Arecibo, Cabo Rojo). It is also widespread in the Lesser Antilles (Antigua, Grenada, Saint Lucia, Saint Vincent and the Grenadines; this paper) (Fig. 16b). Based on the record by de la Sagra (1857), the species was introduced to the Greater Antilles no later than the first half of the 19th century.

Biology. A terrestrial species collected in cow and horse dung and in decaying plant matter (e.g., compost piles). It is also frequently collected at light.

Cercyon quisquilius (Linnaeus, 1761)

Figures 3g–i, 6l–n, 13e–f, 15c

Scarabaeus quisquilius Linnaeus, 1761: 138.

Cercyon quisquilius Stephens (1829: 153).

For complete synonymy see Smetana (1978) and Hansen (1999).

Figures in Flickr. www.flickr.com/photos/142655814@N07/albums/721576716-88128241

Type locality. “Suecia” [= Sweden, without specified locality].

Specimens examined. **CUBA:** **Holguín:** Mayarí Municipality, Feltón, Vuelta Larga, permanent lagoon, 23.iii.2013, leg. A. Deler-Hernández (2 spec.: NMPC) [DNA extraction: MF1599].

Published records. **JAMAICA:** without precise locality (Leng and Mutchler 1917).

Diagnosis. Body size 2.4–3.2 mm; dorsal surface of head completely black; pronotum (Figs 3g, i) black with vaguely defined yellowish to brownish lateral margins,

broadener in anterolateral corners; scutellar shield black; elytra yellow to brownish-yellow; mesoventral plate (Fig. 13e) narrow, ca. 6.3× as long as wide; metaventrite (Fig. 13f) without femoral lines, with raised pentagonal area very wide, 0.6× as long as wide in widest part; first abdominal ventrite without spiniform process in both sexes; apex of fifth abdominal ventrite without triangularly bulged projection; aedeagus with parameres ca. 0.75× as long as phallobase, narrowing towards slightly lobate apex; median lobe fusiform, without spines.

Cercyon quisquilius was assigned to *C. unipunctatus* group according to Smetana (1978). This species can be only confused with *C. nigriceps* in Greater Antilles. It may be distinguished from it by the coloration of the pronotum (blackish with diffuse yellowish areas on lateral margins in *C. quisquilius*, almost homogeneously piceous to reddish brown and similar to elytral coloration in *C. nigriceps*), larger body size (2.4–3.2 mm in *C. quisquilius*, 1.0–2.1 mm in *C. nigriceps*), and by metaventrite without femoral lines and with wide raised median part (with femoral lines and narrower median part in *C. nigriceps*).

Distribution. *Cercyon quisquilius* is a species native to the Palearctic Region, but currently introduced to the Nearctic, Neotropical and Australian Regions (Smetana 1978; Hansen 1999; Fikáček 2009). We are providing the first precise records of this species from the Caribbean based of specimens from Cuba (Holguín province) (Fig. 15c).

Cercyon insularis Chevrolat, 1863

Figures 4a–i, 12 a–i, 16c

Cercyon insulare Chevrolat, 1863: 208.

Cercyon insulare Gundlach (1891: 50, redescription).

DNA barcodes. GANTC001-16, GANTC011-17, GANTC012-17

BIN ID. BOLD:ADC9388.

Figures in Flickr. www.flickr.com/photos/142655814@N07/albums/7215766-9492393134

Type locality. Cuba: Havana.

Type material. Holotype (unsexed specimen): “Havana, D. Poey // *Cercyon insulare*, Chev Cuba, [illegible] // TYPE [red label]” (MNHN).

Additional material examined. CUBA: Camagüey: Sierra de Cubitas municipality, Limones-Tuabaquey, 21°35'52.10"N, 77°47'17.62"W, 16.v.2013, leg. R. Anderson (1 spec.: NMPC). **Guantánamo:** El Yunque, 3.2 km SW of campismo popular, at right tributary of Duabe river, secondary evergreen forest, cow excrement, 20°19'N, 74°34'W, 150 m a.s.l., 13.vi.2012, leg. Deler-Hernández & Fikáček (MF09) (7 spec.: NMPC); El Yunque, ca. 1.4 km W of campismo popular, cocoa plantations shaded by palms, cow excrement, 20°20.2'N, 74°33.7'W, 60–150 m a.s.l., 11.vi.2012, Deler-Hernández & Fikáček (MF03) (16 spec.: NMPC). **Santiago de Cuba:** El Vivero, 1.6 km E of Dos Caminos, cow excrements on pasture, 20°10.8'N,

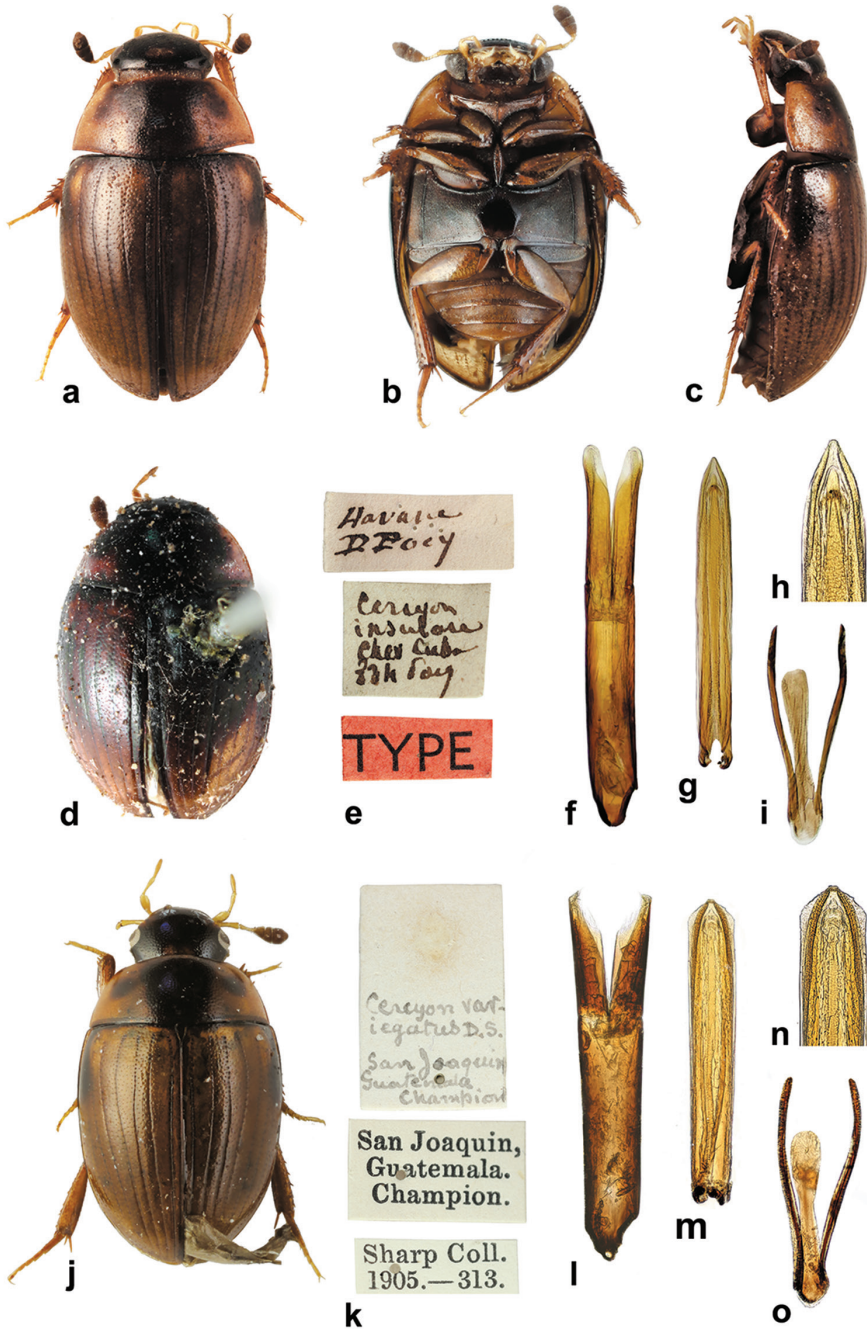


Figure 4. *Ceryon insularis* Chevrolat and *C. variegatus* Sharp. **a–i** *C. insularis*: **a–c** dorsal, ventral and lateral habitus of the non-type specimen from Cuba **d** habitus of the holotype **e** labels of the holotype **f–i** male genitalia of non-type specimen from Dominican Republic. **j–o** lectotype of *C. variegatus*: **j** dorsal habitus **k** labels **l–o** male genitalia. Genital parts illustrated: **f, l** tegmen of aedeagus **g, m** median lobe of aedeagus **h, n** detail of apex of median lobe; **i, o** 9th sternite.

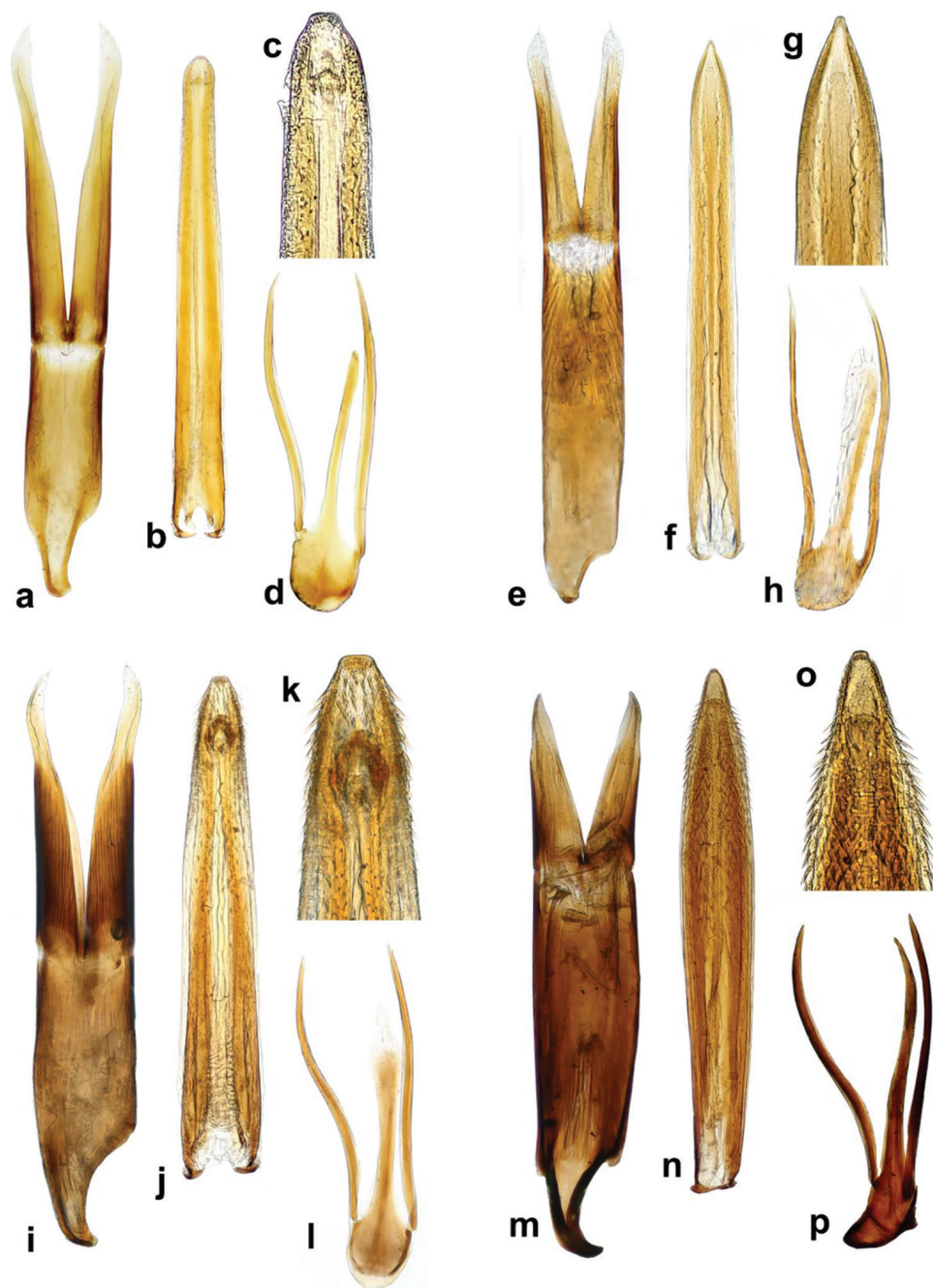


Figure 5. *Cercyon* spp. n. genitalia **a–d** *Cercyon gimmeli* sp. n. **e–h** *Cercyon taino* sp. n. **i–l** *Cercyon armatipenis* sp. n. **m–p** *Cercyon sklodowskiae* sp. n. **a, e, i, m** tegmen of aedeagus **b, f, j, n** median lobe of aedeagus **c, g, k, o** 9th sternite.



Figure 6. *Cercyon* spp. n. genitalia **a–d** *Cercyon praetextatus* Say **e–h** *Cercyon spiniventris* sp. n. **i–k** *Cercyon nigriceps* Marsham **l–n** *Cercyon quisquilius* Linnaeus **a, e, i, l** tegmen of aedeagus **b, f, j, m** median lobe of aedeagus **c, g** 9th sternite.

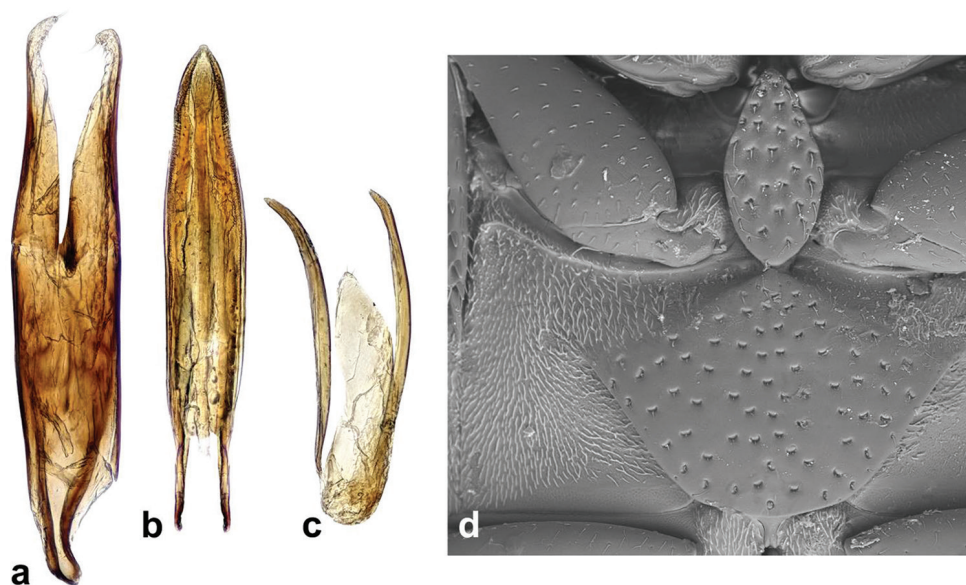


Figure 7. *Cercyon floridanus* Horn **a** tegmen of aedeagus **b** median lobe of aedeagus **c** 9th sternite **d** ventral view of pterothorax.

75°46.4'W, 150 m, 20–21.vi.2012, leg. Deler-Hernández & Fikáček (MF18) (1 spec.: NMPC); San Luis Municipality, Dos Caminos, 20°10'57.82"N, 75°46'40.84"W, 3.x.2012, leg. Deler-Hernández (12 spec.: NMPC). **Granma:** PN Turquino, around La Platica, 20°0.7'N, 76°53.4'W, 880 m, 25–26.vi.2012, leg. Deler-Hernández & Fikáček (MF24) (12 spec.: NMPC); PN Turquino, on the trail up to 0.5 km S of La Platica, 20°0.5'N, 76°53.3'W, 920 m, 23–27.vi.2012, leg. Deler-Hernández & Fikáček (MF20) (2 spec.: NMPC); PN Turquino, La Siguapa, ca. 1.5 km SE of La Platica, sifting leaf litter in evergreen forest, 20°0.2'N, 76°52.8'W, 1290 m, 25.vi.2012, leg. F. Cala-Riquelme (MF25) (1 spec.: NMPC) [DNA extract at NMPC] (1: NMPC). **Artemisa:** Cañón de Santa Cruz, Río de Santa Cruz, 22°45'1.29"N 83°08'56.36"W, 199 m a.s.l., 16.vii.2016, leg. A. Deler-Hernández (1 spec.: NMPC) [DNA extraction: MF1749]. **DOMINICAN REPUBLIC: La Vega:** 7.0 km W of Manabao, side of a stony stream in a valley with scattered houses and plantations surrounded by montane forest, in cow excrements, 19°4.56'N, 70°51.46'W, 1185 m a.s.l., 23.viii.2014, leg. Deler-Hernández, Fikáček & Gimmel (DR18) (3 spec.: NMPC); at S margin of Manabao, 19°3.85'N, 70°47.61'W, 912 m a.s.l., 27.viii.2014, leg. Deler-Hernández & Fikáček (DR23) (3 spec.: NMPC). **Samaná:** MN Salto El Limón 2.8 km SSW of El Limón, secondary vegetation and tiny remnants of forests among coffee plantations and pastures, cow excrements, 19°16.56'N, 69°26.47'W, 2.ix.2014, leg. Deler-Hernández, Fikáček & Gimmel (DR29a) (16 spec.: NMPC). **Monseñor Nouel:** PN La Humeadora; 11.6 km SSW, of Piedra Blanca, in horse excrement in moist broad-leaf forest in a valley of a small stony stream, 18°44.92'N, 70°21.63'W, 636 m a.s.l., 8.ix.2014, leg. Deler, Fikáček & Gimmel (DR41) (4 spec.: NMPC) [DNA

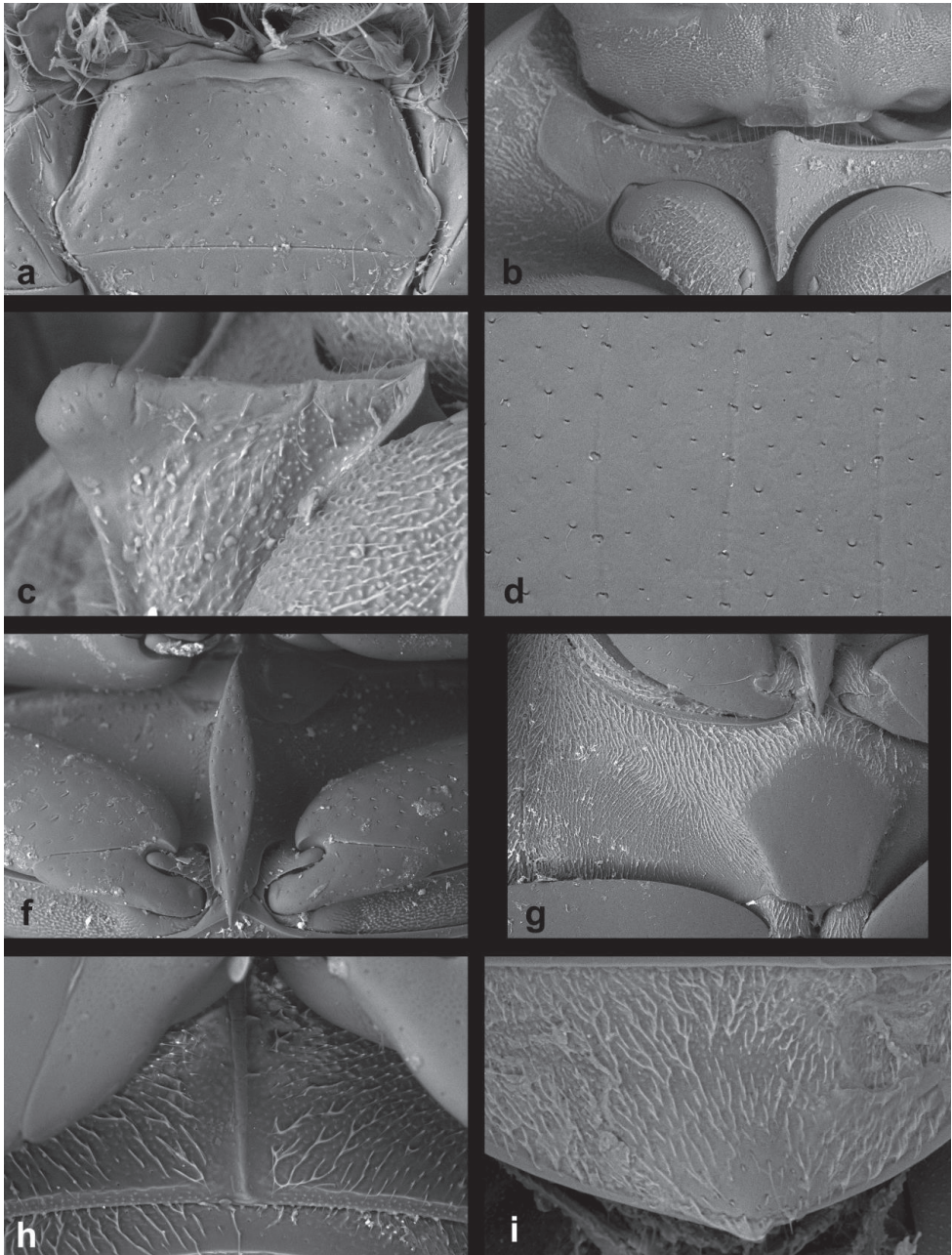


Figure 8. *Cercyon gimmeli* sp. n. **a** mentum **b** prosternum **c** lateral view of median ridge of prosternum **d** detail of elytral surface **e** mesoventral plate **f** metaventrite **g** median ridge of first abdominal ventrite **h** fifth abdominal ventrite.

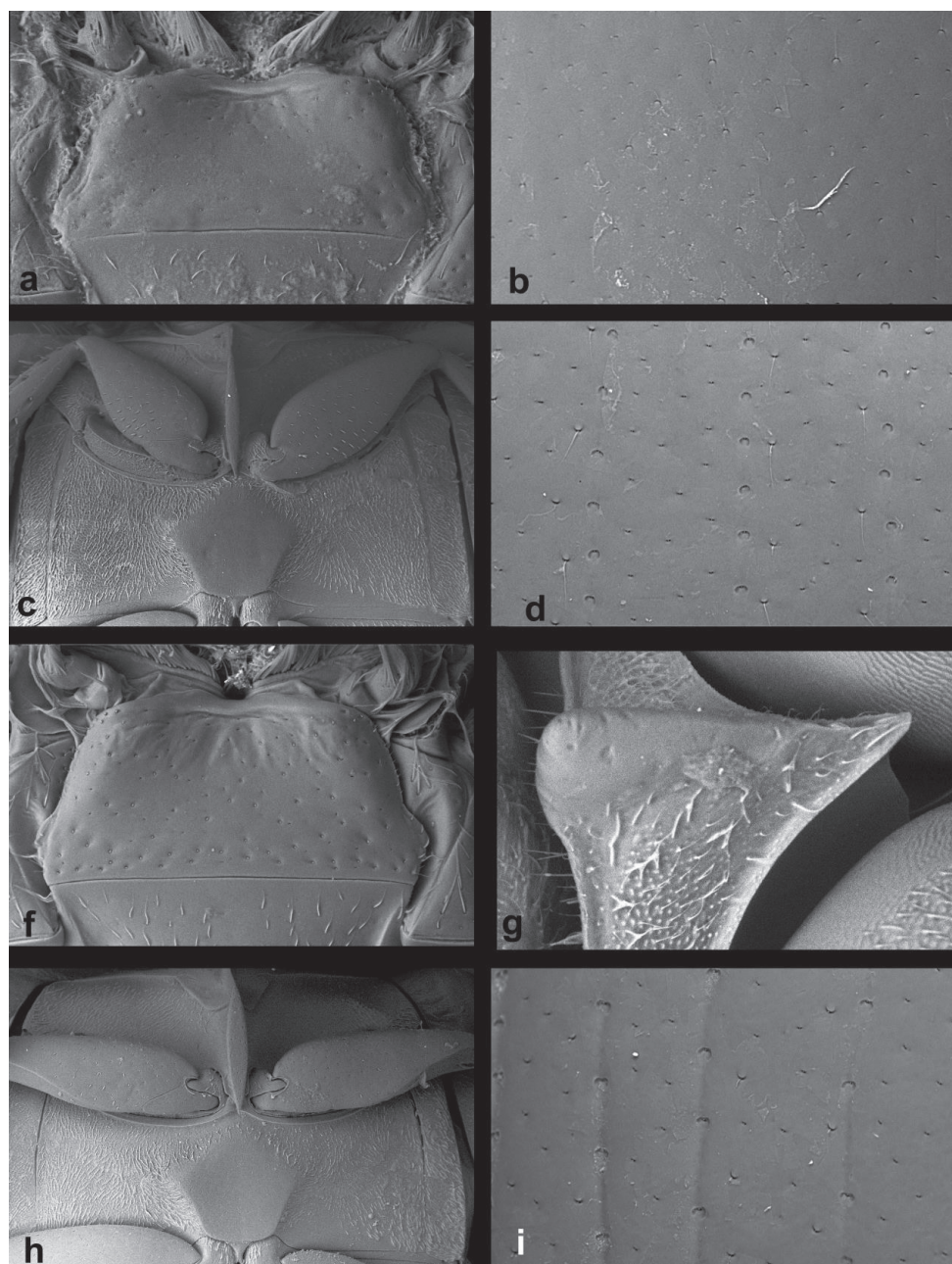


Figure 9. *Cercyon* spp. n. **a–d** *Cercyon armatipenis* sp. n. **f–i** *Cercyon taino* sp. n. **a, f** mentum **b** detail of pronotal surface **c, h** ventral view of pterothorax **d, i** detail of elytral surface **g** lateral view of median ridge of prosternum.

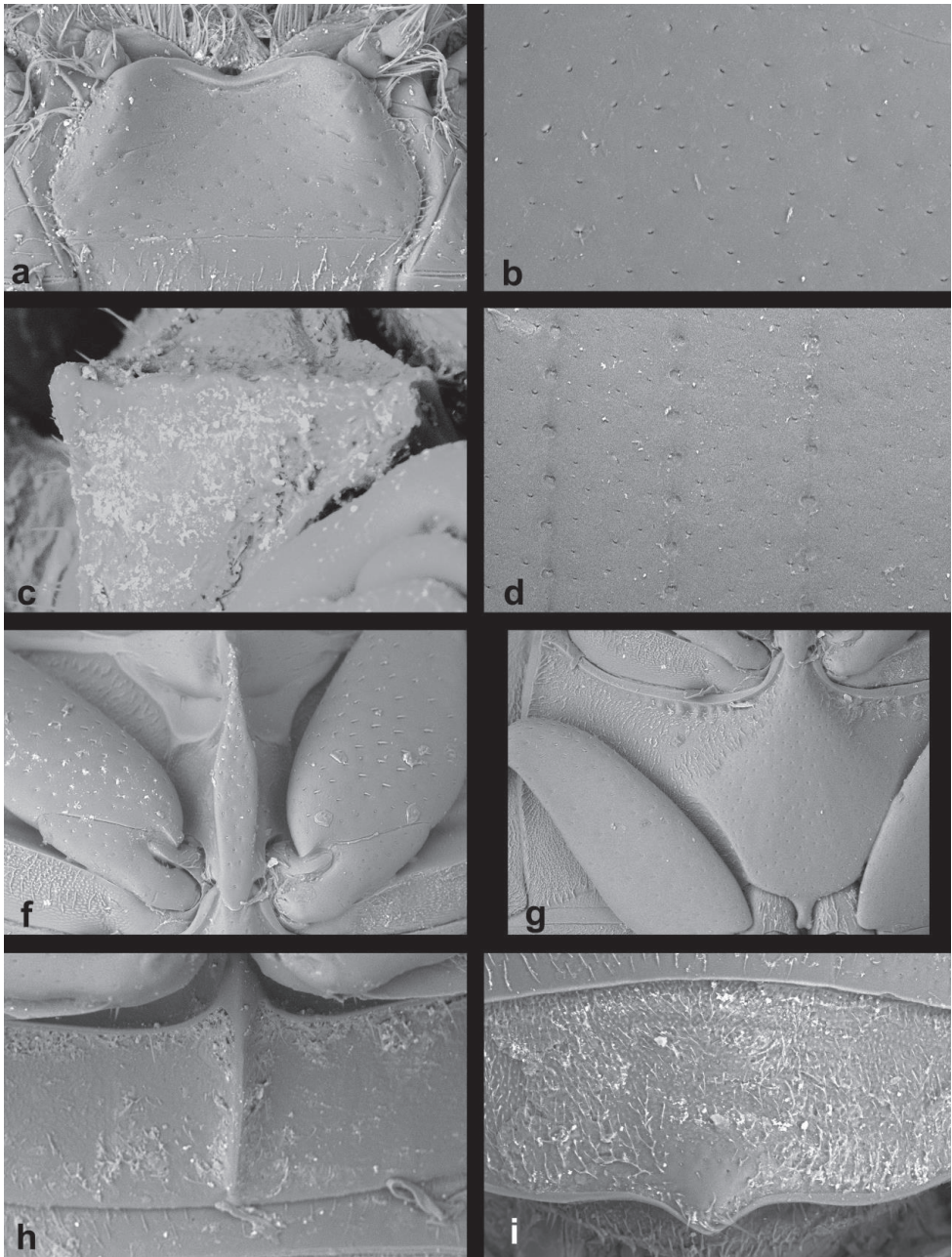


Figure 10. *Cercyon sklodowskiae* sp. n. **a** mentum **b** detail of pronotal surface **c** lateral view of median ridge of prosteron **d** detail of elytral surface **e** detail of elytral surface **f** mesoventral plate **g** metaventricle **h** median ridge of first abdominal ventrite **i** female fifth abdominal ventrite.

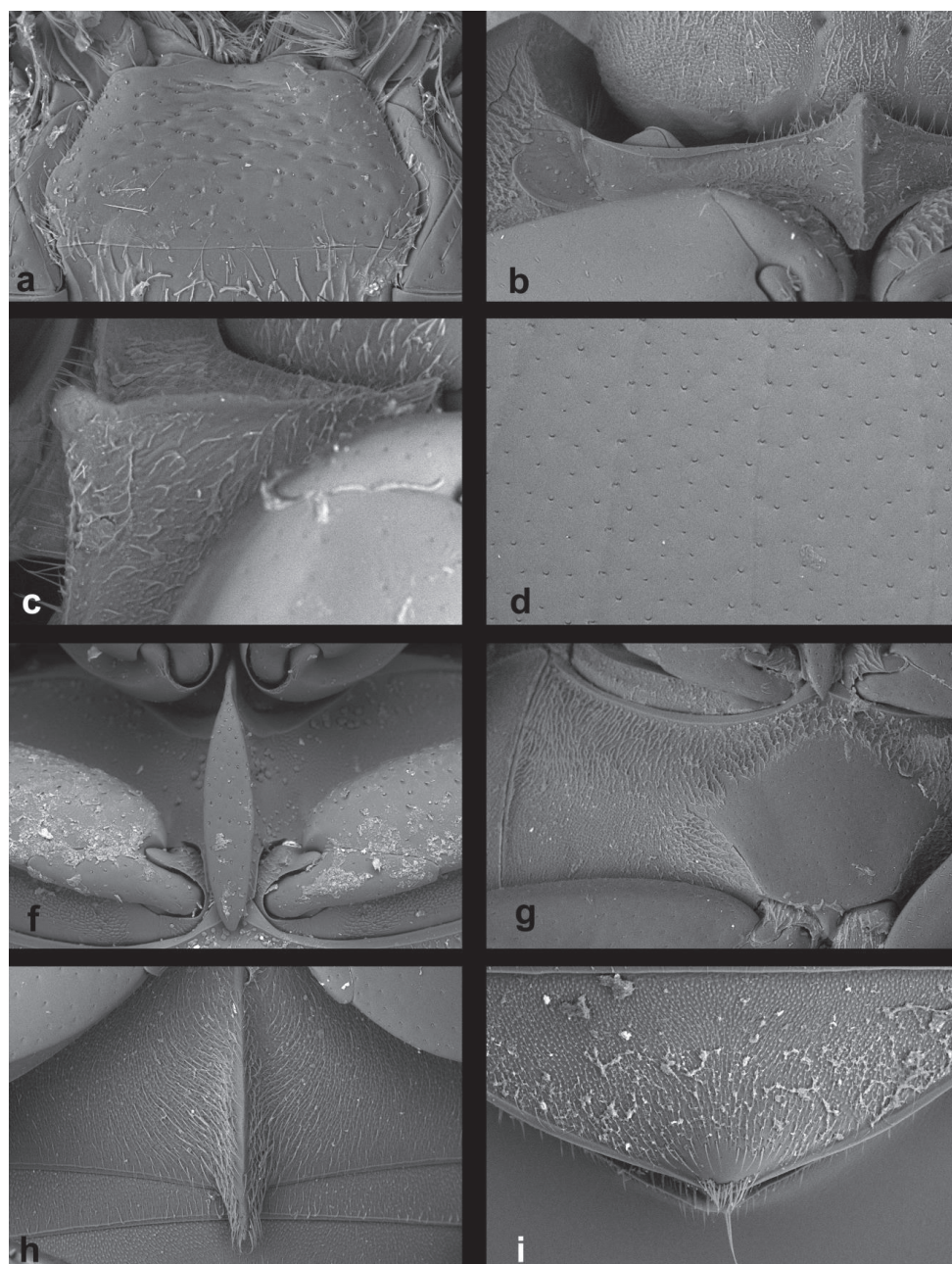


Figure 11. *Cercyon spiniventris* sp. n. **a** mentum **b** prosternum **c** lateral view of median ridge of prosternum **d** detail of elytral surface **f** mesoventral plate **g** metaventricle **h** median ridge of female first abdominal ventrite **i** fifth abdominal ventrite.

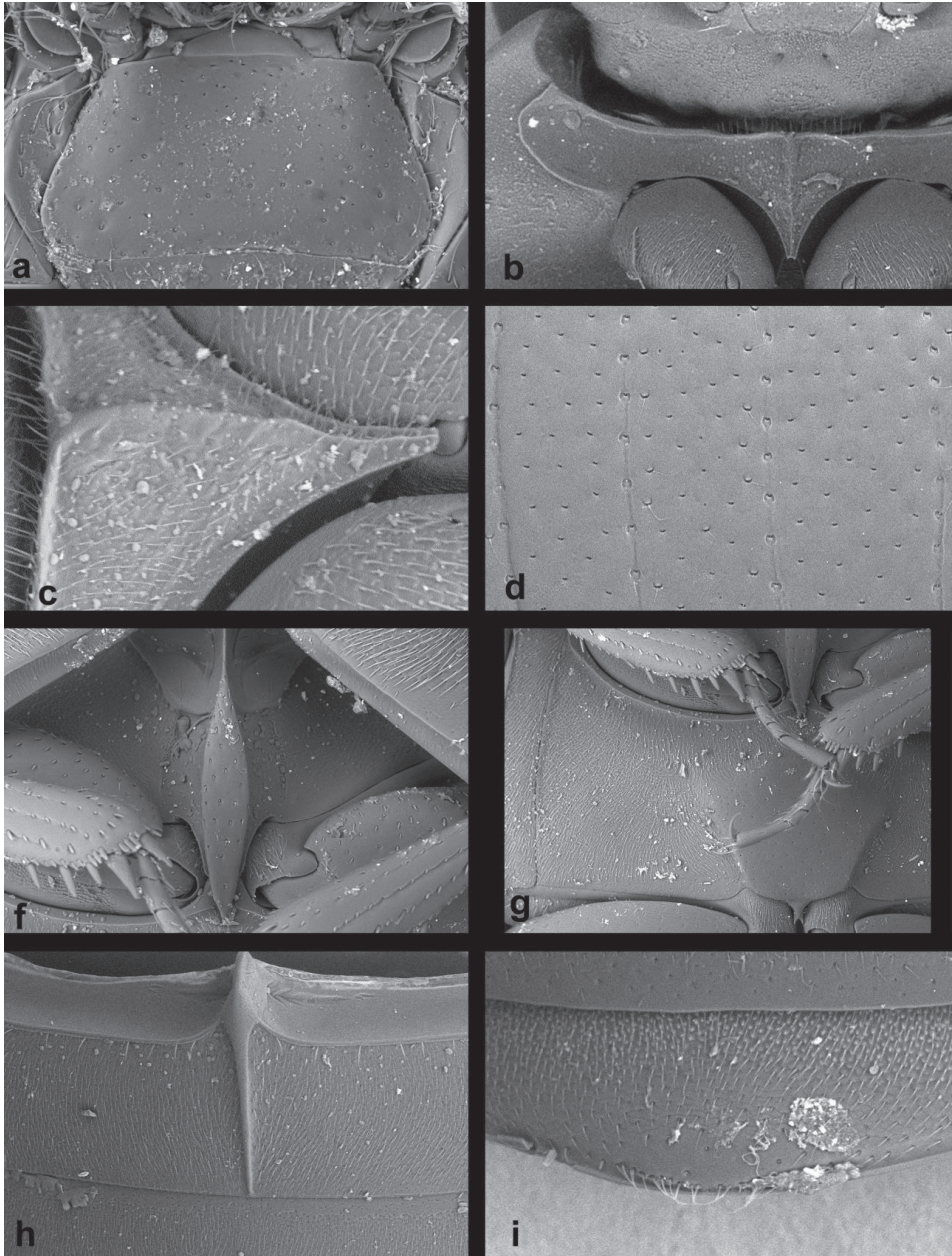


Figure 12. *Cercyon insularis* Chevrolat **a** mentum **b** prosternum **c** lateral view of median ridge of prosternum **d** detail of elytral surface **f** mesoventral plate **g** metaventricle **h** median ridge of female first abdominal ventrite **i** fifth abdominal ventrite.

extracts: MF1214.1, MF1214.2]. **PUERTO RICO: Naguabo:** El Yunque National Forest (southern part), 3.45 km N of Río Blanco at road PR191, in horse excrements on exposed small pasture on the slope of El Yunque massive, 18°14.8'N, 65°47.9'W,

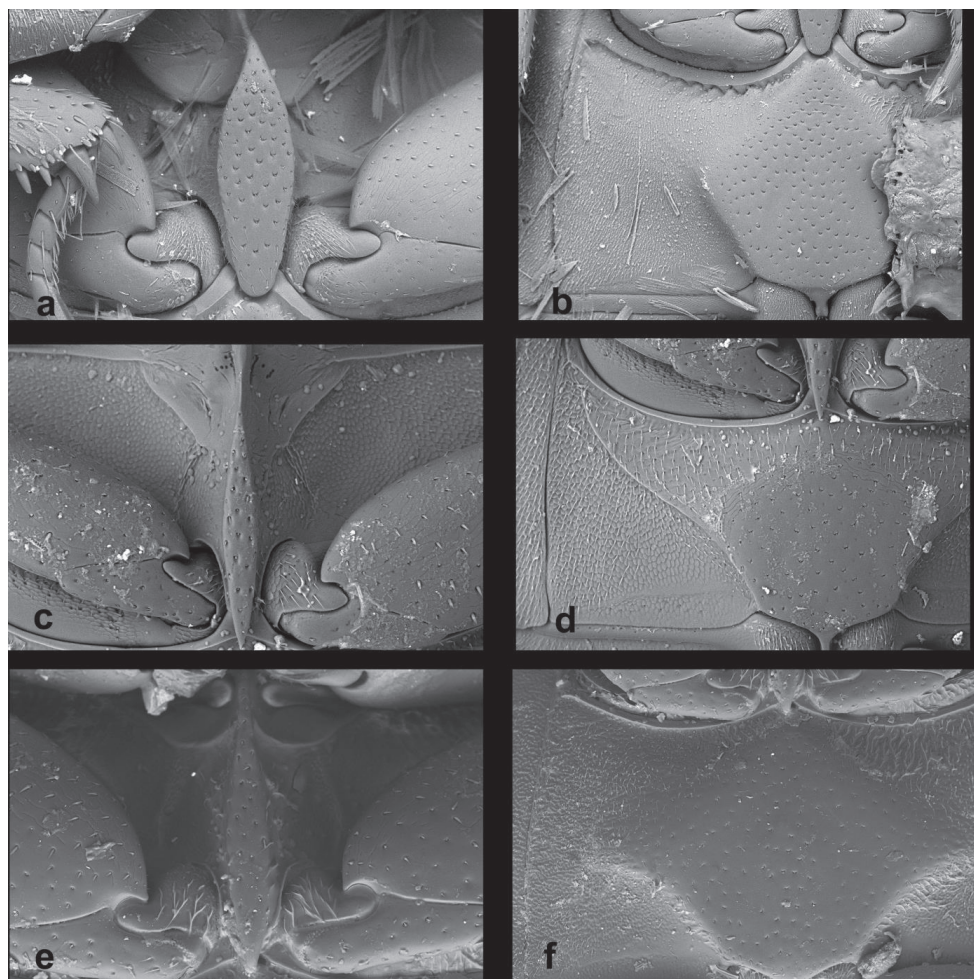


Figure 13. *Cercyon* spp. **a–b** *Cercyon praetextatus* Say **c–d** *Cercyon nigriceps* Marsham **e–f** *Cercyon quisquilius* Linnaeus **a, c, e** mesoventral plate **b, d, f** metaventrite.

170 m a.s.l., 24.vi.2016, leg. Deler-Hernández, Fikáček & Seidel (PR2a) (19 spec.: NMPC) [DNA extraction: MF1731]; El Yunque National Forest (southern part), 4.9 km N of Río Blanco, margin of the rainforest in an area with many flowering *Etilingera elatior* plants, FIT, 18°15.8'N, 65°47.3'W, 495 m a.s.l., 24.vi.–2.vii.2016, leg. Fikáček & Seidel (PR11) (3 spec.: NMPC). **Arecibo:** small settlement in Bosque Estatal Río Abajo, in the middle of the lowland forest, horse excrement, 18°19.7'N, 66°42.1'W, 340 m a.s.l., 27.vi.2016, leg. Deler-Hernández, Fikáček & Seidel (PR15) (1 spec.: NMPC). **Lesser Antilles: DOMINICA:** Springfield Estate, mature secondary forest, FIT, 15°20.796'N, 61°22.142'W, 30.v.–16.vi.2004, S. & J. Peck (04-86) (3 spec.: SBP). **GRENADA:** Grand Etang Forest Reserve, FIT in rainforest, 12°04.846'N 61°42.333'W, 360 m a.s.l., leg. S. Peck (10-61) (2 spec.: SBP); Grand Etang Forest Reserve, FIT in rainforest, 12°04.162'N 61°42.162'W, 400 m a.s.l.,

leg. S. Peck (10–63) (2 spec.: SBP); St. Andrew, Mirabeu Agriculture Lab, light trap, 19.iv.1990, leg. J. Telesford (2 spec.: SBP). **SAINT LUCIA:** Mon Repos, 6.5 km W Fox Grove Inn, submontane forest, carrion traps, 13°52.5'N, 60°56.4'W, 300 m a.s.l., leg. S. & J. Peck (0759) (2 spec.: SBP).

Published records (as *C. variegatus*). **JAMAICA:** without precise locality (Smetana 1978). **PUERTO RICO:** without precise locality (Smetana 1978). **DOMINICA:** without precise locality (Leng and Mutchler 1917; Peck 2006).

Diagnosis. Body size 2.4–3.4 mm; dorsal surface of head (Fig. 4a) black with a pair of small pale spots on vertex (sometimes fused in one central spot), pronotum yellowish to dark reddish-brown with a large blackish central spot and two small round blackish spots at sides (sometimes obscured); elytra yellowish with black humeral spot, in dark specimens whole elytral base and suture darkened; medial ridge of prosternum not projected ventrally (Fig. 12c); mesoventral plate narrow, 5.8× as long as wide (Fig. 12f); metaventrite (Fig. 12g) without femoral lines, with raised pentagonal area as long as wide; first abdominal ventrite without spine-like process in both sexes (Fig. 12h); apex of fifth abdominal ventrite (Fig. 12i) without apical projection in both sexes; aedeagus narrow, parameres 0.7× as long as phallobase (Fig. 4f), rounded at apex; median lobe (Fig. 4g) subparallel throughout except for acuminate apex, without subapical spines.

Redescription. *Body.* (Fig. 4a–d) 2.4–3.4 mm long (length of holotype: 2.8 mm); moderately elongate oval, 1.7–1.8× as long as wide, widest at basal fifth of elytra; moderately convex, 2.6–2.8× as long as high (height of holotype: 1.0 mm). *Coloration.* Dorsal surface of head black with a pair of small rufotestaceous spots on vertex. Antennal scape and flagellum and ventral surface of head including mouthparts light-brown, antennal club and mentum dark brown. Pronotum yellowish to dark reddish-brown, with a large blackish central spot and two small round blackish spots at its sides, sometimes connected with central spot. Prosternum yellowish to light brown, hypomeron slightly darkened. Elytra with elongate blackish spot posterior to humeri, elytral base and suture darkened, elytral epipleura uniformly pale. Ventral surface of mesothorax blackish. Metepisternum brown. Metaventrite blackish, darker at medial elevation. Abdomen yellowish to reddish-brown. Legs yellowish to light brown.

Head. Clypeus with moderately dense and shallow punctation consisting of small transverse punctures; interstices without microsculpture. Anterior margin of clypeus with narrow bead. Frontoclypeal suture conspicuous as a zone without punctuation, vanished mesally. Frons with punctation similar to that on clypeus, punctures sparser on sides; interstices without microsculpture. Eyes rather small, interocular distance about 6× the width of one eye in dorsal view. Labrum membranous, nearly completely concealed under clypeus, only with narrowly exposed sinuate anterior margin. Mentum (Fig. 12a) subtrapezoid, widest at posterior fourth, about 2× wider than long, 1.5× wider at widest part than at anterior margin, strongly concave in anterior half, anterior margin not emarginate; surface almost glabrous, punctures small, shallow and

sparse, almost vanishing anteromesally, interstices without microsculpture. Antenna with 9 antennomeres, scapus ca. $1.8\times$ as long antennomeres 2–6 combined; antennal club moderately elongate, about twice as long as wide, as long as scapus; antennomere 9 acuminate at apex.

Prothorax. Pronotum transverse, widest at base $2.1\text{--}2.2\times$ wider than long; $1.7\text{--}1.8\times$ wider at base than between front angles, $1.8\times$ wider than head including eyes, as convex as pronotum in lateral view. Punctuation rather dense and moderately deep, consisting of crescent-shaped punctures intermixed with denser, slightly smaller and rather transverse punctures; punctures slightly feebler on sides. Prosternum (Fig. 12b) strongly tectiform medially, median ridge (Fig. 12c) with the same width throughout, anterior apex not projecting ventrally. Antennal grooves distinct, with lateral margin curved.

Pterothorax. Scutellar shield $1.2\times$ as long as wide, sparsely punctured. Elytra widest at anterior fifth, $1.0\text{--}1.1\times$ longer than wide, $2.6\text{--}2.8\times$ as long as pronotum, $1.2\text{--}1.3\times$ as wide as pronotum, surface glabrous, with 10 series of punctures; series 6, 8 and 9 not reaching anterior margin, surface glabrous (Fig. 12d), serial punctures getting slightly smaller laterally; intervals moderately convex; punctuation on interval 1 and odd intervals composed of crescent-shaped setiferous punctures, close to striae denser and intermixed with smaller, transverse non-setiferous punctures; even intervals with non-setiferous punctures only; all interstices without microsculpture. Humeral bulge indistinct. Mesoventral plate (Fig. 12f) narrowly elongate, ca. $5.8\times$ as long as wide, widest at midlength, symmetrically narrowing to both apices, anterior apex pointed, posterior apex rounded, posterior tip slightly overlapping over anterior portion of metaventrite; surface with few sparse punctures. Metaventrite (Fig. 12g) with raised pentagonal area ca. as wide as long, weakly, sparsely, uniformly punctated, without visible setae, bare part not reaching anterior margin of metaventrite; femoral lines absent; lateral parts of metaventrite densely covered by short pubescence.

Legs. Femora with sparse shallow punctures ventrally, interstices with weak microsculpture consisting of longitudinal lines; tibial grooves distinct. Tibiae with rather small lateral spines. Metatibiae moderately broad and long, straight, $0.33\times$ as long as elytra, $5\times$ as long as wide. Metatarsus long, $0.86\text{--}0.89\times$ as long as metatibia, with just a few short rather stout setae ventrally.

Abdomen with five ventrites, first abdominal ventrite (Fig. 12h) about as long as the second and third ventrites together, with distinct median longitudinal carina narrowing posteriad, not projecting posteriorly in both sexes; fifth ventrite with acuminate apex and weakly bulged in both sexes (Fig. 12i).

Male genitalia. Median projection of sternite 9 (Fig. 4i) rounded apically, with a pair of subapical setae, base symmetrical. Phallobase (Fig. 4f) almost $1.4\times$ longer than parameres, narrow, parallel sided, base widely rounded, manubrium indistinct. Parameres nearly of the same width in basal $3/4$, divergent near apex, rounded and weakly narrowing apically. Median lobe (Fig. 4g) narrow and subparallel throughout, pointed at apex (Fig. 4h), gonopore moderately large, basal portion of median lobe with dorsal plate narrow and simply bifid basally.

Variability. The general dorsal coloration of the pronotum and elytra varies from yellow to dark reddish-brown. In dark specimens, lateral pronotal spots join the large central spot, and the whole anterior part of elytra and the elytral suture are distinctly darkened, with pale areas maintained in humeral area and at sides of scutellar shield. In pale specimens, the lateral pronotal spots are rather small and sometimes very vague and indistinct, and the elytra are completely yellow except base, sutural interval and the posthumeral dark spots.

Distribution. *Cercyon insularis* seems to be widely distributed across Greater and Lesser Antilles, here we are recording it from Cuba, Dominican Republic, Puerto Rico, Grenada, Saint Lucia and Dominica. It seems that all records of *C. variegatus* from the Caribbean (Jamaica, Puerto Rico: Smetana 1978; Dominica: Peck 2006) actually concern *C. insularis*, as we failed to find the true *C. variegatus* in the material examined. For that reason we consider *C. insularis* to occur in Jamaica, although we did not examine any specimens from Jamaica ourselves.

Bionomics. Most of the specimens were collected in cow and horse dung on pastures, in coffee plantations and in tropical forests; few were collected using flight intercept traps.

Discussion. Chevrolat (1863) described *C. insularis* based on a single specimen from Cuba collected by D. F. Poëy and deposited in Chevrolat's collection. On our request to loan this specimen, we received a single specimen standing under the name *C. insularis* in the Chevrolat collection, corresponding well with the original description and marked as a type. In contrast to the data mentioned by Chevrolat (1863), the specimen also bears a label indicating Habana as the place of its origin. Since there is no reason to doubt the type identity of this specimen, we correct the type locality of *C. insularis* to Habana, in agreement with the label data of the holotype.

Cercyon insularis was only briefly mentioned once by Gundlach (1891) and its type was not reexamined, therefore its identity remained unclear. Our inspection of the type revealed it corresponds by coloration with what was recorded from the Caribbean as *Cercyon variegatus* Sharp, 1882, by Smetana (1978), Hansen (1999) and Peck (2006). In order to determine the identity of the species present in the Caribbean we studied the lectotype of *C. variegatus* (Fig. 4j–o, deposited in BMNH) and compared it to the type of *C. insularis* and additional recently collected material from Cuba. Based on this comparison, it became clear that Cuban specimens are not conspecific with *C. variegatus*, but belong to a different species indistinguishable from it by external morphology: all dissected Cuban specimens were conspecific, differed from *C. variegatus* by genital morphology, and no other species of the same external coloration was found. We hence consider the Cuban specimens conspecific with the type specimen of *C. insularis*, even though it cannot be dissected because of its poor condition. Both median lobe (Fig. 4g) as well as phallobase and parameres (Fig. 4f) are narrower in *C. insularis* than in *C. variegatus*. The apices of parameres are rounded in *C. insularis*, while they are more acuminate in *C. variegatus* (Fig. 4l). Moreover, the apex of the median lobe of *C. variegatus* has a small flank on each side (Fig. 4n) (Full set of pictures of the lectotype of *C. variegatus* in www.flickr.com/photos/142655814@N07/albums/72157676248390724).

Cercyon insularis and *C. variegatus* belong to a species complex corresponding to the *C. variegatus* group of Smetana (1978), distributed from the southern USA to Argentina; the species within this complex can be only distinguished by the morphology of the male genitalia (Arriaga-Varela and Fikáček, pers. observation). Only two species of this species complex have been formally described (*C. variegatus* and *C. insularis*) and the group requires a detailed revision. The species recorded from Suriname as “*Cercyon rishwani*” by Makhani (2004) also belongs to this species complex based on color pattern of the pronotum and the general shape of the aedeagus, but a more detailed comparison with *C. insularis* and *C. variegatus* is impossible based on the description and illustrations provided. “*Cercyon rishwani* Makhani, 2004” is moreover considered a *nomen nudum* (see Short and Hebauer, 2006 for details).

Larval morphology

Cercyon taino sp. n.

Figure 14a–f

Material examined. DOMINICAN REPUBLIC: La Vega: PN Valle Nuevo, Salto Aguas Blancas, sifting of moist leaf litter in small remnants of montane forest in a small ravine with a spring and on slopes just above the small river, 18°50.60'N, 70°40.68'W, 1655 m a.s.l., 25.viii.2014, leg. Deler, Fikáček & Gimmel (DR21) (2 larvae associated with adults: NMPC; DNA extraction of one larva: MF1261.L).

Larval diagnosis. Head capsule (Fig. 14e) longer than wide; cuticle with polygonal microsculpture; head capsule with two “lenses” (anteriorly and posterior of the eye spot) on each side, lateral part of head capsule without apparent group of setae ca. at midlength; clypeolabrum uniformly arcuate at the right side from the setiferous emargination. Metanotum (Fig. 14a) with wide and strongly sclerotized transverse tergite. Legs (Fig. 14d) reduced into two-segmented vestiges. Membranous parts of thorax and abdomen (Fig. 14a–c) covered by long blackish cuticular projections. Abdominal segments acutely lobate laterally, abdominal segments 1–7 each with three transverse rows of low tubercles. Tergite on 8th abdominal segment (Fig. 14f) ca. as long as wide, deeply sinuate on anterior margin, with three slightly acute lobes on posterior margin.

Cercyon insularis Chevrolat

Figure 14g–l

Material examined. PUERTO RICO: Naguabo: El Yunque National Forest, (southern part), 3.45 km N of Río Blanco at road PR191, in horse excrements on exposed small pasture on the slope of El Yunque massive, 18°14.8'N, 65°47.9'W, 170 m

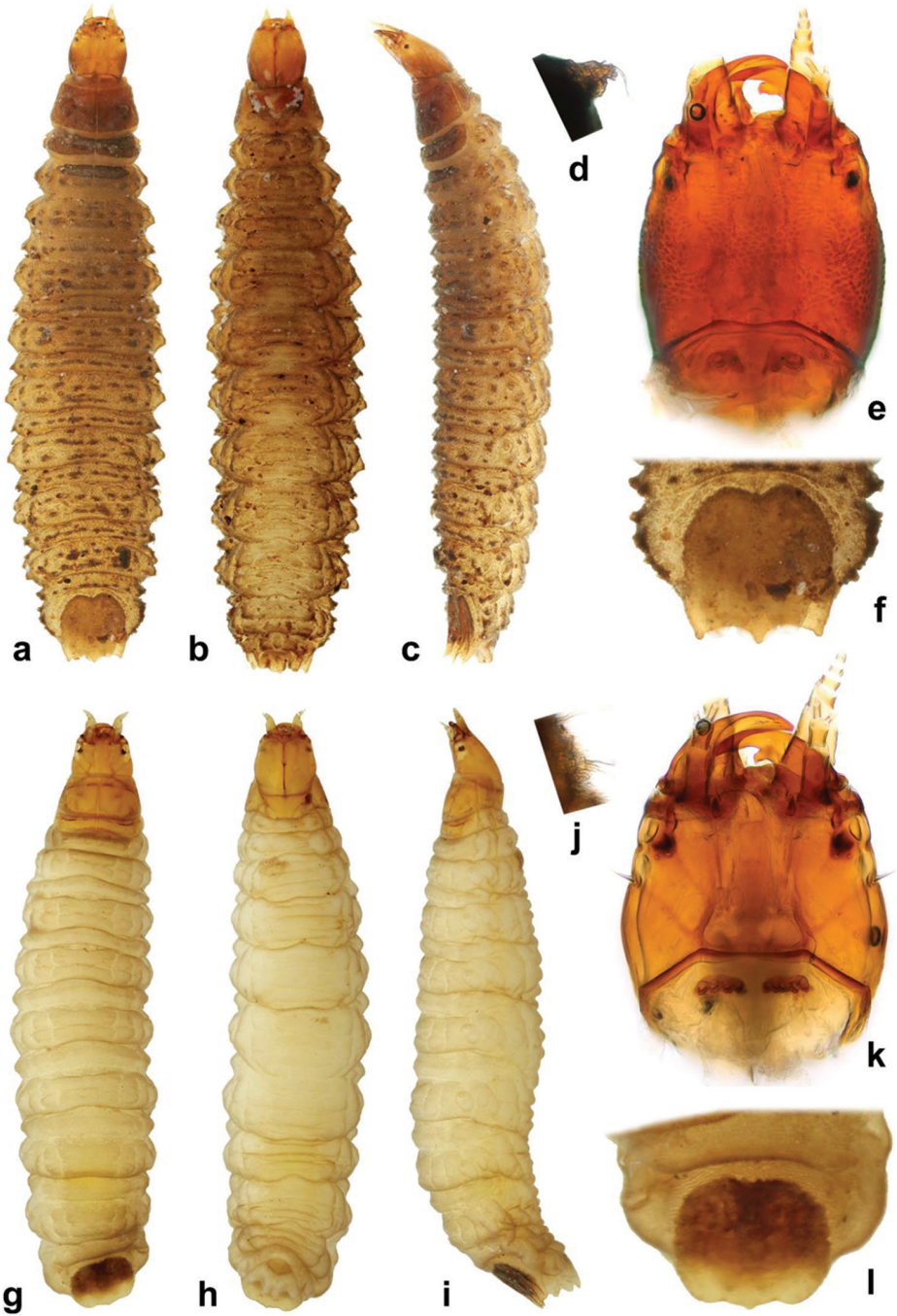


Figure 14. *Ceryon* spp. larval morphology **e–f** *Ceryon taino* sp. n. **g–l** *Ceryon insularis* Chevrolat **a, g** dorsal habitus **b, h** ventral habitus **c, i** lateral habitus **d, j** front leg **e, k** dorsal view of head **f, l** tergite on 8th abdominal segment.

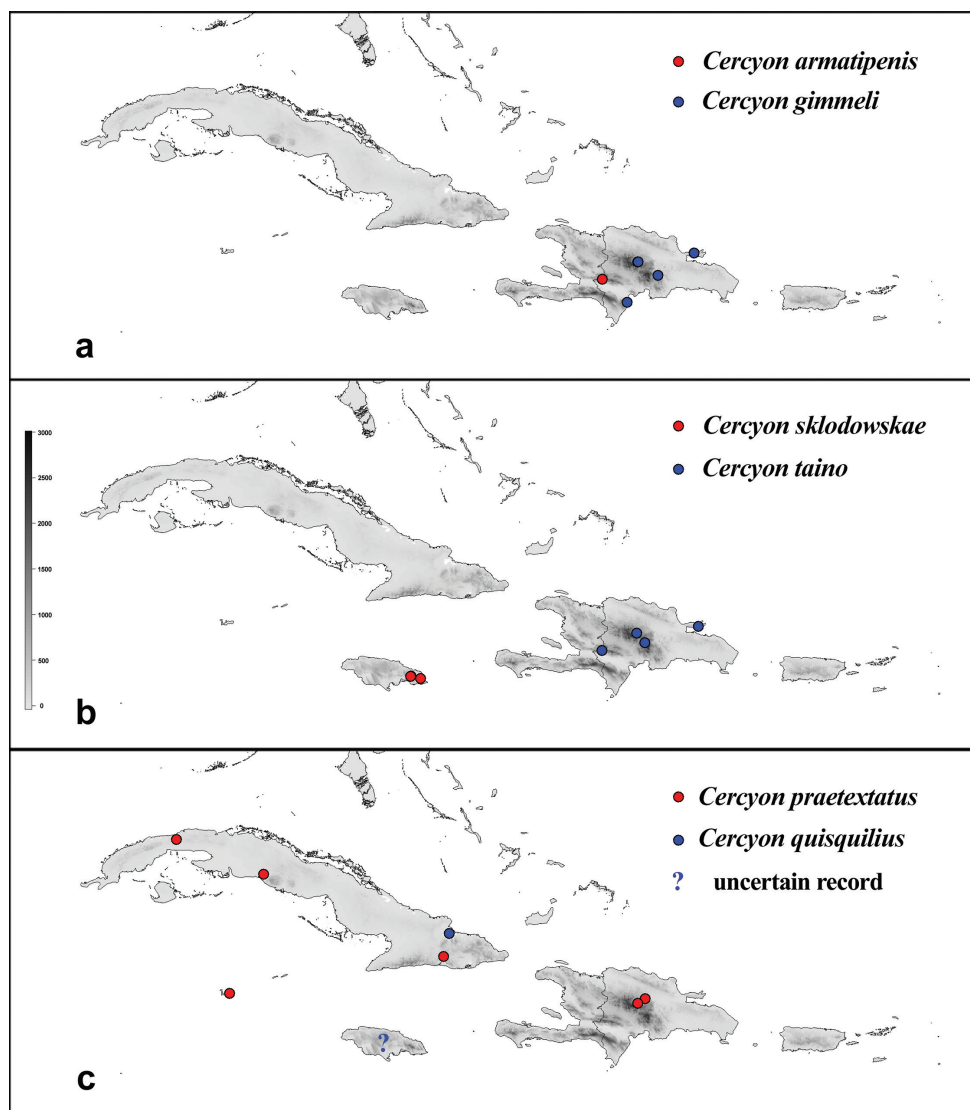


Figure 15. *Cercyon* spp. distribution maps. **a** *Cercyon armatipenis* sp. n. (●) *Cercyon gimmeli* sp. n. (●) **b** *Cercyon sklodowskai* sp. n. (●) *Cercyon taino* sp. n. (●) **c** *Cercyon praetextatus* Say (●) *Cercyon quisquilius* Linnaeus (●).

a.s.l., 24.vi.2016, leg. Deler-Hernández, Fikáček & Seidel (PR2a) (2 larvae associated with adults; NMPC; DNA extraction of one larva: MF1731.L)

Larval diagnosis. Head capsule (Fig. 14k) ca. as long as wide; cuticle smooth, without distinct microsculpture; head capsule with two “lenses” (anteriorly and posterior of the eye spot) on each side, lateral part of head capsule with apparent group of setae (PA12-14 *sensu* Fikáček et al. 2008) ca. at midlength; clypeolabrum angulate at the

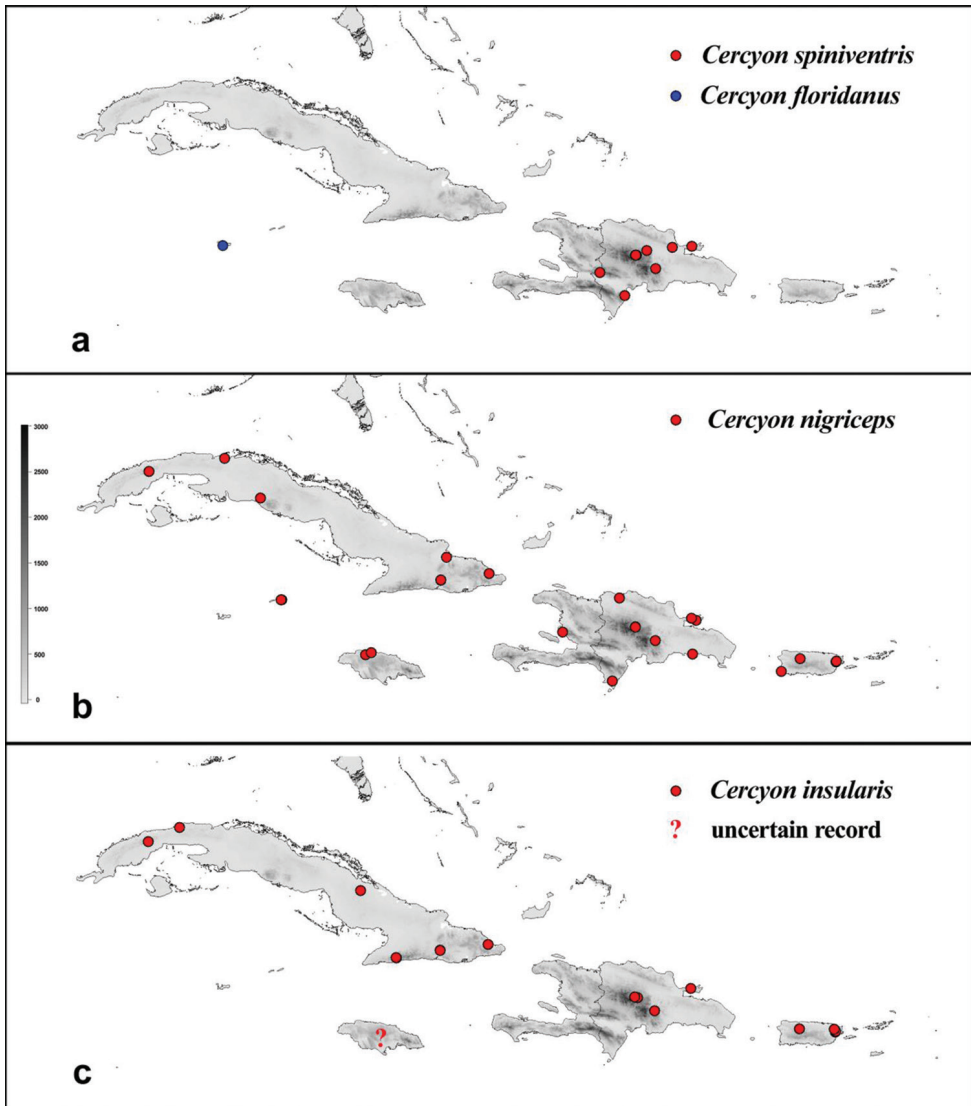


Figure 16. *Cercyon* spp. distribution map. **a** *Cercyon spiniventris* sp. n. (●) *Cercyon floridanus* Horn (●) **b** *Cercyon nigriceps* Marsham (●) **c** *Cercyon praetextatus* Say (●) *Cercyon insularis* Chevrolat (●).

right side from the setiferous emargination. Metanotum (Fig. 14g) with very narrow and weakly sclerotized transverse tergite. Legs (Fig. 14g) reduced into one-segmented setiferous tubercle. Membranous parts of thorax and abdomen covered by extremely short and dense whitish microtrichia. Abdominal segments (Fig. 14g–i) without lateral lobes, smooth (i.e. without transverse rows of tubercles) dorsally. Tergite on 8th abdominal segment (Fig. 14l) wider than long, shallowly sinuate on anterior margin, weakly sinuate on posterior margin.

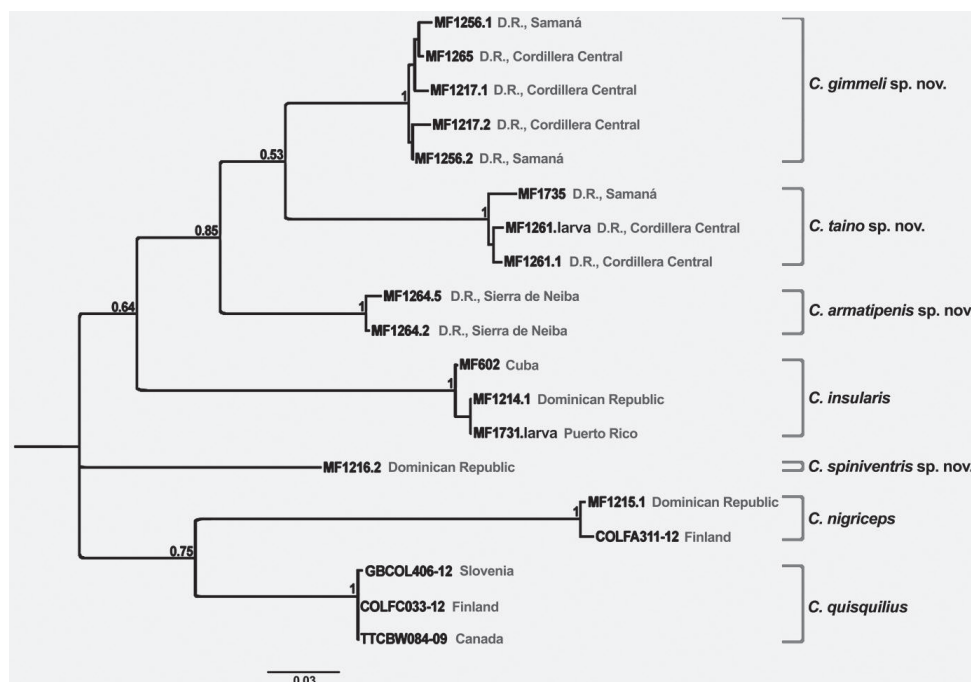


Figure 17. Maximum likelihood tree 1000 bootstrap replicates resulting from the phylogenetic analysis of DNA barcode of 19 specimens of *Cercyon* spp. Newly sequenced Caribbean specimens have the MF codes, other sequences are adopted from BOLD database.

Analysis of molecular data

Partial COI sequences of the 19 *Cercyon* specimens sampled resulted in a 610 bp alignment. JModelTest (Darriba et al. 2012) determined the GTR+I+G model as best nucleotide substitution model. The resulting maximum likelihood tree revealed 7 clades corresponding to the species as defined by morphological characters (Fig. 17). The statistical support for all species clades containing multiple specimens was high (bootstrap 100%), whereas the backbone of the phylogeny was poorly supported (bootstrap 53–85%), corresponding to the fact that we used a single marker with high substitution rate with limited information content for interspecific phylogeny, especially when introduced (and hence likely not closely related) species were included in the analysis. However, we recovered the *C. gimmeli* species complex as a well-supported monophyletic group, containing three well separated lineages (corresponding to the species as delimited by genital morphology) with mean interspecific distances 9–10 %. Sequenced females of the *C. gimmeli* species complex, morphologically not identifiable to species, were all unambiguously associated with male specimens and included as paratypes. *Cercyon insularis*, *C. spiniventris* and the introduced species were also revealed as well separated lineages in our analysis. The intraspecific genetic distances were low in all species for which multiple specimens were included, ranging between 0.0 to 1.4 %.

Larval specimens were unambiguously assigned to co-occurring adults in both cases (larva MF1261.L to *C. taino*, larva MF1731.L to *C. insularis*). The only sequenced specimen of *C. nigriceps* from Puerto Rico is genetically very similar to that of Finland (genetic distance 0.6 %) (See supplementary material 2).

Discussion

Faunal composition of *Cercyon* in the Greater Antilles. Our revision raises the number of *Cercyon* species from six to 10, and shows that the composition of the fauna largely differs from the original ideas: (1) five species, i.e. half of the fauna, are probably single-island endemics (four species in Hispaniola, one in Jamaica) and one additional species (*C. insularis*) seems to be a widespread Caribbean endemic not occurring in the mainland Americas; (2) only two species occurring in the Greater Antilles (*C. praetextatus* and *C. floridanus*) are native to the American continent, of which *C. floridanus* is moreover limited only to Cayman islands and does not occur in the four main islands of Greater Antilles; (3) two introduced Old World species (*C. nigriceps* and *C. quisquilius*) occur in the Greater Antilles, both of which are nowadays also widespread in the American continent (Smetana 1978; Fikáček 2009). The widespread continental *Cercyon variegatus* which was originally recorded from Jamaica and Puerto Rico by Smetana (1978) does not occur in the Caribbean Region at all, and is replaced there by morphologically very similar and likely closely related *C. insularis*.

The comparison of the original ideas about the *Cercyon* fauna and its real composition corresponds to the situation found in many other groups of minute arthropods, which were recently studied in the Greater Antilles. These studies frequently discover higher numbers of single-island endemics than expected, and reveal that some widespread continental species recorded from the Caribbean are in fact endemic species closely related but not identical to the continental ones (e.g., Dziki et al. 2015; Agnarsson et al. 2016).

The probable single-island endemics discovered during this study are distributed in Hispaniola (four species) and Jamaica (one species) only. No new species were discovered in Cuba and Puerto Rico, despite our collecting effort in both islands. Our field work in Puerto Rico was rather short and did not cover all mountain regions. Therefore, we cannot exclude additional discoveries in the island. On the other hand, our sampling effort was highest in Cuba, with intensive field work performed in 2010–2016. Hence we consider the discovery of a new endemic species in Cuba less likely. This puts in contrast Cuba, i.e. the largest Greater Antillean island, with no endemic species, with the smaller Hispaniola, hosting at least four single-island endemics. Moreover, the discovery of *C. armatipenis* sp. n. in a single locality in Sierra de Neiba at the Dominican-Haitian border indicates that additional species may be expected in this species complex in the western part of the island (i.e. Haiti) which was not sampled so far. In the same manner, there is a chance that the only species so far known exclusively from the Lesser Antilles, *Cercyon cribratus* Castelnau (1840), described from Guade-

loupe island, could be present in the Greater Antilles. However, we were not able to find any specimen fitting its description in the examined material.

Both the extremely similar morphology and results of the analysis of the COI sequences imply that the *C. gimmeli* species complex forms a monophyletic clade endemic to Hispaniola. The fact that all species of the complex occur sympatrically and no clear geographic pattern can be observed in their ranges suggests that the radiation of this group in Hispaniola may be a result of subdivision of Hispaniola in smaller paleoislands during the Oligocene to Middle Miocene followed by range expansion when the paleoislands got interconnected more recently (Iturralde-Vinent and MacPhee 1999; Iturralde-Vinent 2006; Matos-Maravi et al. 2014). The group would be hence a good model for a further more detailed biogeographic study.

Novel morphological characters. Morphological studies of the Greater-Antillean *Cercyon* revealed some characters of adults relevant to species discrimination and identification, but not used before: the presence/absence and shape of the projection of the anterior part of the prosternal medial ridge, and the sexually dimorphic characters of abdominal ventrites found in *C. spiniventris* and *C. sklodowskiae*. Females of *C. spiniventris* are characterized by a spine-like process on the first abdominal ventrite (absent in males), which has not been recorded in any other *Cercyon* species so far, but is present in females of the Australian megasternine genus *Cercyodes* Broun (Hansen 1990). Females of *C. sklodowskiae* are characterized by modified shape of the fifth abdominal ventrite (compared to simple one in males). We have observed the variation of the shape of the fifth ventrite also in some other *Cercyon* species (without checking their sex). Hence the sexual dimorphism in this character may be more widespread than expected.

Interesting discoveries were also made by a brief examination of the larvae of *C. insularis* and *C. taino*. Both larvae are surprisingly quite different from each other, differing especially in the head proportions, extent of leg reduction, shape of the tergite of 8th abdominal segment, and surface vestiture membranous parts of thorax and abdomen. In all these characters, *C. insularis* is more similar to other *Cercyon* larvae described in the literature (*C. quisquilius* and *C. praetextatus*: Archangelsky 2016; *C. melanocephalus* and *C. haemorrhoidalis*: De Marzo 2000; *C. unipunctatus*, *C. pygmaeus* and *C. lateralis*: Schulte 1985). When examining the larval head of both *C. insularis* and *C. taino*, we found two circular areas of thickened transparent cuticle, one situated just in front of the ocular spot and another one just behind it (the areas are also visible as paler spots in lateral view of the head). We suppose that these areas of thickened cuticle may function as lenses. This character was never studied in sphaeridiine larvae and the only information about the ocular region available in the literature concerns the presence and shape of the pigmented “ocular spots”: in larval Megasternini one spot is present, interpreted as an aggregation of all six stemmata or three anterior stemmata only (Hansen and Richardson 1998; Archangelsky 1999). Additional studies are needed to understand the function of this structure and its distribution in the Megasternini and Sphaeridiinae. One lens is present on each side of the head capsule of the larvae of *C. praetextatus* and the unidentified Japanese larvae of *Cercyon* (M. Archangelsky and Y. Minoshima, pers. comm. 2016), and two lenses (one before and one behind

the pigmented spot) are present on each side of the head of larval *Sphaeridium*, i.e. the sister-group to the tribe Megasternini (M. Archangelsky, pers. comm.).

The novel characters mentioned above of both adults and larvae are useful for diagnostic purposes, but can also have phylogenetic signal which will help to corroborate the results of the ongoing phylogenetic study of the tribe Megasternini. The differences found between the larvae of *C. insularis* and *C. taino* and the differences in the number of lenses between different megasternine taxa show that larval morphology of the Megasternini is not that uniform as previously believed, and is in need of more studies.

Subgeneric assignment of the Greater Antilles *Cercyon* species. All species treated in this paper fall into the concept of *Cercyon* sensu stricto. However, we refrain from assigning them to any subgenus since the systematics of the genus *Cercyon* and allies is currently under study, and previous studies have shown that *Cercyon* in the current concept may be a polyphyletic assemblage of species (e.g. Short and Fikáček 2013). Newly discovered characters of adults and larvae discussed above also indicate that *Cercyon* is much more morphologically heterogeneous than expected, which corresponds to its supposed polyphyly.

Author contribution

ADH, MF and MS performed the field work; EAV and MF accumulated additional museum material; EAV performed the majority of morphological studies, prepared the first draft and photodocumentation; EAV and MS did the molecular work, analysis of the data and prepared the data for submissions to BOLD; VS, MF and EAV prepared the datasets, wrote and tested the scripts, and submitted the data to BOLD, GBIF and Flickr; all authors commented drafts of the paper at different stages and helped with completing the manuscript for submission.

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Supplementary material 1

Darwin Core formatted distribution data

Authors: Emmanuel Arriaga-Varela, Matthias Seidel, Albert Deler-Hernández, Viktor Senderov, Martin Fikáček

Data type: species distribution

Explanation note: The Excel file includes all fields (columns) defined by the DarwinCore (DwC) format relevant to our data (headers highlighted in green) and ordered in a customized way (order of columns is not important, columns are identified by their header names that need to remain unchanged). We added a few fields (columns), which are not present in DwC, to include additional information needed in our case (about specimens in a DNA-tissue collection, DNA extracts done, and DNA barcodes), or to make the data input more convenient (two separate columns for starting and ending event dates, from which the date range in DwC format is formed and saved in the eventDate field); headers of all additional fields are marked in grey in Suppl. material 1.

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Link: <https://doi.org/10.3897/zookeys.681.12522.suppl1>

Supplementary material 2

Genetic distances within and between species of Caribbean *Cercyon*

Authors: Emmanuel Arriaga-Varela, Matthias Seidel, Albert Deler-Hernández, Viktor Senderov, Martin Fikáček

Data type: molecular data

Explanation note: Mean genetic distances based on barcode CO1 sequences within (in grey fields) and between species (in white fields) calculated using the Maximum Composite Likelihood model as implemented in MEGA7. Standard error estimates (in square brackets) obtained by bootstrapping (1000 replicates).@.

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Supplementary material 3

DwC2BOLD script

Authors: Emmanuel Arriaga-Varela, Matthias Seidel, Albert Deler-Hernández, Viktor Senderov, Martin Fikáček

Data type: script

Explanation note: We used this script to automatically transform the DwC-formatted specimen data into the format required for the submission of specimen data to BOLD. The script uses the Barcode field (column) in our DwC spreadsheet to filter out the specimens that were barcoded and that need to be submitted to BOLD (notice that the Barcode field was added by us and is not a part of the DwC format!). Due to the slightly different data format used in DwC and BOLD, it is not possible to convert all information automatically, and the resulting BOLD-formatted data should be checked before submission. The script displays alerts for fields in which a mismatch between DwC and BOLD is possible. The script is available in Suppl. material 3 as a zip archive containing an R script, a PDF rendering and an HTML rendering.

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Link: <https://doi.org/10.3897/zookeys.681.12522.suppl3>

Supplementary material 4

DwC2Map script

Authors: Emmanuel Arriaga-Varela, Matthias Seidel, Albert Deler-Hernández, Viktor Senderov, Martin Fikáček

Data type: script

Explanation note: The script reads the decimal GPS data from our DwC Excel file and creates a dataframe with all observations for each species. In the next step it allows to construct the maps of the area from freely available on-line data and map the occurrences of the species on these maps. The maps in Figs 15–16 were generated using this script. The script is available in Suppl. material 4 as a zip archive containing an R script, a PDF rendering and an HTML rendering.

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New Curculionoidea (Coleoptera) records for Quebec, Canada

Pierre de Tonnancour¹, Robert S. Anderson², Patrice Bouchard³, Claude Chantal⁴,
Stéphane Dumont⁵, Robert Vigneault⁶

1 22 5e avenue, Terrasse-Vaudreuil, Quebec, Canada, J7V 3P5 **2** Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario, Canada, K1P 6P4 **3** Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, 960 Carling Avenue, Ottawa, Ontario, Canada, K1A 0C6 **4** 302 Gabrielle-Roy, Varennes, Quebec, Canada, J3X 1L8 **5** Département de biologie et de biotechnologies, Collège Ahuntsic, 9155 rue Saint-Hubert, Montréal, Quebec, Canada, H2M 1Y8 **6** 16 rue du Mont Saint-Pierre, Oka, Quebec, Canada, J0N 1E0

Corresponding author: Patrice Bouchard (patrice.bouchard@agr.gc.ca)

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Abstract

The following species of Curculionoidea are newly recorded from the Canadian province of Quebec: *Coelocephalapion emaciipes* (Fall, 1898); *Ischnopterapion virens* (Herbst, 1797); *Omphalapion hookerorum* (Kirby, 1808); *Perapion punctinasum* (J.B. Smith, 1884) (all Brentidae); *Anthonomus robustulus* LeConte, 1876; *Pseudanthonomus helvolus* (Boheman, 1843); *Bagous magister* LeConte, 1876; *Bagous tanneri* O'Brien, 1979; *Buchananius striatus* (LeConte, 1876); *Ceutorhynchus bolteri* Dietz, 1896; *Ceutorhynchus pallidactylus* (Marsham, 1802); *Ceutorhynchus pauxillus* Dietz, 1896; *Conotrachelus buchanani* Schoof, 1942; *Conotrachelus pusillus* LeConte, 1878; *Conotrachelus recessus* (Casey, 1910); *Curculio rubidus* (Gyllenhal, 1835); *Cylindrocopturus longulus* (LeConte, 1876); *Hadroplontus litura* (Fabricius, 1775); *Hypera rumicis* (Linnaeus, 1758); *Lixus terminalis* LeConte, 1876; *Myosides seriehispidus* Roelofs, 1873; *Phloeotribus dentifrons* (Blackman, 1921); *Plocamus echidna* (LeConte, 1876); *Scolytus muticus* Say, 1824; *Sirocalodes sericans* (LeConte, 1876); *Smicronyx sculpticollis* Casey, 1892 (all Curculionidae). Among these, *Buchananius striatus*, *Conotrachelus buchanani*, *Conotrachelus pusillus*, and *Curculio rubidus* (all Curculionidae) are also recorded from Canada for the first time. The latter is also newly reported from Ontario. Collecting data are provided for *Lixus punctinasum* LeConte, 1876, previously reported to occur

in Canada without any further information, and for *Choragus sayi* LeConte, 1876 (Anthribidae) and *Rhyssomatus aequalis* Horn, 1873 (Curculionidae), both previously recorded from Quebec, also without further details.

Résumé

Les auteurs mentionnent pour la première fois la présence au Québec des espèces de Curculionoidea suivantes : *Coelocephalapion emaciipes* (Fall, 1898); *Ischnopterapion virens* (Herbst, 1797); *Omphalapion hookerorum* (Kirby, 1808); *Perapion punctinasum* (J.B. Smith, 1884) (tous des Brentidae); *Anthonomus robustulus* LeConte, 1876; *Pseudanthonomus helvolus* (Boheman, 1843); *Bagous magister* LeConte, 1876; *Bagous tanneri* O'Brien, 1979; *Buchananius striatus* (LeConte, 1876); *Ceutorhynchus bolteri* Dietz, 1896; *Ceutorhynchus pallidactylus* (Marsham, 1802); *Ceutorhynchus pauxillus* Dietz, 1896; *Conotrachelus buchanani* Schoof, 1942; *Conotrachelus pusillus* LeConte, 1878; *Conotrachelus recessus* (Casey, 1910); *Curculio rubidus* (Gyllenhal, 1835); *Cylindrocopturus longulus* (LeConte, 1876); *Hadropontus litura* (Fabricius, 1775); *Hypera rumicis* (Linnaeus, 1758); *Lixus terminalis* LeConte, 1876; *Myosides seriehispidus* Roelofs, 1873; *Phloeotribus dentifrons* (Blackman, 1921); *Plocamus echidna* (LeConte, 1876); *Scolytus muticus* Say, 1824; *Sirocalodes sericans* (LeConte, 1876); *Smicronyx sculpticollis* Casey, 1892 (tous des Curculionidae). Parmi ces espèces, *Buchananius striatus*, *Conotrachelus buchanani*, *Conotrachelus pusillus* et *Curculio rubidus* (tous des Curculionidae) sont également mentionnés pour la première fois comme étant présents au Canada et, dans le cas de la dernière espèce, également en Ontario. Des données de collecte sont fournies pour *Lixus punctinasus* LeConte, 1876, déjà répertorié au Canada sans données de capture, ainsi que pour *Choragus sayi* LeConte, 1876 (Anthribidae) et *Rhyssomatus aequalis* Horn, 1873 (Curculionidae), dont la présence avait déjà été signalée au Québec, également sans données de capture.

Keywords

Curculionoidea, Anthribidae, Brentidae, Curculionidae, new records, Canada, Quebec, Ontario, weevils

Introduction

Douglas et al. (2013) recently reported five Brentidae and 29 Curculionidae species new to Quebec (of which 3 and 11 were new to Canada, respectively), increasing the total number of species of each family known to occur in the province to 22 and 386, respectively (Bousquet et al. 2013). Recent collection efforts, mainly by amateur entomologists, have since yielded new findings. The new records and new documented record (*Lixus punctinasus* LeConte, 1876) reported herein (4 Brentidae and 23 Curculionidae), listed according to the classification of Bouchard et al. (2011), bring these totals to 26 and 409, respectively. Additions to the province's weevil fauna will undoubtedly be recorded in the years to come not only due to increased collection efforts, but as more species continue to expand their range northwardly under present global warming conditions or are being introduced from other countries. Among the species newly reported here, *Ischnopterapion virens* (Herbst, 1797), *Omphalapion hookerorum* (Kirby, 1808), *Ceutorhynchus pallidactylus* (Marsham, 1802),

Curculio rubidus (Gyllenhal, 1835), *Hadroplontus litura* (Fabricius, 1775), *Myosides seriehispidus* Roelofs, 1873, and *Hypera rumicis* (Linnaeus, 1758) are all adventive species (*sensu* Wheeler and Hoebeke 2009) that were accidentally introduced in Canada or intentionally brought in as biological control agents.

Materials and methods

Specimens belonging to species recorded or referred to in the present article were identified (or their identity was confirmed) by recognized specialists listed henceforth under each species name by their name, or if an author of this paper, by their initials.

Label data are provided in chronological order for every species. These data were translated from French to English, and various details (e.g., current regional county municipality [MRC], collecting technique, general habitat), when known, have been added between brackets.

Specimens were either swept or beaten from various plant species, attracted to mercury vapour, ultraviolet or porch lights or handpicked from various substrates or from a flight interception trap made of tulle fabric (~2,5m x 10m) held between two wood piles or set up in a suburban backyard.

Plant family, generic and specific names follow the classification used in Database of Vascular Plants of Canada (VASCAN) (<http://data.canadensys.net/vascan/search>).

Acronyms of collections referred to in this article are as follows:

- CCCH** Claude Chantal Insect Collection (private collection), Varennes, Quebec, Canada
- CCOB** Charles W. O'Brien Insect Collection (private collection), Green Valley, Arizona, United States
- CCTE** Claude Tessier Insect Collection (private collection), Quebec, Quebec, Canada
- CHMS** Henri Miquet-Sage Insect Collection (private collection), Mont-Saint-Hilaire, Quebec, Canada
- CMNC** Canadian Museum of Nature, Ottawa, Ontario, Canada
- CNCI** Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture and Agri-Food Canada Research Centre, Ottawa, Ontario, Canada
- CPTO** Pierre de Tonnancour Insect Collection (private collection), Terrasse-Vaudreuil, Quebec, Canada
- CRVI** Robert Vigneault Insect Collection (private collection), Oka, Quebec, Canada
- CSDU** Stéphane Dumont Insect Collection (private collection), Montreal, Quebec, Canada
- CSLA** Serge Laplante Insect Collection (private collection), Gatineau, Quebec, Canada

Results

Family Anthribidae Billberg, 1820

Subfamily Choraginae Kirby, 1819

Tribe Choragini Kirby, 1819

Choragus sayi LeConte, 1876, new data supporting first record for Quebec

Species identification confirmed by RSA, 2015 and 2016

Note. Bousquet et al. (2013) recorded this species from Quebec without any further comment, possibly on the basis of a vague record (“Quebec to Georgia west to Indiana and Texas”) by Valentine (1998). This small species is strongly saltatorial and can be difficult to catch in hot weather. We provide, for the first time, data on the occurrence of this species in the province.

Specimen data. [Agglomération de Longueuil] Longueuil, 18-VII-1992, C. Chantal (1, CCCH); [MRC Marguerite-d’Youville] Varennes, 16-VII-1999, attracted to UV light, C. Chantal (1, CCCH); same except: 29-VI-2006 (1, CCCH); [MRC Brome-Missisquoi] Saint-Armand, 2-VIII-2007, understory, on foliage, C. Chantal (1, CCCH); [MRC Marguerite-D’Youville] Île Sainte-Thérèse, 1-IX-2009, C. Chantal (1, CCCH); [MRC Deux-Montagnes] Parc national d’Oka, La Grande Baie, 19-VII-2014, beaten from dead branches over forest litter, R. Vigneault (3, CRVI); [MRC Coaticook] Compton, 25-VIII-2014, C. Levesque (1, CNCI); [MRC Deux-Montagnes] Parc national d’Oka, La Grande Baie, 27-VI-2015, beaten from dead branches over forest litter, R. Vigneault (1, CRVI); same except: 30-VI-2015 (16:00), P. de Tonnancour (1, CPTO); same except: 2-VII-2015, R. Vigneault (1, CRVI); same except: 5-VII-2015 (16:00), beaten from dead branches of *Acer saccharum*, P. de Tonnancour & R. Vigneault (1, CMNC; 4, CPTO; 6, CRVI); same except: 9-VII-2015, R. Vigneault (2, CRVI); [MRC Deux-Montagnes] Parc national d’Oka, Calvaire, 25-VI-2016, beaten from dead branches over forest litter, R. Vigneault (3, CRVI); same except: 1-VII-2016 (19, CRVI); same except: La Grande Baie, 6-VII-2016, beaten from dead branches of *Acer saccharum*, R. Vigneault (11, CPTO); same except: La Grande Baie, 6-VII-2016, beaten from dead branches over forest litter, R. Vigneault (1, CRVI), 12-VII-2016 (1, CRVI), and 1-VIII-2016 (1, CRVI).

Family Brentidae Billberg, 1820

Subfamily Apioninae Schönherr, 1823

Tribe Apionini Schönherr, 1823

Perapion punctinatum (J.B. Smith, 1884), new to Quebec

Species identification confirmed by RSA, 2016

Note. This native species is easily separated from all other Apioninae known to occur in Quebec by the conspicuous elongate postscutellar spot of white vestiture and spot of dense white scales at the base of elytral interstriae 2 and 3. Nothing is known of its habits or life history, except that adults were collected in August on dock, *Rumex* L. spp., including golden dock, *Rumex persicarioides* L. (Polygonaceae) (Bright 1993). Ontario was until now considered as the eastward limit of its range in Canada (Bousquet et al. 2013). A photograph of one of the specimens reported herein is posted on bugguide.net (<http://bugguide.net/node/view/1077586/bgpape>).

Specimen data. [MRC Deux-Montagnes] Parc national d'Oka, composting site, 29-V-2015, white tulle fabric flight interception trap, R. Vigneault (2, CRVI).

***Omphalapion hookerorum* (Kirby, 1808), new to Quebec**

Species identification confirmed by RSA, 2015

Note. This Palaearctic adventive species was recorded for the first time in North America in 1993 based on specimens collected in Nova Scotia in 1990 (Peschken 1993 and Sampson and MacSween 1993, *in* Majka et al. 2007b). In Canada, it was subsequently released and is established as a biological control agent against scentless chamomile, *Tripleurospermum inodorum* (L.) Sch.Bip. (= *Matricaria perforata* Mérat) (Asteraceae) in British Columbia, Alberta, Saskatchewan, and Manitoba (McClay and De Clerck-Floate 1999). It was also collected on stinking chamomile, *Anthemis cotula* L. (Asteraceae), in Nova Scotia (Majka et al. 2007b).

Specimen data. [MRC La Vallée-du-Richelieu] Saint-Charles-sur-Richelieu, 29-VI-2003, H. Miquet-Sage (3, CHMS; 1, CPTO); [MRC Marguerite-D'Youville] Varennes, 30-VI-2008, C. Chantal (2, CCCH); [MRC La Vallée-du-Richelieu] Mont-Saint-Hilaire, 2-VII-2008, H. Miquet-Sage (2, CHMS); [MRC Marguerite-D'Youville] Varennes, 2-V-2010, C. Chantal (2, CCCH; 1, CPTO); same except: 20-V-2010 (1, CCCH), and 9-VI-2010 (1, CCCH); [MRC La Vallée-du-Richelieu] Mont-Saint-Hilaire, 13-VI-2010, H. Miquet-Sage (1, CPTO); [MRC Marguerite-D'Youville] Varennes, 30-V-2011, C. Chantal (1, CCCH); same except 9-VI-2012 (1, CCCH), and 21-V-2014 (1, CCCH); [MRC La Vallée-du-Richelieu] Mont-Saint-Hilaire, 12-V-2014, H. Miquet-Sage (1, CHMS); same except: 20-VI-2014 (1, CHMS), and 25-VI-2014 (1, CHMS); [MRC Marguerite-D'Youville] Varennes, 7-VI-2015, C. Chantal (1, CCCH).

***Ichnopterapion virens* (Herbst, 1797), new to Quebec**

Species identification confirmed by RSA, 2016

Note. Widely distributed through most of the Palaearctic region (Alonso-Zarazaga 2011), this adventive species was recorded for the first time in North America in

1994, in Pennsylvania (Hoebeke et al. 2000). Until now, it was known to occur in Canada only in the Maritime Provinces (Bousquet et al. 2013). It is considered a pest of clovers, *Trifolium* L. spp. (Fabaceae). It can be distinguished from the superficially similar *Stenopteropion meliloti* Kirby, 1808, by its smaller size and the bluish colour of its pronotum and venter (black in *S. meliloti*). As indicated by Hoebeke et al. (2000) and by the label data provided hereafter, the flight season extends until late in the year.

Specimen data. [MRC Haut-Richelieu] Henryville [dike adjacent to Réserve écologique Marcel-Raymond], 29-IX-2012, C. Chantal (2, CCCH); same except: 3-X-2013 (3, CCCH); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 15-IX-2014 (15:00), white tulle fabric flight interception trap, P. de Tonnancour (1, CPTO); same except: 7-X-2014 (15:00) (1, CPTO) and 12-X-2014 (17:00) (1, CPTO); [MRC Coaticook] Waterville, 11-VII-2015, H. Miquet-Sage (1, CHMS); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 21-IX-2015 (12:30), white tulle fabric flight interception trap, P. de Tonnancour (1, CPTO); [MRC Marguerite-D'Youville] Varennes, 21-IX-2015, C. Chantal (1, CCCH); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 22-IX-2015 (15:00), white tulle fabric flight interception trap, P. de Tonnancour (1, CPTO); same except, 22-IX-2015 (15:00), beaten from *Oidium* infected foliage of *Helianthus strumosus*, (1, CPTO); same except: 27-IX-2015 (11:30, 13:30), white tulle fabric flight interception trap (2, CPTO); same except: 6-X-2015 (16:15) (1, CPTO), and 7-X-2015 (14:30–15:30) (3, CPTO); same except: 11-X-2015 (15:00), beaten from *Oidium* infested foliage of *Helianthus strumosus* (1, CPTO); same except: 12-X-2015 (11:00–15:00), white tulle fabric flight interception trap (8, CPTO; 2, CSDU); same except: 5-XI-2015 (14:00–15:00), climbing on pale house exterior wall (1, CPTO; 1, CRVI); same except: 6-XI-2015 (15:00) (1, CPTO), 9-XI-2015 (15:00) (1, CPTO), 19-XI-2015 (12:00) (1, CPTO), 26-XI-2015 (13:00) (1, CPTO), 27-XI-2015 (12:30) (1, CCCH), 11-XII-2015 (13:00–15:00) (4, CPTO), and 12-XII-2015 (12:00) (1, CPTO); Montreal, Parc Zotique-Racicot (45.5427, -73.6903), 11-V-2106, swept from *Trifolium* sp., S. Dumont (6, CSDU); same except: 12-V-2016 (3, CSDU); MRC Haut-Richelieu, Henryville, dike adjacent to Réserve écologique Marcel-Raymond], 12-V-2016 (13:00–16:00), swept from grasses, *Equisetum* and *Solidago*, P. de Tonnancour (1, CPTO); MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 20-V-2016 (17:00), swept from *Trifolium pratense*, P. de Tonnancour (11, CPTO); Montreal, Parc Zotique-Racicot (45.5427, -73.6903), 23-V-2106, swept from *Trifolium* sp., S. Dumont (5, CSDU); same except: 24-V-2016 (2, CSDU); MRC Brome-Missisquoi, Saint-Armand, 25-V-2016 (16:00), swept from *Trifolium pratense*, P. de Tonnancour (6, CPTO); MRC Vaudreuil-Soulanges, Saint-Lazare, 29-VI-2013 (16:00–17:00), swept from *Trifolium pratense*, P. de Tonnancour (2, CPTO); MRC Laval, Laval, rue des Charmes (45.5884, -73.8244), 20-VII-2016 (15:00), swept from *Trifolium pratense*, P. de Tonnancour (2, CPTO); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 10-XI-2016 (15:00), climbing on pale house exterior wall (1, CPTO).

***Coelocephalapion emaciipes* (Fall, 1898), new to Quebec**

Species identification confirmed by RSA, 2016

Note. The occurrence of this small native pale-legged species in the province was expected as it was previously known in Canada from Ontario and the Maritime Provinces. Although this species has been tentatively associated with tick-trefoil, *Desmodium* Desv. sp. (Fabaceae), based on the very few available data at the time (Bright 1993), it is worth noting that most of the specimens caught in 2016 were found in association with *Scirpus* L. spp. (Cyperaceae) in wet habitats.

Specimen data. [MRC Marguerite-D'Youville] Varennes, 30-VI-2014, C. Chantal (1, CCCH); same except: 15-V-2015 (1, CCCH); MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 11-V-2016 (13:00), swept from *Scirpus atrovirens* (1, CPTO); same except: 14-V-2016 (15:00) (1, CPTO); [MRC Deux-Montagnes] Parc national d'Oka, 19-V-2016, swept from herbs in field (2, CRVI); MRC Brome-Missisquoi, Saint-Armand, 25-V-2016 (15:00), swept from *Scirpus* sp. (2, CPTO).

Family Curculionidae Latreille, 1802**Subfamily Curculioninae Latreille, 1802****Tribe Anthonomini C.G. Thompson, 1859*****Anthonomus robustulus* LeConte, 1876, new to Quebec**

Species identification confirmed by RSA, 2015

Note. This small native species is characterized by its 6-jointed funicle, compact, short and broad form, and light bluish-gray scales. It is said to occur on goldenrods, *Solidago* L. spp. (Asteraceae) (Blatchley and Leng 1916). It was previously known in Canada from Alberta, Saskatchewan, and New Brunswick (Bousquet et al. 2013).

Specimen data. [MRC Brome-Missisquoi] Saint-Armand, 7-VI-2004, C. Chantal (2, CCCH); same except: 3-VII-2006 (2, CCCH), and 2-VII-2008 (2, CCCH); MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 31-V-2011 (13:00), meadow, swept from *Solidago/Aster*, P. de Tonnancour (2, CPTO); same except: 1-VI-2011 (14:00) (1, CPTO); [MRC Brome-Missisquoi] Saint-Armand, 3-VIII-2011, C. Chantal (1, CCCH); [MRC Haut-Richelieu] Henryville [dike adjacent to Réserve écologique Marcel-Raymond], 28-V-2013, (14:00–17:00), swept from grasses, *Equisetum* and *Solidago*, C. Chantal and P. de Tonnancour (1, CCCH; 1, CPTO); MRC Haut-Saint-Laurent, Saint-Anicet (45°04'22", -74°44'73"), 14-VI-2013 (18:00), beaten from *Cornus stolonifera*, P. de Tonnancour (1, CPTO); same except: 15-VI-2013 (13:00), wet meadow, swept from various herbaceous plants, P. de Tonnancour (1, CPTO); [MRC La Vallée-du-Richelieu] Mont-Saint-Hilaire, 24-VI-2013, H. Miquet-Sage (1, CHMS); MRC Haut-Saint-Laurent, Franklin, roadside opposite to Ré-

serve écologique du Pin-Rigide, 17-VII-2013 (14:00), beaten from *Lythrum salicaria*, P. de Tonnancour (7, CPTO); MRC Haut-Richelieu, Henryville, dike adjacent to Réserve écologique Marcel-Raymond, 8-VI-2014 (14:00–16:00), swept from grasses, *Equisetum* and *Solidago*, P. de Tonnancour (4, CPTO); [MRC Brome-Missisquoi] Saint-Armand, 16-VI-2014, C. Chantal (1, CCCH); MRC Haut-Richelieu, Henryville, dike adjacent to Réserve écologique Marcel-Raymond, 4-VI-2015, P. de Tonnancour (16:00–18:00) (1, CPTO); [MRC Brome-Missisquoi] Saint-Armand (45.0199, -73.0838), 25-V-2016, S. Dumont (1, CSDU).

***Pseudanthonomus helvolus* (Boheman, 1843), new to Quebec**

Species identification confirmed by RSA, 2016

Note. This native species is associated with witch hazel, *Hamamelis virginiana* L. (Hamamelidaceae) (Clark 1987). Adults emerging from hibernation are active from mid-May to early July, and those from the current-year generation emerge from mid-August to early September and then hibernate until the following spring (DeSteven 1981).

Specimen data. MRC Deux-Montagnes, Parc national d'Oka (45.4916, -74.0137), 30-VI-2015 (17:00), beaten from *Hamamelis virginiana*, P. de Tonnancour & R. Vigneault (4, CPTO; 5, CRVI); same except: 2-VII-2015 (18:00) (16, CPTO) and 5-VII-2015 (18:00) (1, CCCH; 6, CPTO); same except: 5-IX-2015 (17:00), R. Vigneault (1, CPTO) and 20-VIII-2016 (2, CRVI); same except: 27-VIII-2016 (14:00), P. de Tonnancour (2, CNCI; 2 CMNC; 13, CPTO; 1, CSDU); same except: (45.4619, -74.0489), 27-VIII-2016 (16:00) (1, CPTO; 3, CRVI).

Tribe Curculionini Latreille, 1802

***Curculio rubidus* (Gyllenhal, 1835), new to Canada**

Species identification confirmed by RSA, 2015

Note. This record comes three years after the first North American detection of the species in Michigan (Anderson et al. 2013) and is based on the incidental finding in the Montreal area (Notre-Dame-de l'Île-Perrot) of a single specimen in 2013 and of dozens of additional specimens 2–3 years later. This widespread Palaearctic species is easily separated from all North American native *Curculio* species by its very small size (<3.5mm), lack of femoral teeth and association with birch, *Betula* L. spp. All specimens recorded in Quebec were collected in a stand of gray birch, *Betula populifolia* Marshall (Betulaceae), and most were directly beaten from gray birch. Adults are said to be active from May to October in Europe (Hoffmann 1954; as “*Balaninus undulatus* Herbst, 1795”), but all specimens reported herein were captured in August (except

three specimens caught on September 1, 2016). This species is also newly recorded from Ontario, based on a specimen photographed by Burke Korol in Barrie, Simcoe County, on August 21, 2015 and posted on bugguide.net (<http://bugguide.net/node/view/1127147>).

Specimen data. MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 10-VIII-2013 (17:00), beaten from *Quercus rubra*, P. de Tonnancour (1, CPTO); same except: 8-VIII-2015 (15:00), beaten from *Alnus rugosa* (1, CPTO), beaten from *Betula populifolia* (2, CPTO) or swept from various herbaceous plants in gray birch stand (1, CPTO); same except: 10-VIII-2015 (13:00), swept from various herbaceous plants in gray birch stand (2, CPTO); same except: 16-VIII-2015 (15:00), beaten from *Betula populifolia* (4, CCOB; 5, CMNC; 5, CNCI; 18, CPTO; 1, CRVI); 17-VIII-2015 (14:00) (2, CNCI; 2, CPTO); 17-VIII-2015 (14:00 and 18:00) (2, CMNC; 2, CNCI; 11, CPTO); 18-VIII-2015 (19:00) (5, CNCI; 2, CSDU; 1, CRVI); 22-VIII-2015 (14:00), C. Chantal (10, CCCH); 20-VIII-2016 (16:00), P. de Tonnancour (3, CPTO); 23-VIII-2016 (16:00) (1, CPTO); 28-VIII-2016 (16:00) (2, CPTO); 29-VIII-2016 (18:00) (1, CPTO); 1-IX-2016 (13:00) (3, CPTO).

Tribe Smicronychini Seidlitz, 1891

Smicronyx sculpticollis Casey, 1892, new to Quebec

Species identification confirmed by RSA, 2015

Note. This record is based on two specimens collected ten years apart from low vegetation in two localities. This native species was previously known in Canada only from Ontario (Bousquet et al. 2013). It is associated with dodders, *Cuscuta* L. spp. (Convolvulaceae) (Anderson 1962), obligate parasitic leafless vines almost entirely deprived of chlorophyll that wrap around various plants.

Specimen data. [MRC Pierre-De Saurel] Saint-Roch-de-Richelieu, 20-VI-2005, C. Chantal (CCCH, 1); [MRC Deux-Montagnes] Parc national d'Oka, La Grande Baie, 30-VI-2015 [swept from low vegetation in swampy area], R. Vigneault (1, CRVI).

Subfamily Bagoinae C.G. Thompson, 1859

Bagous magister LeConte, 1876, new to Quebec

Species identification confirmed by RSA, 2016

Note. This native species is easily separated from other species of its genus by the deep impressions on the prothorax, the elytral pattern created by fuscous and light brown scales with a fascia crossing the suture near middle, and its large size (Tanner 1943).

It is associated with fragrant water-lily, *Nymphaea odorata* Aiton (Nymphaeaceae) (O'Brien et Marshall 1979). It was previously known in Canada only from Ontario (Bousquet et al. 2013).

Specimen data. MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 31-V-2013 (21:30), UV + porch light, P. de Tonnancour (2, CPTO); same except 30-V-2013 (1, CMNC); same except 23-VI-2013 (1, CMNC); MRC Deux-Montagnes, Parc national d'Oka, 30-VII-2012 (18:00), swept from Cyperaceae, *Polygonum* sp., *Pontederia cordata*, and *Sagittaria* sp., P. de Tonnancour (1, CPTO).

***Bagous tanneri* O'Brien, 1979, new to Quebec**

Species identification confirmed by RSA, 2009, 2016

Note. This native species was previously known in Canada only from Ontario (Bousquet et al. 2013). It feeds in the larval stage on submerged petioles of fragrant water-lily, *Nymphaea odorata* (McGaha 1952).

Specimen data. [MRC Brome-Missisquoi] Saint-Armand, 2-VII-2001, attracted to UV lamp, C. Chantal (1, CCCH); [MRC Haut-Richelieu] Henryville, 24-VI-2003, attracted to UV lamp, C. Chantal (1, CCCH); [MRC Deux-Montagnes] Parc national d'Oka, La Grande Baie, 30-VI-2015 [swept from low vegetation, edge of swampy bay], R. Vigneault (1, CRVI); same except: 2-VII-2015 (16:00), beaten from dead branches, edge of swampy bay, P. de Tonnancour (1, CPTO).

Subfamily Baridinae Schönherr, 1836

Tribe Apostasimerini Schönherr, 1844

***Buchananius striatus* (LeConte, 1876), new to Canada**

Species identification confirmed by RSA, 2015

Note. This minute native species (1.4–1.6mm) is easily distinguished from all other Baridinae occurring in Quebec by its extremely wide and convex shape, its tiny size (genus *Buchananius* Kissinger, 1957, contains the smallest members of Nearctic Baridinae) and its vestiture of sparse but long erect scales. The only other North American congener, *Buchananius sulcatus* (LeConte, 1876), has been recorded as developing in the fruiting bodies of the fungus *Trichoderma peltatum* (Berk.) Samuels, Jaklitsch & Voglmayr (Hypocreaceae) growing on American Beech, *Fagus grandifolia* Ehrh. (Fagaceae), in Maryland (Prena et al. 2014). This species also represents a new record at the generic level for Canada.

Specimen data. [MRC Joliette] Joliette, 7-IX-2013 [swept from forest understorey], J.-F. Roch (1, CCCH); [MRC Deux-Montagnes] Parc national d'Oka, La Grande

Baie, 28-VI-2014 [beaten/swept from undergrowth/fallen branches in deciduous stand], R. Vigneault (1, CRVI); same except: composting site, 28-V-2016 (19:00), white tulle fabric flight interception trap, R. Vigneault (1, CRVI); same except: Calvaire d'Oka, 1-VII-2016, beaten from fallen dead branches of deciduous tree, R. Vigneault (1, CRVI).

***Plocamus echidna* (LeConte, 1876), new to Quebec**

Species identification confirmed by RSA, 2016

Note. This remarkable native species was previously known in Canada only from Ontario (Bousquet et al. 2013). The circumstances under which all specimens caught in 2016 were found closely match the description provided by Drury (quoted by Blatchley and Leng 1916): "This curious little porcupine beetle was in clusters on trunk of a dead beech tree, near Cincinnati, Sept. 27, 1900. I took one cluster of 30; they very closely resemble the color of the bark". A photograph of the 2015 specimen reported herein is posted on bugguide.net (<http://bugguide.net/node/view/1078735/bgimage>).

Specimen data. [MRC Deux-Montagnes] Parc national d'Oka, composting site, 04-VI-2015 (18:00), white tulle fabric flight interception trap, R. Vigneault (1, CRVI); MRC Deux-Montagnes, Parc national d'Oka, La Grande Baie, 3-VII-2016, brushed from trunk of a recently dead *Fagus grandifolia*, R. Vigneault (18, CRVI); same except: 6-VII-2016 (12:00), P. de Tonnancour (1, CCCH; 1, CNCI; 16, CPTO; 1, CSDU); same except: 13-VII-2016 (17:00), P. de Tonnancour & R. Vigneault (1, CMNC; 4, CPTO, 4, CRVI); same except: 24-VII-2016 (17:00), P. de Tonnancour, R. Vigneault & S. Laplante (3, CPTO; 1, CRVI; 3, CSLA); same except: 1-VIII-2016, R. Vigneault (1, CRVI); same except: 20-VIII-2016 (2, CRVI).

Subfamily Ceutorhynchinae Gistel, 1848

Tribe Ceutorhynchini Gistel, 1848

***Ceutorhynchus bolteri* Dietz, 1896, new to Quebec**

Species identification confirmed by RSA, 2014, 2016

Note. This native species was previously recorded in Canada only from British Columbia (Bousquet et al. 2013), but it is known to occur in several states in eastern United States (O'Brien and Wibmer 1982). The British Columbia specimen (CNCI) was collected on spotted water-hemlock, *Cicuta occidentalis* Greene (now *Cicuta maculata* L.) (Apiaceae).

Specimen data. [MRC Haut-Richelieu], Henryville, 28-V-2013, sweeping, C. Chantal (1, CCCH); MRC Deux-Montagnes, Parc national d'Oka, 29-V-2015 (18:00–20:00), white tulle fabric flight interception trap, P. de Tonnancour (1, CPTO); MRC

Haut-Richelieu, Henryville, dike adjacent to Réserve écologique Marcel-Raymond, 4-VI-2015 (16:00–18:00), swept from grasses, *Equisetum* and *Solidago*, P. de Tonnancour (5, CPTO); same except: 12-V-2016 (13:00–16:00) (8, CPTO).

***Ceutorhynchus pallidactylus* (Marshall, 1802), new to Quebec**

Species identification confirmed by PB, 2014

Note. This adventive Palaearctic species, known as the cabbage stem weevil, is reported to attack several Brassicaceae and Resedaceae and is occasionally associated with *Cannabis sativa* L. (Cannabaceae) (Colonnelli 2004). It was previously known in Canada only from Nova Scotia (Bousquet et al. 2013), where it was first detected in 1994 (Majka et al. 2007a).

Specimen data. [MRC Coaticook] Missisquoi Co., Mont le Pinacle, 10-VI-1984, Larochelle, Larivière (1, CNCI); [MRC Nouvelle-Beauce] East of St-Lambert-de-Lauzon, Rd. 218, 18-VII-2001, 46°36.133'N; 71°11.412'W, corn field with radish, Mason, Sarazin & Boudreault, QC 2001–110 (1, CNCI); same except: QC 2001–100 (1, CNCI); [MRC de l'Érable] NE of Plessisville, Road 116, 18-VII-2001, 46°18.796'N; 71°40.129'W, small canola field, Mason, Sarazin & Boudreault, QC 2001–330 (1, CNCI); [MRC Arthabaska] Saint-Albert, Hwy 122, 12-VII-2002, 46°00.455'N; 72°06.016'W, wild radish along edge of corn field, Mason, Boudreault & Farmakis, QC 2002–213 (1, CNCI); same except: QC 2002–214 (1, CNCI); [MRC Drummond] Domaine-Descoteaux, 22-VII-2003, 45°49.142'N; 72°13.983'W, J. Miall & P. Mason, wild mustard, QC03-121 (1, CNCI); [MRC Drummond] St-Guillaume, 22-VII-2003, 45°54.909'N; 72°44.660'W, J. Miall & P. Mason, wild mustard, QC03-116 (1, CNCI); [MRC Drummond] S[ain]t-Cyrille-de-Wendover, north-east, 45°57.049'N; 72°23.877'W, 22-VII-2003, J. Miall & P. Mason, wild radish, QC03-119 (2, CNCI); [MRC Pierre-De-Saurel] S[ain]te-Victoire, Hwy 239, 2km east, 45°56.580'N; 73°04.189'W, 22-VII-2008, ex. stem of *Raphanus raphanistrum*, em[ergence] 26-VIII-2008, Mason, Miall & Brauner, Site QC 08-710 (3, CNCI); same except: 22-VII-2003, 45°57.744'N; 73°06.760'W, J. Miall & P. Mason, wild radish, QC 03-114 (1 CNCI); Centre-du-Québec, [MRC Arthabaska] Saint-Rosaire, 19-VII-2012, swept from canola (1, CPTO); [MRC Coaticook] Compton, 27-VI-2014, C. Levesque (1, CNCI); same except: 24-VII-2014 (2, CNCI); same except: 1-VIII-2014 (2, CNCI).

***Ceutorhynchus pauxillus* Dietz, 1896, new to Quebec**

Species identification confirmed by RSA, 2014, and Hiraku Yoshitake, 2014

Note. This native species was previously known in Canada from Alberta, Saskatchewan, and Manitoba (Bousquet et al. 2013). The host plant for this species is unknown (Colonnelli 2004).

Specimen data. [MRC de D'Autray] Lanoraie, 26-VIII-1986, sweeping Sphagnum bog, L. LeSage, on *Prunus pensylvanica* Linnaeus (39, CMNC; 16, CNCI); MRC Marguerite-D'Youville, Verchères, 4-VI-2010, C. Chantal (1, CCCH); MRC Vaudreuil-Soulanges, Saint-Lazare, 9-VI-2013 (15:00), sandpit, beaten from *Erysimum* sp., P. de Tonnancour (3, CPTO); same except: 12-VI-2013 (14:00), beaten from *Brassica* sp. (3, CPTO); same except: 14-VI-2013 (13:00) (1, CNCI; 1, CPTO), 19-VI-2013 (14:00) (9, CPTO); same except: 6-VI-2014 (13:00), swept from *Equisetum* and grasses (1, CPTO), 10-VI-2014 (17:00) (2, CPTO); same except: 23-VI-2014 (17:00), swept from *Equisetum* (2, CMNC; 4, CPTO).

Hadroplontus litura (Fabricius, 1775), new to Quebec

Species identification confirmed by RSA, 2016.

Note. This Palaearctic species has been introduced in various parts of North America as a biological control agent against Canada thistle, *Cirsium arvense* (L.) Scop. (Asteraceae) (McClay et al. 2002), an invasive plant also of Palaearctic origin. It was previously known in Canada from British Columbia, Alberta, Saskatchewan, Ontario, and Nova Scotia (Bousquet et al. 2013). All specimens reported herein were beaten from Canada thistle.

Specimen data. Montreal, Parc Zotique-Racicot (45.5427, -73.6903), beaten from *Cirsium arvense*, P. de Tonnancour and/or S. Dumont, 8-VII-2015 (13:00) (17, CPTO; 4, CSDU); 9-VII-2015 (3, CMNC; 3, CNCI; 2, CSDU); 10-VII-2015 (4, CCCH); 12-VII-2015 (16:00) (5, CPTO); 14-VII-2015 (15:00) (6, CPTO); 26-VII-2015 (2, CMNC; 2, CNCI; 2, CSDU); 25-VIII-2015 (1, CSDU); 01-IX-2015 (13:00) (1, CRVI); same except: (45.5426, -73.6902), 28-VI-2016 (13:00) (7, CPTO; 2, CSDU); 30-VI-2016 (4, CCCH; 4 CPTO; 2, CSDU); same except: 4-VII-2016 (6, CSDU); MRC Vaudreuil-Soulanges, Ville de l'Île-Perrot, 11-VII-2016 (15:00), beaten from *Cirsium arvense*, P. de Tonnancour (1, CPTO); MRC Laval, Laval (45.5819, -73.8206), 20-VII-2016 (14:00), beaten from flowering *Cirsium arvense*, P. de Tonnancour (15, CPTO); Montreal, Parc Zotique-Racicot (45.5427, -73.6903), 26-VII-2016, beaten from *Cirsium arvense*, S. Dumont (2, CSDU); same except: 28-VII-2016 (4, CSDU); MRC Laval, Laval (45.5819, -73.8206), 17-IX-2016, beaten from flowering *Cirsium arvense*, P. de Tonnancour (5, CPTO).

Sirocalodes sericans (LeConte, 1876), new to Quebec

Species identification confirmed by Hiraku Yoshitake, 2014

Note. This native species was previously known in Canada from Manitoba and Ontario (Bousquet et al. 2013), but its presence in Ontario was reported for the first time only recently (Proctor et al. 2010) based on one specimen collected in Algonquin Provincial Park in 2007. The host plant is unknown (Anderson et al. 2014).

Specimen data. MRC Vaudreuil-Soulanges, Saint-Lazare, 12-VI-2013 (14:00), sandpit, beaten from *Brassica* sp., P. de Tonnancour (1, CPTO).

Subfamily Conoderinae Schönherr, 1833

Tribe Zygotini Lacordaire, 1865

Cylindrocopturus longulus (LeConte, 1876), new to Quebec

Species identification confirmed by Hiraku Yoshitake, 2014, and RSA, 2016.

Note. This native species is reported to inhabit in the larval stage the galls formed by the apionine weevil *Podapion gallicola* Riley, 1883, on pine (Blatchley and Leng 1916). In western North America, it is also a reported host of the *Macromesus americanus* Hedqvist, 1960 (Hymenoptera: Pteromalidae), which has been reared from various pines and several other conifers (Askew and Shaw 2001). *Cylindrocopturus longulus* was previously known in Canada only from Ontario, but the gall making species *Podapion gallicola* is known from Ontario, Quebec and New Brunswick (Bousquet et al. 2013).

Specimen data. MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 30-IV-2013 (16:00), beaten from flowering shoots of *Salix* sp., P. de Tonnancour (1, CPTO); MRC Vaudreuil-Soulanges, Mont Rigaud, 31-V-2013 (13:00), beaten from *Asclepias syriaca*, P. de Tonnancour (1, CPTO); same except: 5-VI-2013 (13:00), rocky outcrop, swept from *Rumex acetosella* (1, CPTO); same except: 2-V-2015 (15:00), rocky outcrop, beaten from *Pinus strobus*, P. de Tonnancour (3, CPTO); MRC Collines-de-l'Outaouais, Luskville (Sentier des chutes), 26-V-2015 (13:00), beaten from small *Amelanchier* sp., P. de Tonnancour (1, CPTO).

Subfamily Entiminae Schönherr, 1823

Tribe Cyphicerini Lacordaire, 1863

Myosides seriehispidus Roelofs, 1873, new to Quebec

Species identification confirmed by RSA, 2016

Note. This adventive species, originally from Asia, has gone undetected for many years in collections under the genus *Trachyphloeus* Germar, 1817, and was reported by O'Brien (2000) as established in several eastern states since at least 1973. In Canada, it was known until now only from Ontario (Bousquet et al. 2013). Only females are known to occur in North America (Bright and Bouchard 2008).

Specimen data. [MRC Brome-Missisquoi], Saint-Armand, 6-VII-2015 (afternoon), C. Chantal (1, CCCH).

Subfamily Hyperinae Marseul, 1863**Tribe Hyperini Marseul, 1863*****Hypera rumicis* (Linnaeus, 1758), new to Quebec**

Species identification confirmed by Hiraku Yoshitake, 2014

Note. Since its accidental introduction and first detection in the United States in 1879 (Chamberlin, 1933), this Palearctic species has expanded its range considerably in North America. Surveys conducted from 1997 to 1999 in two Quebec vineyards failed to detect its presence (Bouchard et al. 2005), but its capture by C. Tessier in 2003 indicates that it was already present in the province more than a decade ago. *Hypera rumicis* is associated with various *Polygonum* L. spp. and *Rumex* spp. (Polygonaceae), especially the invasive curled dock, *Rumex crispus* L., also introduced from Europe. Its potential as a biological control agent against this weed was recently assessed (DeGregorio et al. 1992; Piesik 2006). This species was previously known in Canada from Alberta, Saskatchewan, Manitoba, and Ontario (Bousquet et al. 2013).

Specimen data. [MRC Brome-Missisquoi], Saint-Armand, 15-VI-2003, C. Tessier (1, CCTE); MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 3-VII-2011 (17:00), beaten from *Rumex crispus*, P. de Tonnancour (1, CPTO); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 6-VII-2011 (2:00), UV + porch light, P. de Tonnancour (1, CPTO); MRC Haut-Saint-Laurent, Saint-Anicet (45.0425, -74°4459), 15-VI-2013 (13:00), wet meadow, swept from various herbaceous plants, P. de Tonnancour (2, CPTO); Montreal, Île-Bizard (Parc-nature du Bois-de-l'Île-Bizard), 17-VI-2013, ≥ 5 cocoons on *Rumex* sp. (one emergence on 22-VI-2013), C. Pilon (observation documented by photos); MRC Haut-Saint-Laurent, Saint-Anicet (45.0432, -74°4442), 26-VI-2015 (15:00), beaten from *Rumex crispus*, P. de Tonnancour (11, CPTO); MRC Coaticook, Waterville (45.27993 N 71.89987 O), 10-VII-2015 (20:00), beaten from *Rumex crispus*, P. de Tonnancour (4, CCCH; 7, CMNC; 2, CSDU; 1, CRVI); same except 11-VII-2015 (10:00), H. Miquet-Sage, P. de Tonnancour, S. Dumont (7, CHMS; 18, CPTO; 7, CSDU, 1, CRVI); MRC Haut-Richelieu, Henryville, dike adjacent to Réserve écologique Marcel-Raymond, 12-V-2016 (13:00–16:00), swept from grasses, *Equisetum* and *Solidago*, P. de Tonnancour 12-V-2016 (1, CPTO).

Subfamily Lixinae Schönherr, 1823**Tribe Lixini Schönherr, 1823*****Lixus punctinatus* LeConte, 1876, first records for Canada with detailed locality information**

Species identification confirmed by RSA, 2015

Note. Bousquet et al. (2013) listed this species without providing any details on its distribution in Canada, based on a similar inclusion in O'Brien and Wibmer (1982). We

provide specific locality data for Canada for the first time. Like other *Lixus* Fabricius, 1801 spp., this species is probably associated with *Polygonum* spp. (Polygonaceae). Numerous CMNC specimens from Texas were collected on *Polygonum*.

Specimen data. MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 3-VII-2008 (17:00), handpicked from building wall, P. de Tonnancour (1, CPTO); same except: 23-VIII-2014 (15:00), small pond margin, beaten from *Bidens cernua*, P. de Tonnancour (1, CPTO).

***Lixus terminalis* LeConte, 1876, new to Quebec**

Species identification confirmed by RSA, 2015

Note. This species was reported to be associated with *Polygonum amphibium* L. (now *Persicaria amphibia* (L.) Delarbre) (Polygonaceae) more than a century ago (Beutenmuller 1893). We also found it to be common on this same species of plant in Oka.

Specimen data. [MRC Deux-Montagnes] Parc national d'Oka, 4-V-1993, R. Vigneault (1, CRVI); same except: 9-V-1993 (1, CRVI), 30-V-1995 (1, CRVI); [MRC Deux-Montagnes] Parc national d'Oka, 26-V-2002, flowers of *Prunus virginiana*, C. Chantal (1, CCCH); [MRC Deux-Montagnes] Parc national d'Oka, La Grande Baie, 28-V-2002, R. Vigneault (1, CRVI); same except: 4-V-2003 (1, CRVI); [MRC Deux-Montagnes] Parc national d'Oka, Calvaire d'Oka, 15-VII-2007, R. Vigneault (1, CRVI); [MRC Deux-Montagnes] Parc national d'Oka, 16-VI-2011, R. Vigneault (1, CRVI); [MRC Deux-Montagnes] Parc national d'Oka, 1-VIII-2012 (16:00–17:00), swept from *Polygonum* sp., P. de Tonnancour & R. Vigneault (5, CPTO; 2, CRVI); same except: 19-VIII-2012 (17:00), swept from *Polygonum amphibium*, P. de Tonnancour (2, CMNC; 21, CPTO); same except: 26-VIII-2012 (17:00) (4, CPTO); same except: 18-V-2013 (15:00), beaten from *Crataegus* sp., P. de Tonnancour (1, CPTO); same except: 25-V-2014, composting site, white tulle fabric flight interception trap, R. Vigneault (1, CRVI).

Subfamily Molytinae Schönherr, 1823

Tribe Cleogonini Gistel, 1848

***Rhyssomatus aequalis* Horn, 1873, first records for Quebec with detailed locality information**

Species identification confirmed by RSA, 2015

Note. This native species was known in Canada only from Ontario (McNamara 1991) until Bousquet et al. (2013) recorded it from Quebec without providing any specific details about its distribution within the province. Before the recent addition of a few speci-

mens from the series reported herein, the CNCI contained 33 specimens from Canada, all collected by W.J. Brown in extreme southern Ontario between 1931 and 1940, 17 of them on "*Convolvulus sepium pubescens*" (hedge false bindweed, now known as *Calystegia sepium* (L.) R. Br. (Convolvulaceae)). Based on these label data and on those of most specimens reported henceforth, *R. aequalis* appears to be associated with *C. sepium*.

Specimen data. MRC Haut-Saint-Laurent, Saint-Anicet (45.0425, -74°44'59"), 15-VI-2013, wet meadow, swept from various herbaceous plants, P. de Tonnancour & S. Laplante (1, CPTO; 2, CSLA); Montreal, Parc Zotique-Racicot (45.5436, 73.6903), 8-VII-2015 (13:00), beaten from *Castylegia sepium* + *Cirsium arvense*, P. de Tonnancour (1, CPTO); same except: 9-VII-2015, S. Dumont (2, CSDU), 24-VII-2015 (4, CPTO); same except: 26-VII-2015, beaten from *Castylegia sepium* + *Cirsium arvense*, S. Dumont (1, CMNC; 1, CNCI; 1, CSDU); same except: 25-VIII-2015, beaten from *Castylegia sepium* + *Cirsium arvense*, S. Dumont (2, CPTO; 2, CSDU); same except: 1-IX-2015 (13:00), beaten from *Castylegia sepium*, P. de Tonnancour & S. Dumont (1, CMNC; 1, CNCI; 6, CPTO; 1, CSDU); same except: 7-VI-2016 S. Dumont (13, CSDU; 10, CCCH); same except: 10-VI-2016 (8, CSDU); 14-VI-2016 (11, CSDU); MRC Vaudreuil-Soulanges, Ville-de-l'Île-Perrot, 15-VI-2016 (12:00), beaten from *Castylegia sepium*, P. de Tonnancour (2, CPTO); Montreal, Parc Zotique-Racicot (45.5436, 73.6903), 16-VI-2016, beaten from *Castylegia sepium*, S. Dumont (1, CSDU); MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 17-VI-2016 (12:30), beaten from *Castylegia sepium*, P. de Tonnancour (3, CPTO); MRC Vaudreuil-Soulanges, Ville-de-l'Île-Perrot (45.3970, -73.9629), 18-VI-2016 (12:00), beaten from *Castylegia sepium*, P. de Tonnancour (1, CPTO); MRC Vaudreuil-Soulanges, Notre-Dame-de-l'Île-Perrot, 21-VI-2016 (17:00), beaten from *Castylegia sepium*, P. de Tonnancour (4, CPTO); Montreal, Parc Zotique-Racicot (45.5436, 73.6903), 23-VI-2016, beaten from *Castylegia sepium*, S. Dumont (1, CSDU); same except: 28-VI-2015 (13:00), P. de Tonnancour (14, CPTO); same except: 30-VI-2016, S. Dumont (2, CSDU); same except: 4-VII-2016 (2, CSDU); same except: 26-VII-2016 (2, CSDU); same except: 28-VII-2016 (1, CSDU); same except: 18-VIII-2016 (1, CSDU).

Tribe Conotrachelini Jekel, 1865

Conotrachelus buchanani Schoof, 1942, new to Canada

Species identification confirmed by RSA, 2015

Note. This native species is associated with *Celtis* L. spp. (Cannabaceae) (Schoof 1942), specifically common hackberry, *Celtis occidentalis* L., in Quebec. All specimens collected in Montreal were beaten from common hackberry, and all those from Terrasse-Vaudreuil were attracted to a light source located no more than 10 m from a hackberry tree. Hackberry has been favoured as a street tree and planted in great numbers in some boroughs by the City of Montreal between 1972 and 1984 (QuéBio 2016), obviously

much to the benefit of the weevil. Records provided herein represent a significant northerly extension of the range of this species which was previously only known from as far north as Pennsylvania (O'Brien and Wibmer 1982).

Specimens from southern USA were examined and found to be consistently larger than the northern forms from Quebec and northern USA, but dissections failed to reveal any further significant differences between the two groups. The status of the Canadian and northern USA forms needs further study. For the time being specimens reported herein will be considered as *C. buchanani*.

Specimen data. [MRC Brome-Missisquoi], Saint-Armand, 5-VI-2007, C. Chantal (1, CCCH); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 21-V-2009 (21:00–22:00), mercury vapour light, P. de Tonnancour (1, CPTO); same except: 18-VI-2010 (23:00), mercury vapour + UV + porch light, P. de Tonnancour (1, CPTO); same except: 6-VII-2011 (23:00), UV + porch light, P. de Tonnancour (1, CPTO); MRC Marguerite-D'Youville, Contrecoeur, 8-VII-2012 (0:30), mercury vapour + UV light, P. de Tonnancour (1, CPTO); [MRC La Vallée-du-Richelieu] Mont-Saint-Hilaire, 2-VI-2013, H. Miquet-Sage (2, CHMS); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 21-IX-2014 (21:00), UV + porch light, P. de Tonnancour (1, CPTO); Montreal, Parc Zotique-Racicot (45.5424, -73.6874), 19-VI-2015, beaten from *Celtis occidentalis*, S. Dumont (3, CMNC; 3, CNCI; 3, CSDU); same except: 2-VII-2015 (5, CSDU); Montreal, 11875, rue Zotique-Racicot (45.5424, -73.6901), beaten from *Celtis occidentalis*, 8-VII-2015, P. de Tonnancour & S. Dumont (6, CPTO; 1, CSDU); same except: 12-VII-2015 (16:00), P. de Tonnancour (2, CPTO); same except: 9-VII-2015, S. Dumont (2, CMNC; 2, CNCI; 1, CSDU); same except: 16-VIII-2015 (6, CMNC; 6, CNCI; 1, CSDU); 21-VIII-2015 (2, CSDU); 25-VIII-2015 (3, CSDU); same except: 1-IX-2015, P. de Tonnancour & S. Dumont (21, CPTO; 2, CSDU); same except: 12-X-2015, S. Dumont (2, CSDU); same except: 22-V-2016 (3, CSDU); same except: 24-V-2016 (5, CSDU); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 30-V-2016 (01:00), UV + porch light, P. de Tonnancour (1, CPTO); Montreal, Parc Zotique-Racicot (45.5424, -73.6874), 7-VI-2016, beaten from *Celtis occidentalis*, S. Dumont (9, CSDU); same except: 14-VI-2016 (1, CSDU); same except: 27-VI-2016, UV light (1, CSDU); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 27-VI-2016 (22:45), UV + porch light, P. de Tonnancour (1, CPTO); Montreal, Parc Zotique-Racicot (45.5424, -73.6874), 30-VI-2016, beaten from *Celtis occidentalis*, S. Dumont (10, CCCH; 7, CSDU); same except: 8-VIII-2016 (13, CSDU); same except: 18-VIII-2016 (3, CSDU).

***Conotrachelus pusillus* LeConte, 1878, new to Canada**

Species identification confirmed by RSA, 2015, 2016

Note. This native species was previously known to occur in eastern North America from New York and Florida to Kansas and Texas (O'Brien and Wibmer 1982). Host plants are unknown.

Specimen data. [MRC Deux-Montagnes] Parc national d'Oka, composting site, 23-VII-2011, R. Vigneault (1, CRVI); same except: plage d'Oka, 2-VIII-2011 (1, CRVI); [MRC Marguerite-D'Youville] Varennes, 8-IX-2015, attracted to UV lamp, C. Chantal (1, CCCH); MRC Deux-Montagnes, Parc national d'Oka, 21-VII-2015 (1:00), beaten from foliage of *Carya ovata*, P. de Tonnancour (1, CPTO).

***Conotrachelus recessus* (Casey, 1910), new to Quebec**

Species identification confirmed by RSA, 2015

Note. This small *Conotrachelus* Dejean, 1835 was previously known in Canada only from Ontario (Bousquet et al. 2013). It is superficially similar to a *Tychius* Germar, 1817 sp. and was in fact originally described by Casey in the tribe Tychiini (Curculioninae) as the type of the monobasic genus *Loceptes* Casey, 1910 (Schoof 1942). It can be separated from its congeners by its very small size (2.5 – 3.0mm), golden colored scales and recurved elytral setae. Available data on host plants are inconclusive.

Specimen data. MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 19-VI-2014 (0:00), attracted to UV + porch light, P. de Tonnancour (1, CPTO).

Subfamily Scolytinae Latreille, 1804

Tribe Phloeotribini Chapuis, 1869

***Phloeotribus dentifrons* (Blackman, 1921), new to Quebec**

Species identification confirmed by Hume Douglas, 2016

Note. This minute native species (1.2–1.6mm) was previously known to occur in Canada only in the southernmost part of Ontario (all 61 CNCI Canadian specimens are from Point Pelee National Park). As for the above-mentioned *Conotrachelus buchanani*, this native species is associated with *Celtis* spp. (Wood 1982), specifically common hackberry, *Celtis occidentalis*, in Quebec. It is probably more widely distributed than currently known in Quebec, as it was found in close association with its host plant in three different localities. It has also been reared recently (2016) from dead branches of *Celtis occidentalis* in Almonte, Ontario, ca. 30 km from the Quebec border (Hume Douglas, pers. comm. 2017).

Specimen data. MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil (45.3923, -73.9922), 20-IX-2013 (18:00), white tulle fabric flight interception trap, P. de Tonnancour (1, CPTO); same except: 20-V-2016 (16:30) (1, CPTO); Montreal, rue Zoltique-Racicot (45.5436, -73.6901), 21-VIII-2015, beaten from *Celtis occidentalis*, S. Dumont (1, CSDU); same except: 21-V-2016 (9, CSDU); same except: 22-V-2016 (4, CSDU); same except: 23-V-2016 (7, CPTO); same except: 24-V-2016 (3, CSDU); same except: 7-VI-2016 (1, CSDU); MRC Laval, Laval, rue des Charmes (45.5888,

-73.8268), 20-VII-2016 (15:00), beaten from *Celtis occidentalis*, P. de Tonnancour (1, CPTO); MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil (45.3927, -73.9922), 20-VII-2016, ex-larva from dead branch of *Celtis occidentalis*, P. de Tonnancour (3, CPTO); same except: 28-VII-2016 (1, CPTO); same except: 14-VIII-2016 (2, CPTO); same except: 15-VIII-2016 (1, CPTO); same except : 18-III-2017 (8, CNCI); MRC Laval, Laval, rue des Charmes (45.5846, -73.8226), 2-IV-2017, ex-larva from dead branch of *Celtis occidentalis*, P. de Tonnancour (5, CPTO).

Tribe Scolytini Latreille, 1804

Scolytus muticus Say, 1824, new to Quebec

Species identification confirmed by Hume Douglas, 2016

Note. As for the above-mentioned *Phloeotribus dentifrons*, this native species was previously thought to be confined in Canada to the southernmost part of Ontario (all 11 CNCI Canadian specimens are from Pelee Island and Point Pelee National Park). It occurs in association with common hackberry, *Celtis occidentalis*, in Quebec, but also with dwarf hackberry, *Celtis tenuifolia* Nutt. (Smith and Cognato 2014), an endangered species, in southern Ontario (COSEWIC 2003). At 2.2–5.3mm, it is the largest member of the genus known to occur in Quebec.

Specimen data. MRC Vaudreuil-Soulanges, Terrasse-Vaudreuil, 14-VI-2016 (14:00), white tulle fabric flight interception trap, P. de Tonnancour (1, CPTO); MRC Laval, Laval, rue des Charmes (45.5846, -73.8226), 6-VII-2016 (15:00), beaten from *Celtis occidentalis*, P. de Tonnancour (1, CPTO).

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Taxonomic revision of imitating carpenter ants, *Camponotus* subgenus *Myrmopytia* (Hymenoptera, Formicidae) of Madagascar, using morphometry and qualitative traits

Nicole Rasoamanana¹, Sándor Csősz², Brian L. Fisher²

1 Madagascar Biodiversity Center, BP 6257, Parc Botanique et Zoologique de Tsimbazaza, Antananarivo, Madagascar **2** Entomology, California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118, U.S.A.

Corresponding author: Nicole Rasoamanana (rsoanarivo35@gmail.com)

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Abstract

The ant genus *Camponotus* (Mayr, 1861) is one of the most abundant and species rich ant genera in the Malagasy zoogeographical region. Although this group is commonly encountered, its taxonomy is far from complete. Here, we clarify the taxonomy of the Malagasy-endemic *Camponotus* subgenus *Myrmopytia* (Emery, 1920). Species delimitation was based on traditional morphological characters and multivariate morphometric analyses, including exploratory Nest Centroid clustering and confirmatory cross-validated Linear Discriminant Analysis. Four species are recognized: *Camponotus imitator* (Forel, 1891), *Camponotus jodina* **sp. n.**, *Camponotus karaha* **sp. n.**, and *Camponotus longicollis* **sp. n.** All four species appear to mimic co-occurring *Aphaenogaster* species. A diagnosis of the subgenus *Myrmopytia*, species descriptions, an identification key based on minor and major subcastes of workers, and the known geographical distribution of each species are provided.

Keywords

Malagasy region, taxonomic revision, *Camponotus*, subgenus *Myrmopytia*, NUMOBAT, species delimitation, exploratory analyses, biogeography

Introduction

Malagasy *Camponotus* species are known to mimic other ant species or genera, such as *Tetraponera*, *Catalaucus* and *Aphaenogaster*, highlighting the incredible potential for morphological adaptation in *Camponotus* species (Forel 1886, Ward 2009, BLF, pers. obs.). In this study, we assess the diversity of the Malagasy subgenus *Myrmopytia*. Minor workers of this subgenus all appear to mimic *Aphaenogaster*. In 1891, when describing *Camponotus imitator*, Forel noted that the minor workers exhibited strikingly similar morphology to the myrmicine ant *Aphaenogaster swammerdami* Forel, 1886 (Formicidae: Myrmicinae) (see Figure 1). Little is known about the evolutionary advantage of this phenomenon, although where *A. swammerdami* occurs, it is a dominant species and there might be some level of protection in imitating a dominant ant. The genus *Camponotus* (Mayr, 1861) is among the most diverse and abundant ant lineages in Madagascar. Of the more than 1500 valid species and subspecies worldwide, 78 *Camponotus* species are known from the Malagasy region (Antcat.org) with an additional estimated 100 undescribed taxa (AntWeb.org). Several complications have hindered progress in the refinement of *Camponotus* taxonomy. The first is morphological variation, especially the high level of intraspecific and intranidal polymorphism; the presence at times of three morphological castes (minor, media and major); and the poorly tested diagnostic value of morphological traits that make species delimitation using conventional approaches extremely difficult. The second difficulty is linking past works to current taxon concepts, as these same morphological challenges complicate the association of previously named type specimens to current species hypotheses. The third complication is that the existing subgenus classification of *Camponotus* is an amalgamation of past taxonomic works that have tried to “fix” the problem of taxa delimitation by adding new names rather than by completely revising the global classification (Bolton 1995, Clouse et al. 2015, Ward et al. 2016).

We have attempted to overcome the problem of morphological variation in the Malagasy-endemic *Camponotus* subgenus *Myrmopytia* (Emery, 1920) by combining traditional morphology (i.e. evaluation of qualitative traits) with a numeric morphology-based approach. For quantitative analyses of morphometric data we follow the protocol introduced by Csősz and Fisher (2016) using a combination of NC-clustering (Seifert et al. 2014) and PART (Nilsen and Lingjaerde 2013). In this protocol, boundaries of operational taxonomic units (OTUs) are tested via cross-validated Linear Discriminant Analysis (LOOCV-LDA). In order to obtain high quality resolution of morphometric analyses we extended the existing set of morphometric characters by including many new traits. Our extended character set includes 19 traits of which four are defined for the first time.

In terms of overcoming the challenges of historical names, our work builds on 15 years of tracking down type material of all Malagasy taxa from across European collections to assess the identity of previous descriptions in relation to more recently collected material. Although we are still missing a small percentage of *Camponotus* type specimens, the identities of most names have been clarified.



Figure 1. *Camponotus* species in the subgenus *Myrmopytia* are thought to mimic co-occurring *Aphaenogaster* species **A** *Aphaenogaster swammerdami* (CASENT0017663) **B** *Camponotus imitator* (CASENT0452849).

Lastly, this work does not address the issue of the unnatural subgeneric classification for the genus which is better addressed with molecular phylogenetic methods and global sampling. Instead, for this revision, we retain the historic subgenus *Myrmopytia*,

for *Camponotus imitator* (Forel, 1891), and include for the convenience of this revision, species with morphologically similar workers.

All species are described here based on the worker caste, and the key provided combines qualitative characters and morphometric ratios that will help resolve the most problematic cases. Distribution maps are also provided.

Materials and methods

Abbreviations of depositories

CASC	California Academy of Sciences, San Francisco, CA, USA.
MHNG	Muséum d'Histoire Naturelle, Geneva, Switzerland.
NHMB	Naturhistorisches Museum, Basel, Switzerland.
PBZT	Parc Botanique et Zoologique de Tsimbazaza, Antananarivo, Madagascar.
PSWC	P. S. Ward Collection, University of California, Davis, CA, USA.
ZMHB	Museum für Naturkunde, Humboldt-Universität, Berlin, Germany.

Materials

The morphometric analysis was based on 130 workers principally collected by B.L. Fisher and the Madagascar Biodiversity Center team in 74 collecting events across Madagascar. Specimen data and images for material examined in this study is available on AntWeb (<http://www.antweb.org>) and can be accessed using the unique specimen identifiers (e.g. CASENT0101365).

Methods

Imaging

Digital color montage images were created using a JVC KY-F75 digital camera and Syncroscopy Auto-Montage software (version 5.0), or a Leica DFC 425 camera in combination with the Leica Application Suite software (version 3.8).

Mapping

Distribution maps for all species were generated by importing specimen distribution records into the Diva-GIS program (Hijmans et al. 2011). For material lacking locality data such as older type material, georeferenced coordinates are placed in brackets. Georeferencing was completed with the aid of online maps and the Missouri Botanical Garden's Gazetteer to Malagasy Botanical Collecting Localities (2015).

Morphometric character recording and terminology

Measurements were taken with a Leica MZ 9.5 stereomicroscope equipped with a cross-scaled ocular micrometer. Each worker was evaluated using 19 continuous morphometric traits, measured as in Rakotonirina et al. (2016) for the *Camponotus edmondi* group. The morphometric data are expressed in μm . All measurements were made by NR allowing to achieve the highest consistency in character recording throughout the entire data collection procedure.

Definitions and abbreviations for the measured characters are as follows (see Figure 2):

- CL** *Maximum cephalic length.* The maximum median length of the head in full-face view, measured from the midpoint of the posterior margin of head to the midpoint of the anterior margin of the clypeus (Fig. 2A).
- ClyL** *Clypeal length.* The maximum median length of the clypeus measured from the posterior margin to the anterior margin in frontal view, in which the anterior and posterior clypeal margins are aligned to the same focus. Median concavity on either or both margins reduces the length of the clypeus (Fig. 2A).
- CS** *Cephalic size.* This derived character is used as body size indicator and is calculated from the arithmetic mean of head length (CL) and maximum head capsule width (CWb).
- CW** *Maximum cephalic width.* The longest distance between the lateral margins of the compound eyes in full-face view (Fig. 2A).
- CWb** *Maximum head capsule width.* The maximum width of the head capsule excluding the compound eyes (Fig. 2A).
- EL** *Eye length.* Maximum diameter of the compound eye (Fig. 2A).
- FR** *Frontal carina distance.* The longest distance between the frontal carinae (Fig. 2A).
- GPD** *Maximum tentorial pit distance.* The longest distance between the centers of the fossae located at or very close to the posterolateral margin of the clypeus (Fig. 2A).
- HTL** *Maximum hind tibia length.* Straight line length of the hind tibia measured from the constriction immediately before its proximal insertion to its distal-most point, excluding the bristles or spines (Fig. 2B).
- ML** *Mesosoma length.* The longest anatomical line that connects the posteriormost point of the propodeal lobe with the anteriormost point of the pronotal collar; preferentially measured in lateral view, but if one of the reference points is not visible, dorsal view may help (Fig. 2B).
- MPD** *Mesothoracico-propodeal distance.* With the promesonotal suture and the anterior petiolar foramen margin in the same plane of focus in dorsal view, the maximum length between the promesonotal suture and the posteriormost point of the propodeal process dorsal to the petiolar insertion (Fig. 2C).
- MPH** *Mesothoracico-propodeal height.* Measured in lateral view, using as a diagonal reference line that connects the anteriormost point of the pronotal shield and the posteriormost point of the propodeal process dorsal to the petiolar

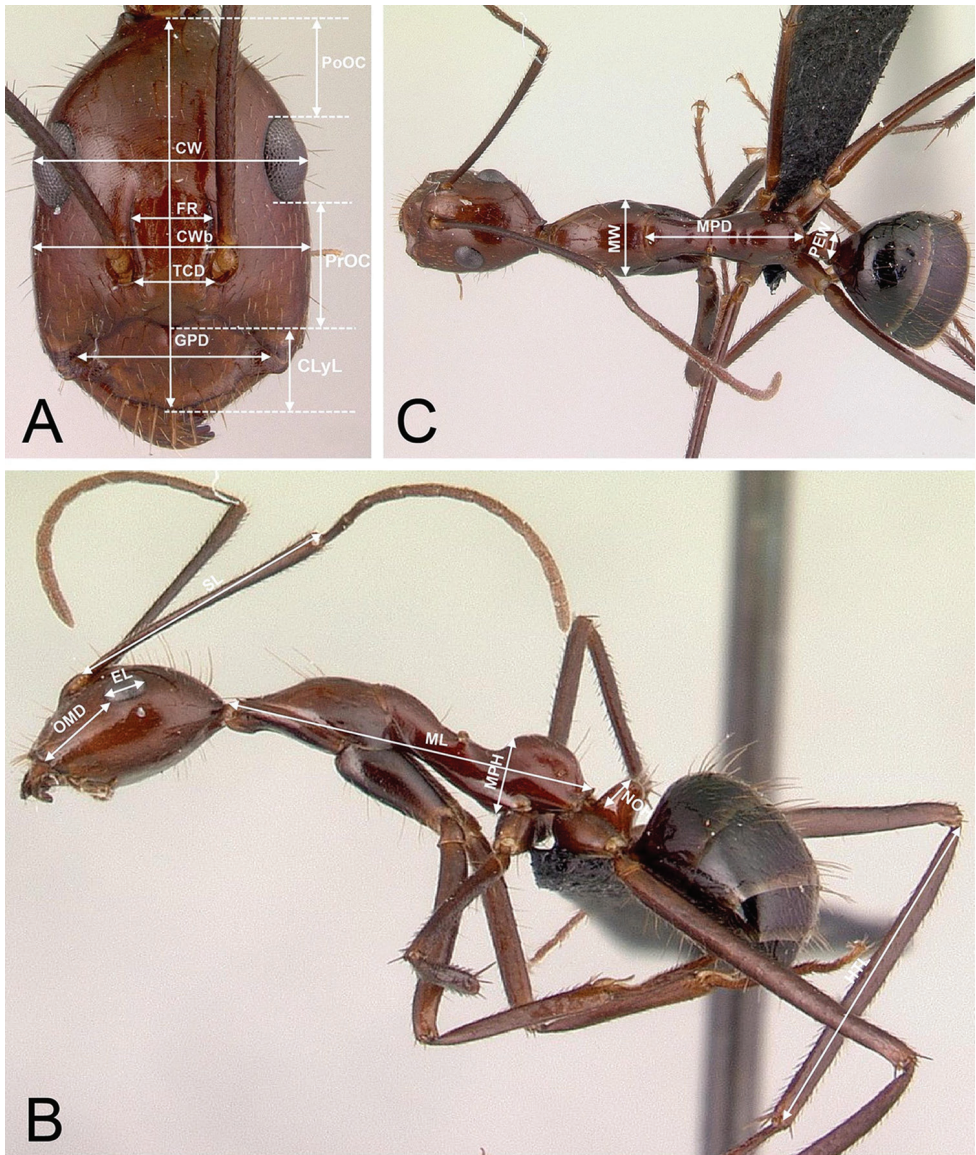


Figure 2. Illustrations of measurements used to distinguish members of *Myrmopytia*. **A** Full-face view of the head illustrating measurement lines for maximum cephalic length (CL), clypeal length (ClyL), maximum cephalic width (CW), maximum head capsule width (CWb), eye length (EL), frontal carina distance (FR), maximum tentorial pit distance (GPD), postocular distance (PoOC), preocular distance (PrOC) and torular carina distance (TCD) **B** Lateral view of the body illustrating measurement lines for oculo-mandibular distance (OMD), scape length (SL), mesosoma length (ML), mesothoraco-propodeal height (MPH), petiolar node height (NOH) and maximum hind tibia length (HTL) **C** Dorsal view of the body illustrating measurement lines for mesosoma width (MW), mesothoraco-propodeal distance (MPD) and petiolar width (PEW).

- insertion, MPH is the perpendicular distance between two lines parallel to this line, one of which just touches the anteroventral corner of the mesopleuron, dorsal to the insertion of the mesocoxa, and other which the dorsalmost point of the propodeum (Fig. 2B).
- MW** *Mesosoma width*. Maximum width of the pronotum in dorsal view, which in the *Myrmopytia* is also the maximum mesosomal width (hence “mesosoma width”) (Fig. 2C).
- NOH** *Petiole node height*. The maximum distance between the petiole spiracle and the dorsalmost point of the petiole node (Fig. 2B).
- OMD** *Oculo-mandibular distance*. The minimum distance between the anterior margin of the compound eye and the mandibular insertion to the head (Fig. 2B).
- PEW** *Petiole width*. The maximum width of the petiole in dorsal view (Fig. 2C).
- PoOC** *Postocular distance*. The longest distance between the posteromedian margin of the head and the reference line set on the posterior margins of the two compound eyes. Measured at a right angle to the reference line in full-face view (Fig. 2A).
- PrOc** *Preocular distance*. The longest distance between the anteromedian margin of the clypeus and the level of the anterior margin of the compound eyes as reference line. Measured at a right angle to the reference line in full-face view (Fig. 2A).
- SL** *Scape length*. Straight line length of the first antennal segment excluding the basal condyle (Fig. 2B).
- TCD** *Torular carina distance*. The minimum distance between the torular arches that surround the antennal insertion (Fig. 2A).

Morphometric data analysis

Altogether 130 worker individuals (96 minor and 34 major workers) were measured and analyzed using multivariate statistics based on the protocol described by Seifert et al. (2014) and extended by Csősz and Fisher (2016). *Camponotus* species may produce two to three subcastes of workers exhibiting quite different allometric properties. The Linear Discriminant Analysis (LDA) cannot properly analyze non-linearly scaled data. Therefore, all specimens were sorted into two subcastes (minor and major were found in the present subgenus) via visual inspection of scaling properties using pairwise matrix scatterplots (see also Rakotonirina et al. 2016). With this procedure, linear within-class allometries were achieved for each trait.

Thanks to the higher number of minor workers (96 were minors out of 130 total) this subcaste was selected for the purpose of morphometric data analyses. Morphometric data and descriptions for major workers are also provided, but their morphometric data were not included in statistical processing.

Generation of species hypotheses by combined application of NC-PART clustering and confirmatory Linear Discriminant Analysis (LDA)

We evaluated the morphometric data recorded from 96 minor workers belonging to 66 samples. All samples represent nest series or individuals from one collecting event. We used a combined application of NC-clustering (Seifert et al. 2014) and PART algorithm implemented in ‘clustergenomics’ package (Nilsen and Lingjaerde 2013) under R environment (R Core Team 2014).

The optimal number of clusters and the partitioning of samples done by Partitioning Based on Recursive Thresholding (PART) were accepted as improved species hypothesis worth testing if the two clustering methods, ‘hclust’ and ‘kmeans’ via PART arrived at the same conclusion (see Seifert et al. 2014, Rakotonirina et al. 2017).

Confirmatory Linear Discriminant Analysis with leave-one-out cross-validation (LOOCV-LDA) was run to confirm species boundaries. The classification returned by the quantitative analyses were further verified by searching for qualitative differences of morphological traits between clusters.

Results and discussion

The NC-PART clustering found three clusters (see numbered bars 1 (black), 2 (red) and 3 (blue) in Figure 3). Qualitative investigation of morphological traits found overall support for these three clusters. However, in cluster 2 (red bar in Figure 3) two samples remarkably differ in morphology from the other specimens in the cluster. Based on the distinct phenotype of the two individuals of the satellite cluster (purple specimens in Figure 3), we propose that these two individuals represent an additional species. These individuals also appear slightly separated in the NC-clustering dendrogram. A larger sample size, however, would be required to statistically evaluate the independence of the cluster using ‘kmeans’ or ‘hclust’. Based on the morphometric and qualitative analysis, four species are hereby named as *C. imitator* Forel, 1891, *C. longicollis* sp. n., *C. karaha* sp. n. and *C. jodina* sp. n. (see Figure 3).

The confirmatory Linear Discriminant Analysis with leave-one-out cross-validation (LOOCV-LDA) yielded complete classification success and every specimen was correctly classified to one of the four species. It is important to note that even though the two specimens of *C. jodina* were correctly classified, the small sample size (2 specimens) is below the sample size criterion for LDA. As supporting evidence for *C. jodina*, univariate comparison of body ratios, PEW/CS and MPD/CS of samples of *C. jodina* and the most similar species, *C. karaha* yield non-overlapping ranges (Table 1).

Diagnosis of the subgenus *Myrmopytia* in the Malagasy region

Myrmopytia, Emery 1920: 243: *Myrmopytia* as subgenus of *Camponotus* (Mayr, 1861).

Type-species. *Camponotus imitator* Forel, 1891: 209, by monotypy.

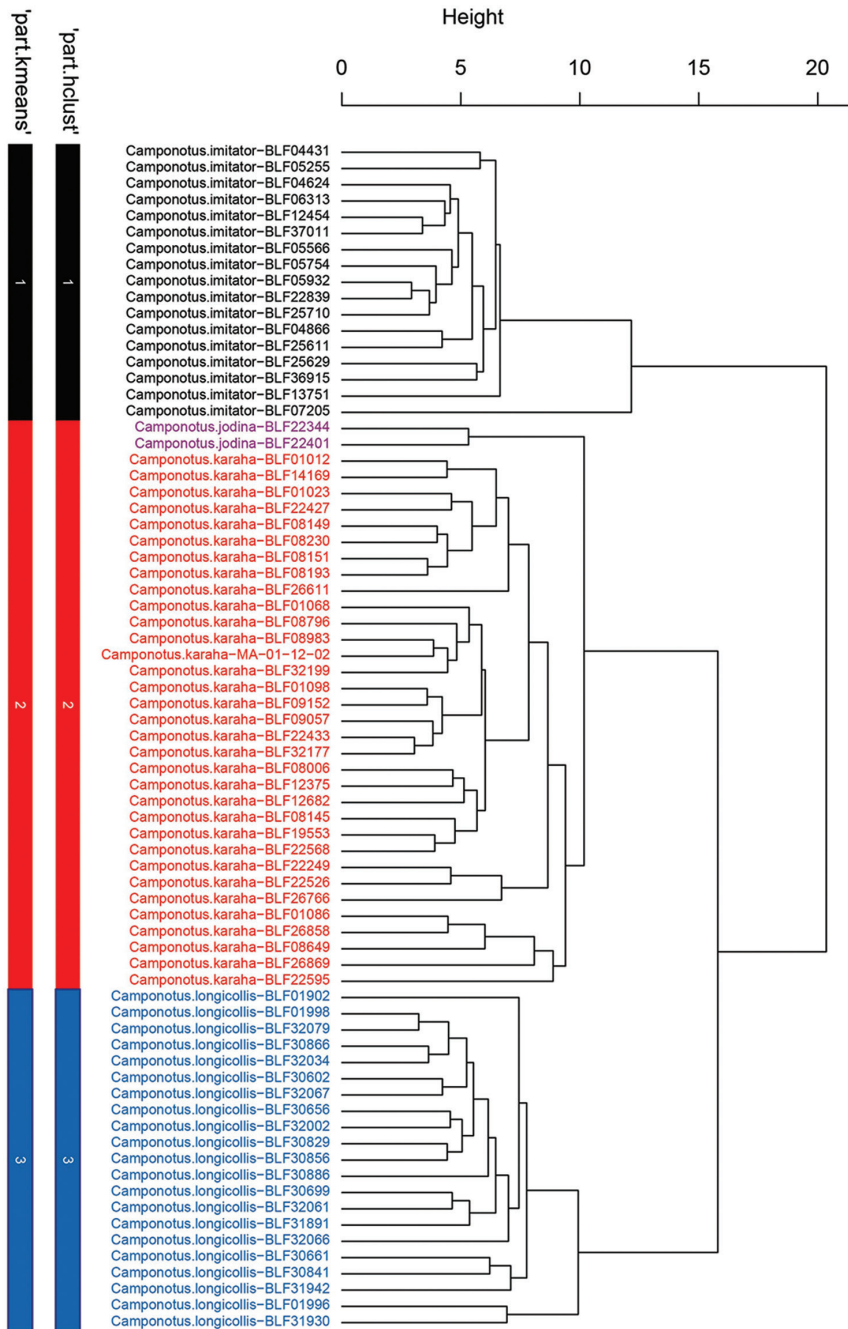


Figure 3. Dendrogram solution for the Malagasy *Myrmopytia* subgenus based on morphometric data. Labels include final species hypothesis followed by collection code separated by a hyphen. The color bars show partitioning yielded by two cluster methods 'hclust' and 'kmeans' via method PART. Color code: *Camponotus imitator*: black (cluster 1), *C. jodina*: purple (cluster 2), *C. karaha*: red (cluster 2), *C. longicollis*: blue (cluster 3)

Table 1. Ratios of morphometric data for minors and majors of the four species. The means of the ratios and the standard deviations are written in bold; minimum and maximum values are shown in parentheses. CS (Cephalic size) values are given in millimeters.

Species	Worker castes	CS	CWb/CL	CW/CL	PoOC/CL	PrOC/CL	ClJ/CL	FR/CS	TCD/CS	GPD/CS	SL/CS
<i>imitator</i>	Minors (n=25)	1.68±0.2 [1.34, 2.18]	0.76±0.0 [0.71, 0.85]	0.73±0.0 [0.68, 0.78]	0.25±0.0 [0.22, 0.29]	0.54±0.0 [0.51, 0.57]	0.27±0.0 [0.23, 0.29]	0.25±0.0 [0.21, 0.28]	0.23±0.0 [0.16, 0.25]	0.47±0.0 [0.42, 0.51]	1.52±0.1 [1.21, 1.73]
	Majors (n=22)	3.26±0.5 [2.32, 3.94]	0.95±0.0 [0.84, 1.03]	0.79±0.0 [0.76, 0.84]	0.28±0.0 [0.24, 0.32]	0.53±0.0 [0.42, 0.56]	0.29±0.0 [0.27, 0.32]	0.26±0.0 [0.25, 0.28]	0.23±0.0 [0.21, 0.24]	0.39±0.0 [0.37, 0.42]	0.85±0.1 [0.71, 1.16]
<i>jodina</i>	Minors (n=2)	1.84±0.0 [1.80, 1.88]	0.53±0 [0.52, 0.54]	0.56±0 [0.55, 0.57]	0.41±0 [0.40, 0.42]	0.40±0.0 [0.40, 0.41]	0.22±0 [0.21, 0.23]	0.22±0 [0.22, 0.23]	0.18±0 [0.17, 0.19]	0.40±0 [0.40, 0.40]	1.87±0 [1.85, 1.88]
	Majors unknown	–	–	–	–	–	–	–	–	–	–
<i>karaha</i>	Minors (n=47)	1.72±0.1 [1.35, 1.92]	0.54±0 [0.49, 0.60]	0.58±0 [0.56, 0.61]	0.43±0 [0.40, 0.47]	0.39±0 [0.35, 0.43]	0.22±0 [0.18, 0.24]	0.23±0 [0.21, 0.26]	0.19±0 [0.17, 0.22]	0.41±0 [0.37, 0.46]	1.83±0 [1.65, 2.05]
	Majors (n=9)	2.10±0.1 [1.92, 2.28]	1.47±0 [1.39, 1.55]	1.47±0 [1.42, 1.55]	0.38±0 [0.36, 0.39]	0.43±0 [0.41, 0.45]	0.26±0 [0.24, 0.28]	0.27±0 [0.25, 0.29]	0.21±0 [0.20, 0.22]	0.41±0 [0.38, 0.42]	1.30±0 [1.22, 1.41]
<i>longicollis</i>	Minors (n=22)	2.03±0.1 [1.74, 2.26]	0.55±0 [0.52, 0.59]	0.56±0 [0.54, 0.58]	0.42±0 [0.36, 0.47]	0.40±0 [0.38, 0.43]	0.23±0 [0.21, 0.26]	0.21±0 [0.19, 0.22]	0.18±0 [0.16, 0.20]	0.41±0 [0.39, 0.44]	1.60±0 [1.43, 1.68]
	Majors (n=3)	2.42±0.0 [2.41, 2.44]	1.53±0 [1.46, 1.60]	1.59±0 [1.54, 1.63]	0.39±0 [0.39, 0.40]	0.43±0 [0.43, 0.45]	0.27±0 [0.25, 0.27]	0.24±0 [0.24, 0.25]	0.19±0 [0.18, 0.21]	0.40±0 [0.39, 0.41]	1.31±0 [1.26, 1.34]
<i>imitator</i>	Worker castes	MW/CS	PEW/CS	ML/CS	MPD/CS	NOH/CS	HTL/CS	OMD/CS	EL/CS	MPH/CS	ML/MPH
	Minors (n=25)	0.59±0.0 [0.57, 0.63]	0.24±0.0 [0.16, 0.26]	1.96±0.1 [1.67, 2.15]	1.18±0.1 [0.95, 1.40]	0.24±0.0 [0.18, 0.27]	2.08±0.2 [1.71, 2.39]	0.47±0.0 [0.33, 0.51]	0.24±0.0 [0.20, 0.27]	0.49±0.0 [0.46, 0.53]	4.04±0.3 [3.64, 4.63]
<i>jodina</i>	Majors (n=22)	0.54±0.0 [0.52, 0.56]	0.22±0.0 [0.20, 0.25]	1.34±0.1 [1.17, 1.66]	0.85±0.1 [0.69, 1.10]	0.19±0.0 [0.11, 0.22]	1.23±0.2 [1.01, 1.64]	0.42±0.0 [0.40, 0.45]	0.18±0.0 [0.16, 0.21]	0.41±0.0 [0.37, 0.47]	3.28±0.3 [2.84, 3.88]
	Minors (n=2)	0.52±0 [0.50, 0.53]	0.15±0 [0.14, 0.15]	2.29±0 [2.25, 2.33]	1.42±0 [1.42, 1.42]	0.25±0 [0.23, 0.27]	2.20±0 [2.17, 2.24]	0.43±0 [0.42, 0.44]	0.21±0 [0.21, 0.22]	0.41±0 [0.40, 0.42]	5.56±0 [5.30, 5.83]
<i>karaha</i>	Majors unknown	–	–	–	–	–	–	–	–	–	–
	Minors (n=47)	0.51±0 [0.46, 0.55]	0.19±0 [0.16, 0.24]	2.20±0 [1.98, 2.40]	1.40±0 [1.19, 1.59]	0.20±0 [0.16, 0.27]	2.22±0 [1.93, 2.55]	0.40±0 [0.36, 0.45]	0.22±0 [0.20, 0.24]	0.42±0 [0.33, 0.50]	5.26±0 [4.50, 6.66]
	Majors (n=9)	0.53±0 [0.46, 0.56]	0.22±0 [0.21, 0.25]	1.87±0 [1.80, 2.00]	1.24±0 [1.10, 1.37]	0.17±0 [0.16, 0.19]	1.75±0 [1.64, 1.93]	0.42±0 [0.40, 0.44]	0.21±0 [0.20, 0.23]	0.42±0 [0.32, 0.45]	4.48±0.63 [4.08, 6.13]

Species	Worker castes	CS	CWb/CL	CW/CL	PoOC/CL	PrOC/CL	ClvL/CL	FR/CS	TCD/CS	GPD/CS	SL/CS
<i>longicollis</i>	Minors (n=22)	0.58±0	0.20±0	2.20±0	1.47±0	0.12±0	2.02±0	0.42±0	0.21±0	0.45±0	4.86±0
		[0.54, 0.61]	[0.17, 0.23]	[2.10, 2.28]	[1.34, 1.58]	[0.09, 0.18]	[1.82, 2.14]	[0.37, 0.46]	[0.19, 0.23]	[0.41, 0.53]	[4.04, 5.40]
	Majors (n=3)	0.62±0	0.20±0	1.92±0	1.30±0	0.14±0	1.59±0	0.39±0	0.20±0	0.44±0	4.32±0
		[0.58, 0.64]	[0.19, 0.21]	[1.85, 1.99]	[1.27, 1.37]	[0.13, 0.15]	[1.54, 1.68]	[0.38, 0.40]	[0.19, 0.20]	[0.42, 0.46]	[4.14, 4.69]

Camponotus imitator was placed in the subgenus *Myrmosphincta* by Forel (1912). Emery, 1920 placed it in a new subgenus, *Myrmopytia*, based on the elongate form of the mesosoma.

Minor workers of this subgenus can be recognized by the combination of the following characters: maxillary palps particularly long with respect to head length, extending past a point on line with posterior margin of eye; mesosoma slender, mesonotum elongated and constricted at midlength, propodeum a protruding rounded hump; mesothoracic spiracles prominent, pointing upward; propodeum protuberant. The major worker can be recognized by the distinct form of the mesosoma. The propodeum is dome-like or subrectangular in lateral view and the metanotum is elongate and impressed, and the upper mesopleuron is laterally pinched (see Figures 10A, 14A, 17A).

Synoptic species list of the subgenus *Myrmopytia*

Camponotus imitator Forel, 1891

= *Camponotus imitator* var. *resinicola* Santschi, 1911, **syn. n.**

Camponotus jodina **sp. n.**

Camponotus karaha **sp. n.**

Camponotus longicollis **sp. n.**

Key to species of *Camponotus* subgenus *Myrmopytia*

- 1 **Minor:** in full-face view, the posterior region of the head elongated into a short, broad neck (Fig. 4A); Post ocular distance shorter: $PoOC/CL < 0.304$. **Major:** head wedge-shaped (Fig. 5A); head wider: $CWb/CL > 0.718$. **Minor and major:** clypeus with a broad rectangular projection; erect to suberect brown pilosity present on entire dorsum; head and mesosoma red, gaster black..... *imitator*
- **Minor:** in full-face view, the posterior region of the head elongated into long, narrow neck (Fig. 4B); Post ocular distance longer: $PoOC/CL > 0.404$. **Major:** head more rectangular or tapering to rear (Fig. 5B); head narrower: $CWb/CL < 0.717$. **Minor and major:** entire anterior clypeal margin produced into an obtuse angle; appressed to subdecumbent white hairs present on its entire dorsum; body uniformly dark brown to black..... 2
- 2 **Minor and major:** in profile, petiole relatively low and nodiform, with the anterodorsal angle higher than the petiolar spiracle, $NOH/CS < 0.146$ (Fig. 6A); anterior tentorial pit slightly impressed so that the posterior portion of clypeus protrudes weakly in lateral view (Fig. 7A). **Major:** head narrowed posteriorly, dorsal outline of mesonotum distinctly constricted longitudinally, propodeum protuberant..... *longicollis*

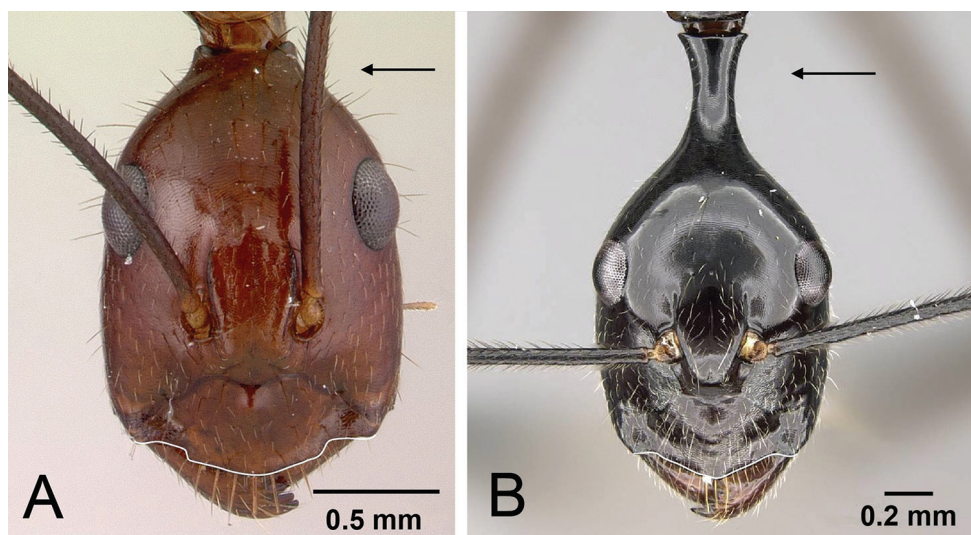


Figure 4. Illustration of the neck (posterior region of the head) and the anterior clypeal margin of **A** *Camponotus imitator* (CASENT0452849), and **B** *Camponotus karaha* (CASENT0152090). Arrows indicate the posterior portion of the head capsule which in *karaha* is drawn out into a strongly constricted neck, behind which the head capsule flares out, forming a pronounced collar.

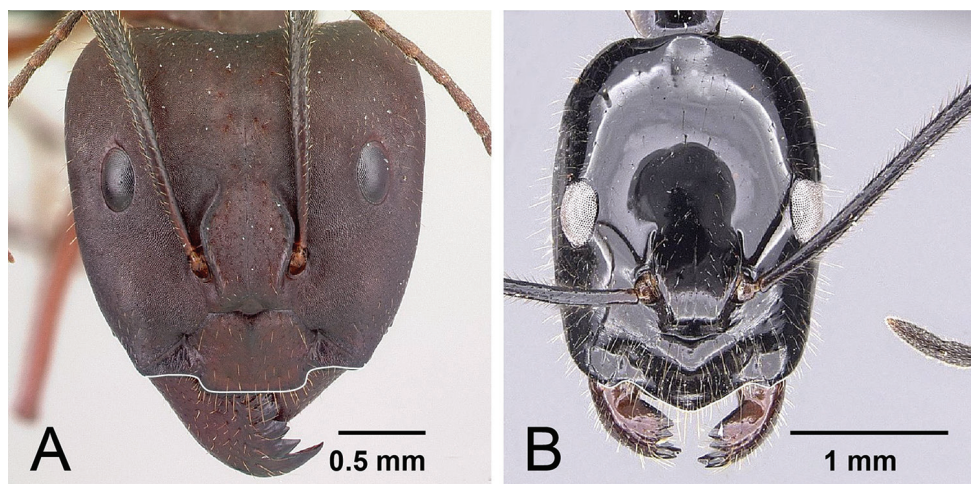


Figure 5. Head of major worker in full-face view. **A** *Camponotus imitator* (CASENT0452863), head wedge-shaped **B** *Camponotus karaha* (CASENT0151921), head rectangular.

- **Minor and major:** in profile, petiole conical, with the anterodorsal angle on the same level as or below the petiolar spiracle, $NOH/CS > 0.160$ (Fig. 6B); anterior tentorial pit distinctly impressed so that posterior portion of clypeus protrudes strongly in lateral view (Fig. 7B). **Major:** head of major worker more rectangular, dorsal outline of mesosoma forms a smooth curve separated by weak promesonotal suture and mesopropodeal impression **3**

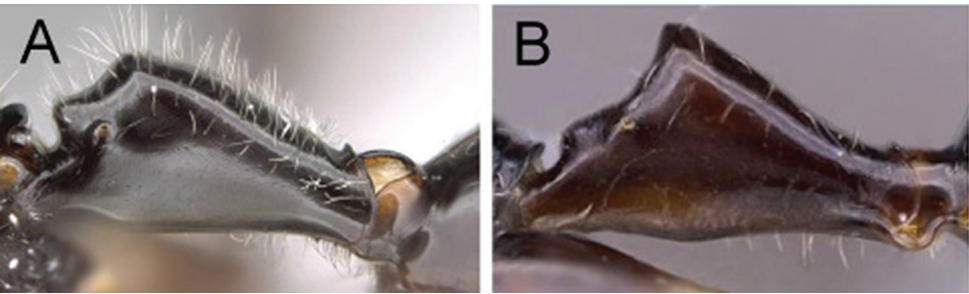


Figure 6. Petiole in lateral view of **A** *Camponotus longicollis* (CASENT0191989), and **B** *Camponotus karaha* (CASENT0067555).

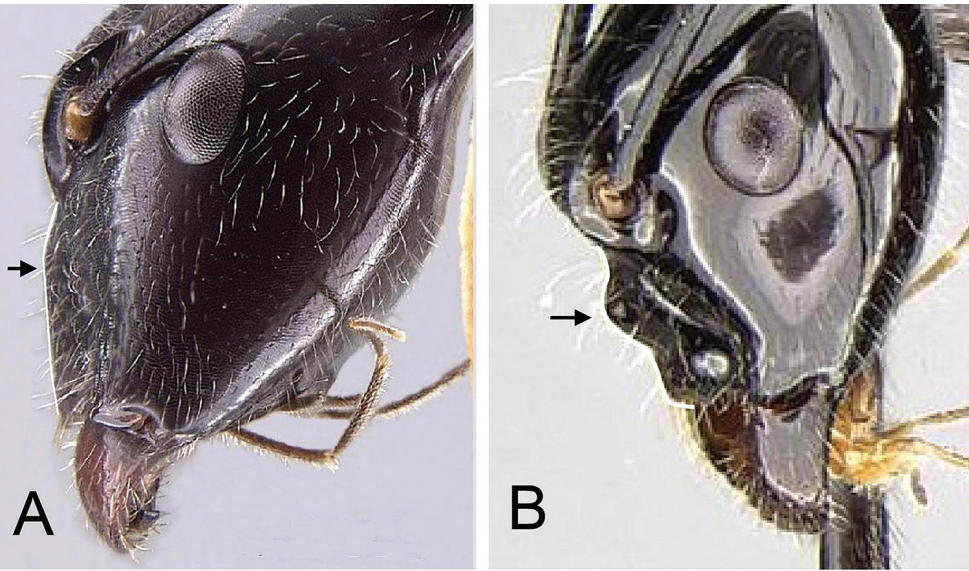


Figure 7. Head in lateral view showing the dorsal margin of the clypeus (similar in minor and major workers). **A** *Camponotus longicollis* (CASENT0191989) **B** *Camponotus karaha* (CASENT0353274).

- 3 **Minor worker:** in lateral view, petiolar apex forms an acute to a right angle, dorsal face of petiole flattened with distinct lateral edge, PEW/CS >0.169 (Fig. 8A); propodeum hemispherical; integument of mesonotum and propodeum glabrous to finely sculptured (Fig. 8A); antennal funiculus, basitarsi and tarsi yellowish to light brown *karaha*
- **Minor worker:** in lateral view, petiolar apex forms a blunt spine, dorsal face of petiole slightly convex without distinct edge, PEW/CS <0.156 (Fig. 8B); propodeum more rectangular, with a raised anterodorsal transverse carina; integument of mesonotum and propodeum strongly sculptured (Fig. 8B); antennal funiculus, basitarsi and tarsi brown..... *jodina*

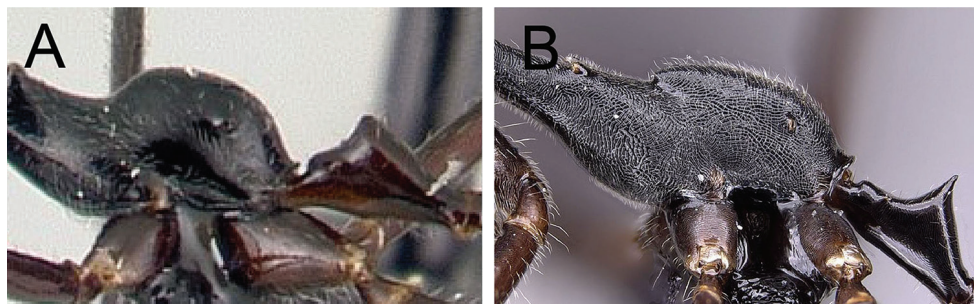


Figure 8. Lateral view of propodeum and petiole in minor workers of **A** *Camponotus karaha* (CASENT0067555), and **B** *Camponotus jodina* (CASENT0152090).

Camponotus imitator Forel, 1891

Figures 1B, 4A, 5A, 9, 10, 11

Camponotus imitator Forel, 1891: 209, pl. 4, fig. 15; pl. 5, fig. 8.

Lectotype worker, present designation, MADAGASCAR, Province Toliara, Morandava [-20.2833, 44.28333] (coordinates obtained from MBG Gazetteer), (Grevé), CASENT0101365 (MHNG) [not examined morphometrically] and two paralectotypes, workers, MADAGASCAR, CASENT0101116 (NHMB): CASENT0104647 (ZMHB) [morphometrically not examined]. [Combination in *Camponotus* (*Myrmosphincta*): Forel, 1912: 92; in *Camponotus* (*Myrmopytia*): Emery, 1920: 257].

Camponotus imitator var. *resinicola* Santschi, 1911 133. Lectotype worker, present designation, MADAGASCAR, Ambolisatra (probably today's Ambolisaka), [-21.7333, 43.36666], 6-7-1898, (C. Grandidier), CASENT0101117 (NHMB) [examined] and one paralectotype worker, Region du Sud, Andrahomana, [-25.183333, 46.63333], Nov. 1901 (Ch. Alluaud), CASENT0101118 (NHMB), and one worker Region du Sud-Est, Fort-Dauphin, [-25.03333, 46.98333], Août, 1901 (Ch. Alluaud), CASENT0101119 (NHMB) [not examined morphometrically].

syn. n. [Raised to species: Wheeler, W.M. 1922: 1049. Reverted to subspecies of *imitator*: Emery, 1925: 115].

Diagnosis. *Camponotus imitator* is easily recognizable within the group on the basis of the following combination of characters: posterior region of head only slightly extended, not narrowed into a long neck in the minor worker, PoOC/CL 0.256 [0.224, 0.304] and trapezoidal in major worker, CWb/CL 0.951 [0.841, 1.031]; anterior clypeal margin with a rectangular projection ClyL/CL 0.289 [0.231, 0.316]; petiole nodiform PEW/CS 0.224 [0.203, 0.255]; both castes bicolored: head, mesosoma and appendages reddish brown to dark brown, gaster black (minor) to mainly black (major).

Description of minor worker. Head suboval, posterior region of head only slightly and broadly extended with margins weakly convex. (CS) 1.68 mm [1.34, 2.18] (n=25).

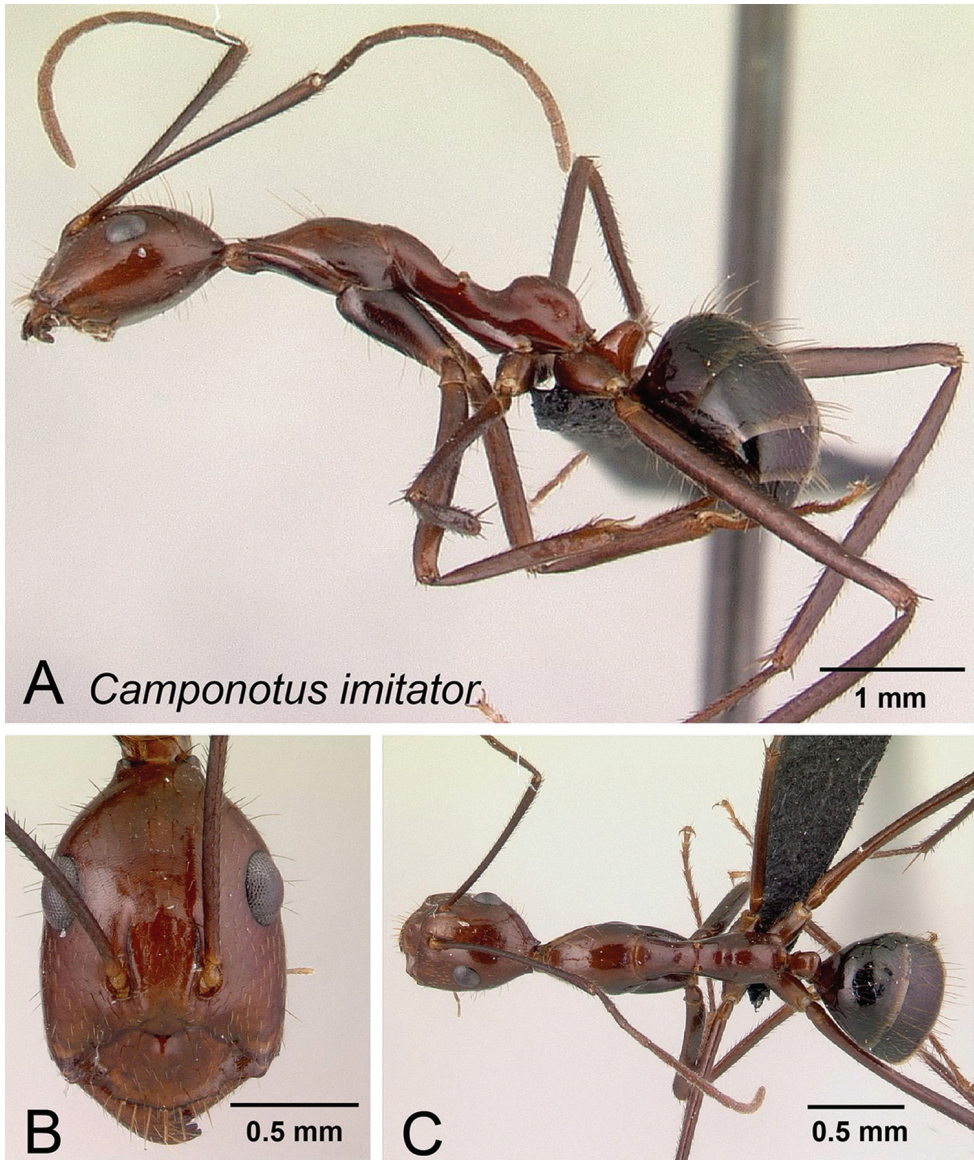


Figure 9. *Camponotus imitator* minor worker CASENT0452849. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

Standing setae present on posterolateral margin of head and vertex in full-face view. Eyes situated on posterior half of head, PoOC/CL 0.253 [0.224, 0.293]. Frontal carina convex, FR/CS 0.254 [0.209, 0.280], antennal scape surpassing posterior margin of head by more than half its length, SL/CS 1.517 [1.211, 1.731]. Anteromargin of clypeus with broad rectangular projection, posterior margin concave, ClyL/CL 0.271 [0.231, 0.293]; mandible with six teeth, palps long with respect to head size.

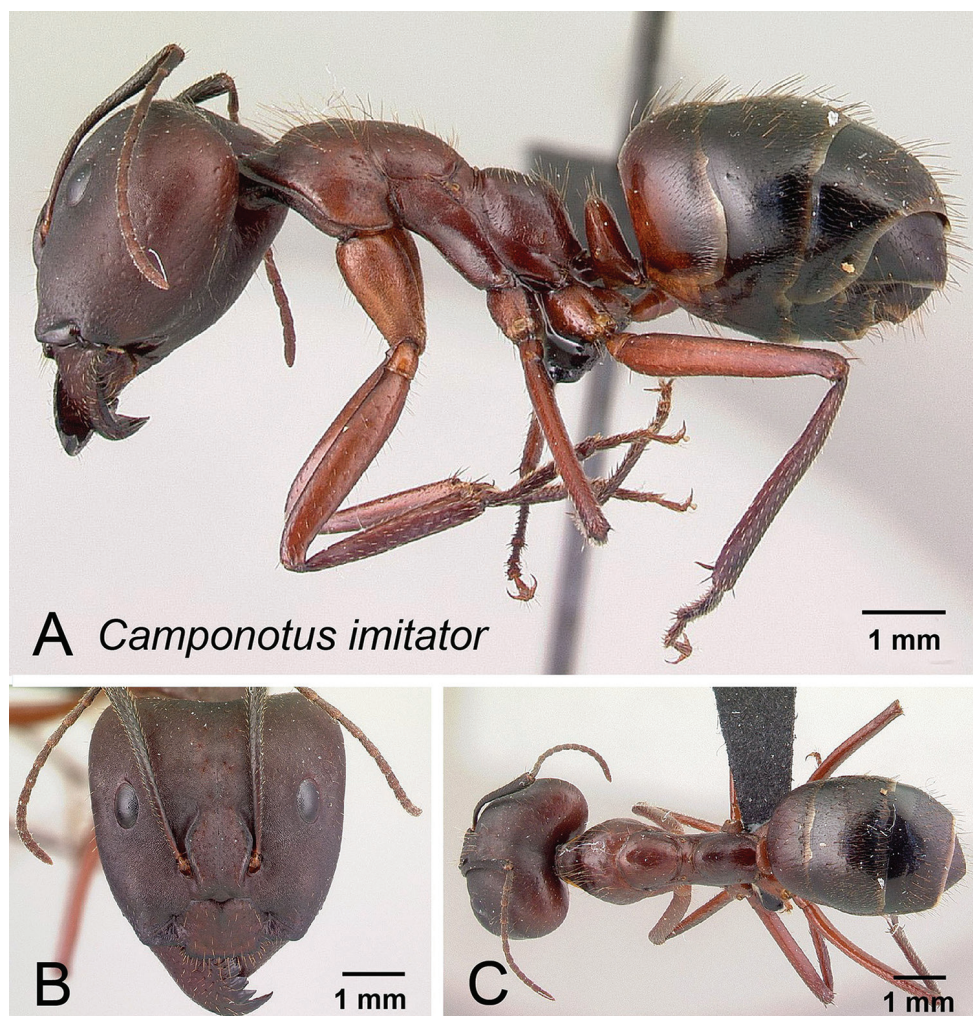


Figure 10. *Camponotus imitator* major worker CASENT0452863. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

Pronotum weakly undulant. Suberect pronotal setae numerous (more than 12). Mesonotum straight, MPD/CS 1.181 [0.954, 1.403]. Erect mesonotal setae varying from absent to numerous (two or three pairs anterior to mesothoracic spiracle). Mesothoracic spiracles prominent; propodeal dorsum protuberant. Erect propodeal setae moderate in number (4–6). ML/CS 1.957 [1.670, 2.149]. Petiole nodiform, dorsum of node convex, petiole higher than broad, PEW/CS 0.242 [0.164, 0.264]. Erect setae present on petiolar apex.

Color: head and mesosoma red to reddish brown, gaster dark brown to black. Erect setae light brown. Sparse appressed pubescence present.

Description of major worker. In full-face view, head truncated posteriorly, evenly tapering to base of mandibles, posterior margin of head weakly concave. Absolute cephalic size (CS) 3.26 mm [2.32, 3.94] (n=22). Cephalic margin with scattered short hairs; cephalic dorsum coarsely reticulate-foveolate. Eye situated on posterior half of the head, PoOC/CL 0.284 [0.242, 0.323]. Frontal carinae sinuate, FR/CS 0.260 [0.209, 0.280], coronal line distinct, antennal scape just surpassing the posterior margin of head by length of one funiculus segment, SL/CS 0.853 [0.711, 1.155]. Anterior margin of clypeus with a rectangular projection, medially straight to slightly convex, ClyL/CL 0.294 [0.269, 0.326]; masticatory margin of mandible with 7–10 teeth, microreticulate at base, becoming finely striolate apically, with scattered piligerous punctures, rarely with a few weak longitudinal rugae near base.

Dorsal outline of mesosoma complex. Promesonotum forms a regular convexity with a shallow impression at the promesonotal suture and is stepped to the propodeal dorsum. Suberect promesonotal setae inclined anteriorly, ML/CS 1.337 [1.168, 1.655]; metanotum distinct; propodeal dorsum almost straight to evenly convex, posterodorsal margin forms rounded angle with declivity.

Petiole higher than broad, node summit flat; brown standing setae present on entire dorsum. PEW/CS 0.221 [0.199, 0.247].

Color: head, mesosoma, petiole, and base of first gastral segment reddish brown, remainder of gaster dark brown to black. Scattered appressed pubescence generally present. Setae light brown.

Distribution and biology. The minor worker of *Camponotus imitator* is thought to mimic the myrmicine ant *Aphaenogaster swammerdami* due to its color and the form of its constricted mesonotum and shape of propodeum, which could appear as a petiole in dorsal view (Forel 1891) (Fig. 11). This myrmicine nests underground and shares its nests with snakes, *Madagascaphis colubrinus* (Schlegel, 1837) and *Leioheterodon modestus* (Günther, 1863); it is an important secondary seed disperser of *Commiphora guillauminii* (Burseraceae) (Böhning-Gaese et al. 1999).

Camponotus imitator is distributed in the dry forest and woodland of western and southern Madagascar at elevations ranging from 25 m to 990 m (Fig. 11). Its distribution is sympatric with *A. swammerdami* through most of its range (Fig. 11). It has been collected by litter sifting, Malaise and pitfall traps, as well as beating low vegetation and from the ground in rotten logs. This species nests underground.

Comment. We propose that *Camponotus imitator resinicola* (Santschi, 1911) is synonymized with *Camponotus imitator* Forel. In the original descriptions, the former differs from the latter by the presence of reddish patches on the first gastral segment near the petiolar insertion. Examination of material from 10 collection events of *C. imitator* colonies indicates that this trait is highly variable within colonies, and no other reliable characters were found to separate the subspecies from *imitator*. Moreover, no other qualitative trait or biogeographic evidence exists that would underpin the subspecies status of *resinicola*.

Additional material examined. Province **Fianarantsoa**: Tsaranoro, 32.8 km 230° Ambalavao, -22.08317, 46.774, 975 m, savannah woodland (B.L. Fisher et al.)

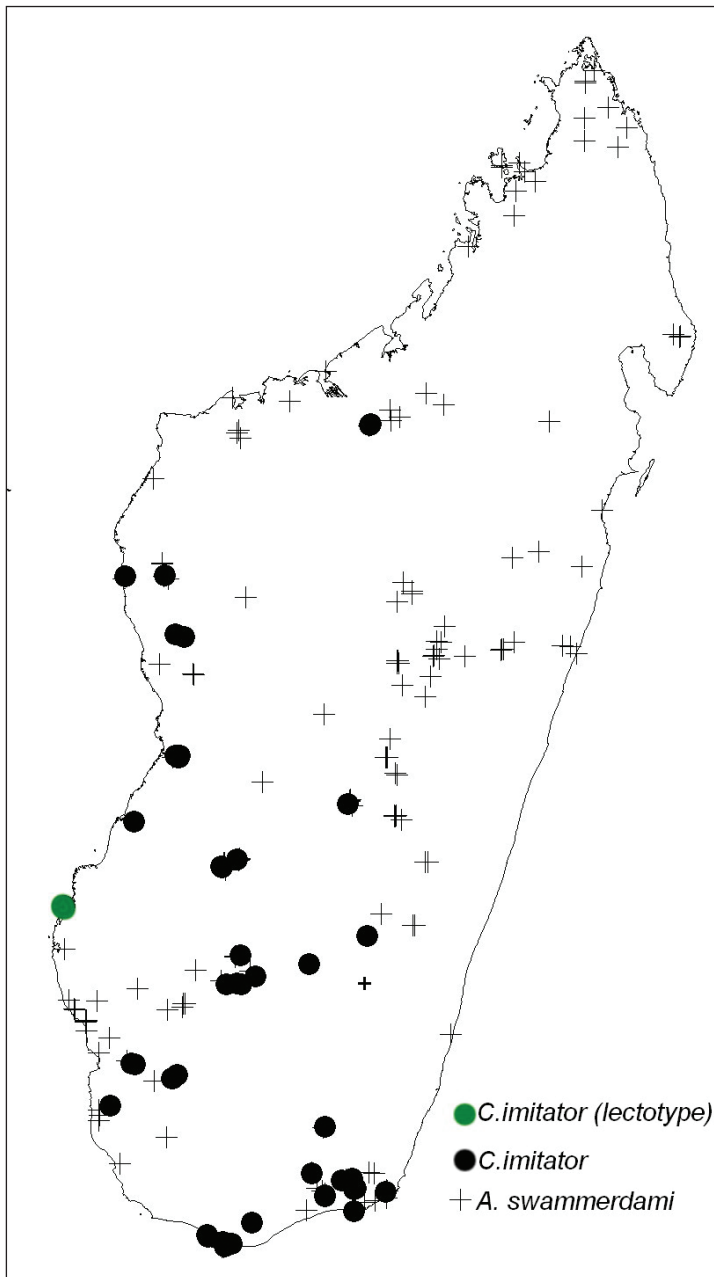


Figure 11. *Camponotus imitator* is sympatric with *A. swammerdami* through most of its range.

(CASC); Parc National d'Isalo, Ambovo Springs, 29.3 km 4° N Ranohira, -22.29833, 45.35167, 990 m, Uapaca woodland (Fisher, Griswold et al.) (CASC); Ihosy, -22.40317, 46.12917, 735 m, urban/garden (B.L.Fisher et al.) (CASC); Forêt d'Atsirakambiaty, 7.6 km 285° WNW Itremo, -20. 59333, 46.56333, 1550 m, grassland (Fisher, Gris-

wold et al.) (CASC). Province **Mahajanga**: Boeny Region, Distric of Marovoay, Ampijoroa National Park, 160 km North of Maevatanana on RN 04, -16.31933, 46.81333, 42 m, Decidious forest (Rinha, Mike) (CASC); Réserve forestière Beanka, 50.2 km E Maintirano, -18.02649, 44.05051, 250m, tropical dry forest on tsingy (B.L.Fisher et al.) (CASC); Station Forestiere Ampijoroa, -16.31667, 46.81667, 80 m, tropical dry forest (P.S.Ward) (PSWC); Antsalova, -18.68333, 44.61667, 100 m (D. Lees) (PSWC); Parc National Tsingy de Bemaraha, 10.6 km ESE 123° Antsalova, -18.70944, 44.71817, 150 m, tropical dry forest on Tsingy (Fisher-Griswold Arthropod Team) (CASC). Province **Toliara**: 45km NE Morondava, -20.05, 44.61667, 30 m, tropical dry forest (P.S.Ward) (PSWC); 48km ENE Morondava, -20.06667, 44.65, 30 m, tropical dry forest (D.M.Olson) (PSWC); Sept Lacs, -23.52472, 44.15917, 160 m, Spiny thicket Gallery forest transition (Frontier Project) (CASC); Forêt de Kirindy, 15.5 km 64° ENE Marofandilia, -20.045, 44.66222, 100 m, tropical dry forest (B.L.Fisher et al.) (CASC); Parc National de Tsimanampetsotsa, Forêt de Bemanateza, 20.7 km 81° E Efoetse, 23.0 km 131° SE Beheloka, -23.99222, 43.88067, 90 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); Parc National d'Andohahela, Forêt de Manatalinjo, 33.6 km 63° ENE Amboasary, 7.6 km 99° E Hazofotsy, -24.81694, 46.61, 150 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC), Parc National d'Andohahela, Forêt de Manatalinjo, -24.82466, 46.60111, 100 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); Parc National de Kirindy Mite, 16.3 km 127° SE Belo sur Mer, -20.79528, 44.147, 80 m, tropical dry forest (Fisher-Griswold Arthropod Team) (CASC); Parc National d'Andohahela, Forêt d'Ambohibory, 1.7 km 61° ENE Tsimelahy, 36.1 km 308° NW Tolagnaro, -24.93, 46.6455, 300 m, tropical dry forest (Fisher-Griswold Arthropod Team) (CASC); Forêt de Kirindy, 15.5 km 64° ENE Marofandilia, -20.045, 44.66222, 100 m, tropical dry forest (Fisher-Griswold Arthropod Team) (CASC); Anosy Region, Distric of Amboasary, 58Km SW of Fort Dauphin, 08 Km NW of Amboasary, Berenty Special Reserve, -25.00667, 46.30333, 85 m, Galery forest (Rin'ha, Mike) (CASC); Tsihombe, -25.31833, 45.48367, 30 m, urban/garden (B.L.Fisher et al.) (CASC); Forêt Vohidava 89.6 km N Amboasary, -24.23333, 46.30167, 230 m, spiny forest/thicket (B.L.Fisher et al.) (CASC); Forêt de Kirindy, 15.5 km 64° ENE Marofandilia, -20.06855, 44.65956667, 30 m, tropical dry forest (B.L.Fisher) (CASC); Anosy Region, Distric of Fort-Dauphin, Andoha National Park Parcelle II, Tsimela, 42Km W of Fort-Dauphin, -24.93683, 46.62667, 177 m, transition forest (Michael Irwin, Frank Parker, Rin'ha) (CASC); Forêt de Kirindy, 15.5 km 64° ENE Marofandilia, -20.06915, 44.66041667, 30 m, tropical dry forest (B.L.Fisher) (CASC); Atsimo Andrefana Region, Distric of Betioky ; Beza Mahafaly Special reserve Parcelle Belle vue 07 Km W of Research Station, -23.68983, 44.5755, 177 m, spiny forest (Rin'ha) (CASC); Réserve Berenty, -25.01667, 46.3, 25 m, tropical dry forest (P.S.Ward) (PSWC); Res. Beza-Mahafaly, Parcel 1, -23.65, 44.63333, 130 m, tropical dry forest (P.S.Ward) (PSWC); Makay Mts., -21.31334, 45.14525, 575 m, Burned savannah (B.L.Fisher et al.) (CASC). Makay Mts., -21.29961, 45.12919, 570 m, Dry forest edge and burned savannah (B.L.Fisher et al.) (CASC); Makay Mts., -21.22344, 45.3135, 550 m, Gallery forest with bamboo (B.L.Fisher et al.)

(CASC); Forêt de Mahavelo, Isantoria River, -24.75833, 46.15717, 110 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); 7.0 km 156° SSE Lavanono, -25.47111, 44.9885, 50 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); 4.4 km 148° SSE Lavanono, -25.45056, 44.97417, 60 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); 12.7 km 287° W Marovato, -25.53611, 45.15017, 130 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); 3.5 km 236° SW Marovato, -25.55389, 45.25583, 230 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); Réserve Spéciale de Cap Sainte Marie, 12.3 km 262° W Marovato, -25.58167, 45.16833, 200 m, spiny forest/thicket (Fisher-Griswold Arthropod Team) (CASC); Forêt de Mite, 20.7 km 29° WNW Tongobory, -23.52417, 44.12133, 75 m, gallery forest (Fisher-Griswold Arthropod Team) (CASC); Tsimelasy - Parcel II, Andohahela National Park, transition forest, Tulear Province, -24.93683, 46.62667, 180 m, transition forest (M.E. Irwin, F.D. Parker, R. Harin'Hala) (CASC); Andohaia N. P., Tsimelasy, -24.93683, 46.62667, 180 m, transition forest (M.E. Irwin, F.D. Parker, R. Harin'Hala) (CASC); Ihazofotsy - Parcel III, Andohahela National Park, transition forest, Tulear Province, -24.83483, 46.48683, 80 m, transition between spiny and dry deciduous forests (M.E. Irwin, F.D. Parker, R. Harin'Hala) (CASC); Parcel I, Beza Mahafaly Reserve, near research station, Tulear Province, -23.6865, 44.591, 165 m, dry deciduous forest (R. Harin'Hala) (CASC); Parcel II, Beza Mahafaly Reserve, near Bellevue, Tulear Province, -23.68983, 44.5755, 180 m, spiny forest (R. Harin'Hala) (CASC).

***Camponotus jodina* sp. n.**

<http://zoobank.org/FFE73B10-0111-40F5-831B-AC72F3D89E0E>

Figures 8B, 12, 18

Type material investigated. Holotype worker: MADAGASCAR, Province Toamasina, Parc National de Zahamena, Onibe River, -17.75908 48.85468, 780 m, 22.ii.2009, rainforest, on low vegetation. (B.L. Fisher et al.). Collection code: BLF22344. Unique specimen identifier: CASENT0152090 (CASC).

Paratype worker: MADAGASCAR, Prov. Toamasina, Parc National de Zahamena, Sahavorondrano River, -17.75257, 48.85725, 765 m, 23.ii.2009, rainforest, beating low vegetation. (B.L. Fisher et al.). Collection code: BLF22401. Unique specimen identifier: CASENT0153052 (CASC).

Diagnosis. *Camponotus jodina* is easily distinguishable from the other species of *Myrmopytia* on the basis of the following character combination: petiole surmounted by a conical node terminated with a blunt spine, PEW/CS 0.152 [0.149, 0.156], propodeum coarsely reticulate with a short vertical anterior face.

Description of minor worker. Head longer than wide, rear portion of head extended into a long neck, sides of head narrowed in front of eyes. CS 1.84 mm [1.80, 1.88] (n=2). Posterior margin of head glabrous, suberect genal setae present on sides of head in full-face view. Eyes located anterior to the midlength of head capsule in full-face view,

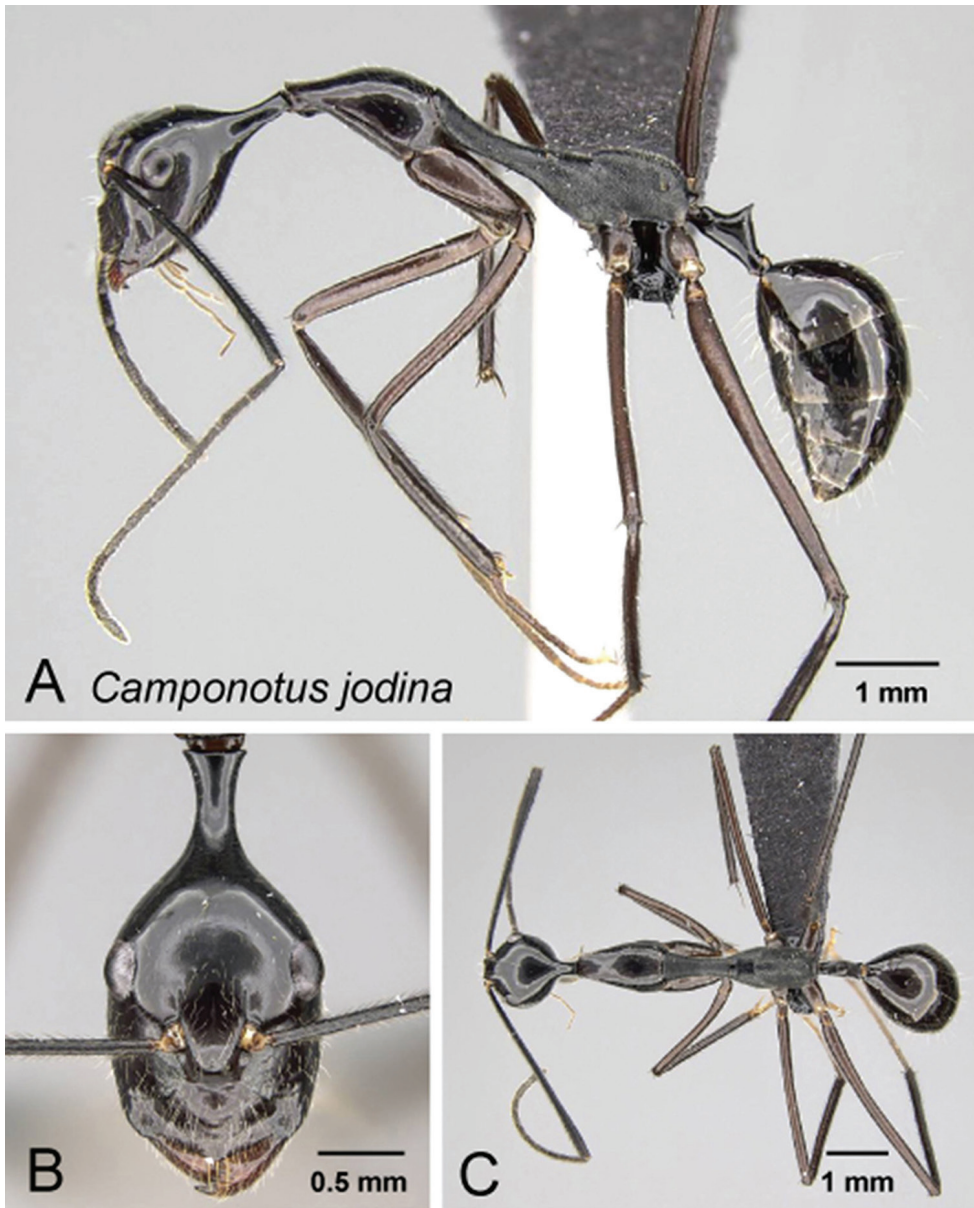


Figure 12. *Camponotus jodina* minor worker CASENT0152090. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

PoOC/CL 0.417 [0.407, 0.426]. Frontal carina convex, FR/CS 0.228 [0.222, 0.234]. Scape distinctly surpassing posterior margin by almost half of its length, SL/CS 1.870 [1.851, 1.889]. Anterior margin of clypeus produced into an obtuse angle, lateral border straight. In profile, posteromedian portion of clypeus with an obtuse angle. ClyL/CL 0.225 [0.213, 0.237]. Mandible with 6 teeth, palps long with respect to head size.

Pronotum evenly curved over its length. Mesonotum straight and elongate, MPD/CS 1.424 [1.422, 1.426]. Erect setae absent, appressed pubescence generally sparse. Mesothoracic spiracles prominent; propodeal dorsum evenly convex, its outline meeting the metanotal groove with transverse carina. ML/CS 2.294 [2.255, 2.333].

Petiole nodiform. Dorsum of petiole strongly concave, tapering apically to a blunt spine, PEW/CS 0.152 [0.149, 0.156].

Entire body including antennae dark brown. Coxae, femora, and tibiae brown. Head, pronotum, fore-coxae and petiole microreticulate, mesonotum and propodeum reticulate-costate.

Major worker. Unknown.

Queen. Unknown.

Male. Unknown.

Distribution and biology. *C. jodina* is known from only two specimens collected in Parc National de Zahamena, in rainforest, at two different localities: Onibe River and Sahavorondrano River (Fig. 18A). Workers were found foraging on lower vegetation. *C. jodina* occurs sympatric with *C. karaha* at the Sahavorondrano River.

Etymology. This species is named for the shape of its petiole in profile; the Malagasy word “jodina” means directed upward.

***Camponotus karaha* sp. n.**

<http://zoobank.org/35B73CB2-30F5-4EAF-8321-F93DFADD95EB>

Figures 4B, 5B, 6B, 7B, 8A, 13, 14, 15, 18

Type material investigated. Holotype worker: MADAGASCAR, Province Antsiranana, Parc National de Marojejy, Manantenina River, 27.6 km 35° NE Andapa, 9.6 km 327° NNW Manantenina, -14.435 49.76, 16.xi.2003, 775 m, rainforest, ex rotten log. (B.L. Fisher et al.). Collection code: BLF08983 Unique specimen identifier: CASENT0487715 (CASC).

Paratype workers: Six workers with the same data as holotype, Collection code: BLF08983, Unique specimen identifiers: CASENT0487711 (2w), CASENT0487712 (2w), CASENT0487713 (2w), (CASC).

Diagnosis. Workers of *Camponotus karaha* can be differentiated from the other three species by the triangular form of the petiole in lateral view, and the protruding clypeus.

Description of minor worker. Head longer than wide, anterior region of head elongated, caudate, sides of the head narrowed in front of eyes, CS 1.723 mm [1.35, 1.92] (n=47). Erect filiform setae on lateral margin of head and on gena. Eyes located anterior to the midlength of sides of head in full-face view, PoOC/CL 0.431 [0.404, 0.473]. Frontal carinae convex, FR/CS 0.238 [0.213, 0.267]. Scape distinctly surpassing posterior margin by almost half of its length, SL/CS 1.832 [1.651, 2.051]. Anterior margin of clypeus produced into an obtuse angle; in lateral view, clypeus protruding strongly, anterior portion may appear indented (Fig. 7B), masticatory margin with 6 teeth, palps long with respect to head size.



Figure 13. *Camponotus karaha* minor worker CASENT0067555. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

Pronotum weakly undulant. Mesonotum straight and elongate, distinctly compressed laterally anterior to mesothoracic spiracles, MPD/CS 1.401 [1.196, 1.595]. Erect setae absent, appressed pubescence sparsely distributed. Mesothoracic spiracles prominent; propodeal dorsum protuberant, noticeably convex. ML/CS 2.203 [1.989, 2.405].

Petiole conical, petiolar apex with an obtuse angle, posterior face of petiole flat to slightly convex, sides always distinct. PEW/CS 0.198 [0.169, 0.244].

Entire body generally black, pronotum may vary to brown, coxae a lighter color than mesosoma, basitarsus and up to 5 basal funiculi whitish. Mesonotum and pro-

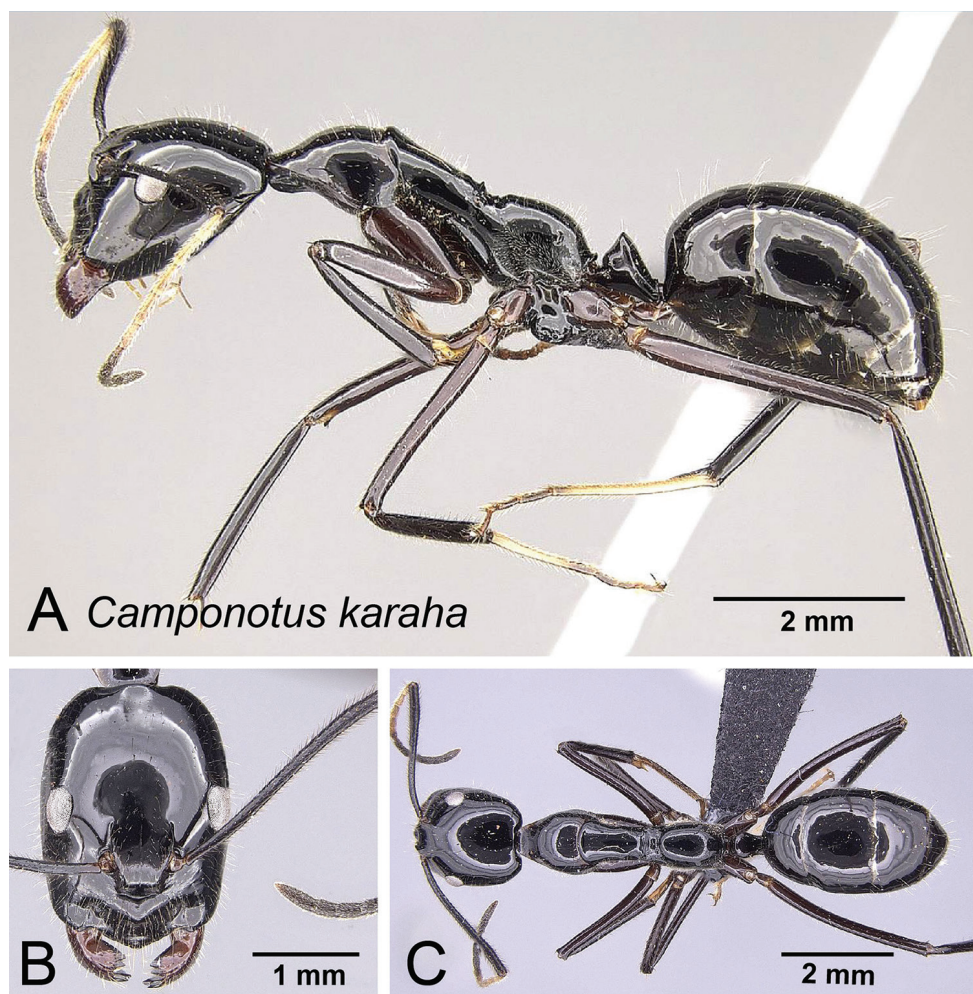


Figure 14. *Camponotus karaha* major worker CASENT0151921. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

podeum smooth and glabrous to microsculptured with sparse appressed to subdecumbent setae.

Description of major worker. Head subrectangular in full face view, occipital portion broad, sides of the head mostly parallel and weakly convex, CS 2.108 mm [1.92, 2.28] (n=9). Erect filiform setae present on entire head capsule. Eyes located at midlength of head capsule in full-face view. PrOc/CL 0.434 [0.417, 0.455]. Frontal carinae straight posterior to antennal insertion and curving smoothly toward the posterior margin of clypeus. FR/CS 0.270 [0.255, 0.292]. Scape surpassing posterior margin by one fourth of its length. SL/CS 0.971 [0.711, 1.331]. Anterior margin of clypeus projecting to an obtuse angle and, in lateral view, posterior portion of clypeus weakly produced dorsally (Fig. 7B) masticatory margin of mandible with 6 teeth, palps long with respect to head size.

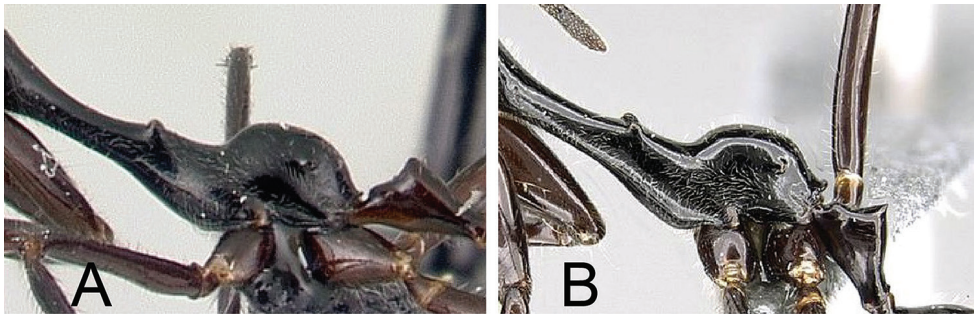


Figure 15. **A** Variant 1, a typical *C. karaha*. CASENT0067555 **B** Variant 2 from the north. CASENT0353274.

Pronotum weakly undulant. Anterior region of mesonotum (immediately posterior to the pro-mesonotal suture) in profile rising above pronotum. Dorsal outline of mesonotum and propodeum form a continuous straight line interrupted by a shallow metanotal groove. Erect setae present, appressed pubescence sparsely distributed. Mesothoracic spiracle feebly produced laterally. ML/CS 1.872 [1.800, 2.009].

In profile, petiole conical, node summit acute. PEW/CS 0.222 [0.211, 0.250].

Entire body black; femora and tibia dark brown, basitarsus of second and third legs light brown, funicular segments light brown, becoming dark apically. Pronotum and mesonotum microreticulate, sides of propodeum finely punctate, standing filiform setae present in all surfaces.

Distribution and biology. *Camponotus karaha* is currently known from 14 localities along the eastern rainforest and montane rainforest of Madagascar at elevations ranging from 175 to 1325 m (Fig. 18B). Specimens have been collected on the ground in rotten logs and on low vegetation.

Etymology. The Malagasy word “karaha” means similar, look-alike.

Notes on morphological variability. Workers of *C. karaha* exhibit morphological variability in qualitative traits such as sculpture, color of mesosoma, and profile of propodeum that differ between populations. This divergence is not, or barely, supported by multivariate analyses involving 19 quantitative traits. For this reason, we conclude that all populations examined represent a single species and ascribe the variation to intraspecific variability of populations occupying diverse sites, making geographic (e.g. elevation) or ecological factors as possible explanations for the variance. Populations from the north of its distribution range differ notably in shape of propodeal dorsum and petiolar node and further research on additional samples are needed to further evaluate species status of these populations. For now, we note the differences of the northern populations from the more typical *karaha*.

Variant 1. This variant is the typical *C. karaha*, and is fairly widespread throughout the eastern rainforest of Madagascar. It can be recognized by having a propodeum dorsum smoothly convex in lateral view, declivitous face of petiole distinctly flat with defined lateral margins, petiolar apex forms a right angle (Fig. 16A).

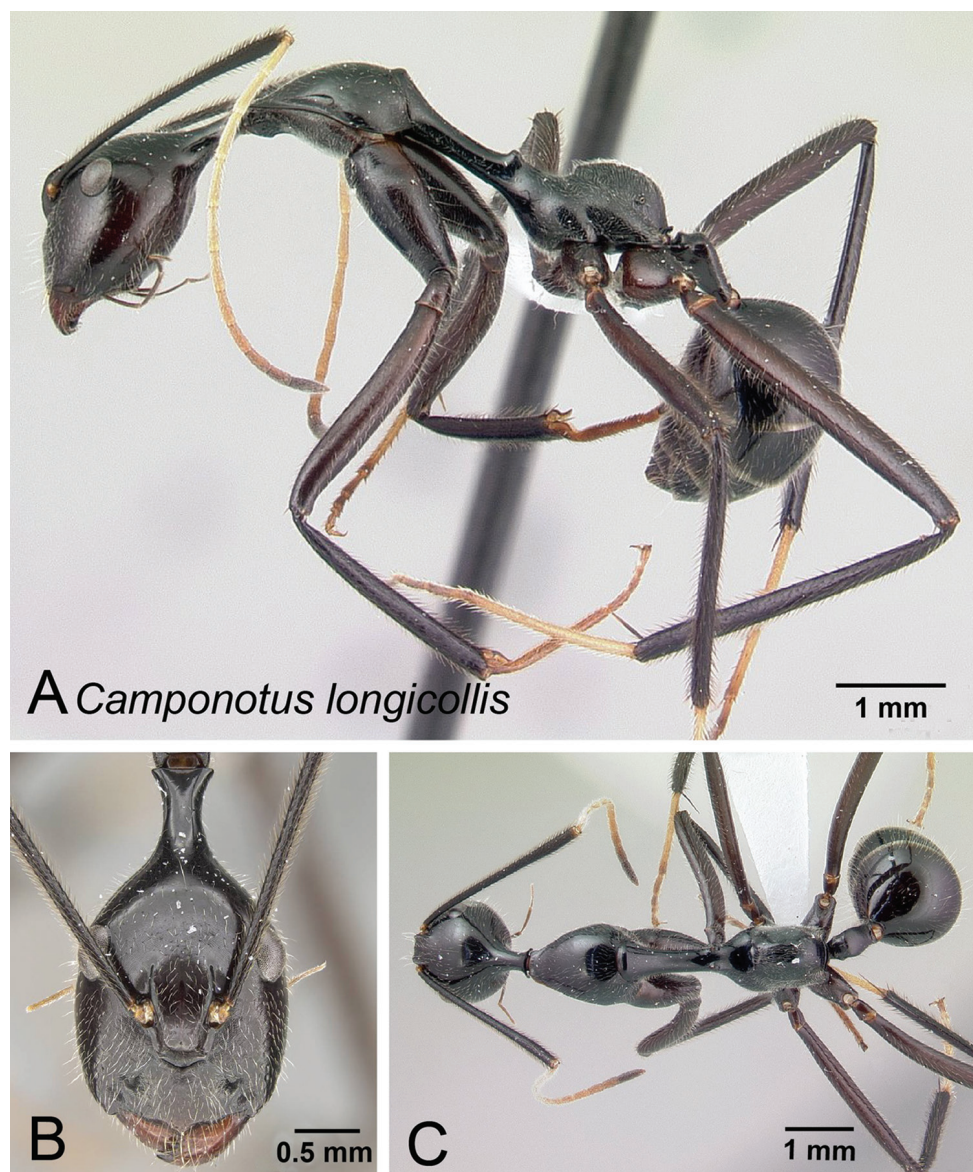


Figure 16. *Camponotus longicollis* minor worker CASENT0191989. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

Variant 2. Workers are known from montane rainforest of Montagne d'Anjanaharibe and Parc National Masoala, Ambanizana, elevation 800–1100 m. It can be differentiated from the other morph by the propodeal dorsum almost flat in lateral view, declivitous face of petiole convex and not marginate laterally, petiolar apex acuminate (Fig. 16B).

Additional material examined. Province **Antsiranana**: 6.5 km SSW Befingotra, Rés. Anjanaharibe-Sud, -14.75, 49.5, 875 m (B.L.Fisher) (CASC); 9.2 km WSW Befingotra, Rés. Anjanaharibe-Sud, -14.75, 49.46667, 1180 m (B.L.Fisher) (CASC); Betaolana Forest, along Bekona River, -14.52996, 49.44039, 880 m (B.L.Fisher et al.) (CASC); Betaolana forest, Ambodihazovolabe village along Ambolokopatrika river, -14.54484, 49.45163, 740 m (B.L.Fisher et al.) (CASC); Binara Forest, -13.26392, 49.59919, 1065 m (B.L.Fisher et al.) (CASC); Binara Forest, -13.26388, 49.60141, 900 m (B.L.Fisher et al.) (CASC); Galoko chain, Mont Kalabenono, -13.63999, 48.67374, 498 m (B.L.Fisher et al.) (CASC); Galoko chain, Mont Kalabenono, -13.64179, 48.67282, 643 m (B.L.Fisher et al.) (CASC); Galoko chain, Mont Kalabenono, -13.64609, 48.67732, 937 m (B.L.Fisher et al.) (CASC); Makirovana forest, -14.17066, 49.95409, 415 m (B.L.Fisher et al.) (CASC); Makirovana forest, -14.16044, 49.95216, 550 m (B.L.Fisher et al.) (CASC); Makirovana forest, -14.16666, 49.95, 715 m (B.L.Fisher et al.) (CASC); Makirovana forest, -14.16506, 49.9477, 900 m (B.L.Fisher et al.) (CASC); Parc National de Marojejy, Antranohofa, 26.6 km 31° NNE Andapa, 10.7 km 318° NW Manantenina, -14.44333, 49.74333, 1325 m (B.L.Fisher) (CASC); Parc National de Marojejy, Manantenina River, 27.6 km 35° NE Andapa, 9.6 km 327° NNW Manantenina, -14.435, 49.76, 775 m (B.L.Fisher et al.) (CASC); Parc National de Marojejy, Manantenina River, 28.0 km 38° NE Andapa, 8.2 km 333° NNW Manantenina, -14.43667, 49.775, 450 m (B.L.Fisher et al.) (CASC); RNI Marojejy, 10km NW Manantenina, -14.43333, 49.76667, 750 m (E.L. Quinter) (CASC). Province **Fianarantsoa**: 7.6 km 122° Kianjavato, Forêt Classée Vavovavy, -21.4, 47.94, 175 m (B.L.Fisher et al.) (CASC) ; Forêt d'Ambalagoavy Nord, Ikongo, Ambatombe, -21.8275, 47.33889, 625 m (R. Harin'Hala & M.E. Irwin) (CASC); Forêt de Vevembe, 66.6 km 293° Farafangana, -22.791, 47.18183, 600 m (B.L. Fisher et al.) (CASC). Province **Toamasina**: 6.9 km NE Ambanizana, Ambohitsitondroina, -13.56667, 50, 1080 m (B.L.Fisher) (CASC); Ambanizana, Parc National Masoala, -15.57167, 50.00611, 800–897 m (D. Andriamalala, D. Silva, et al.) (CASC); Ankerana, -18.4017, 48.80605, 1035 m (B.L.Fisher et al.) (CASC); Ankerana, -18.4061, 48.82029, 725 m (B.L.Fisher et al.) (CASC); Ankerana, -18.40062, 48.81311, 865 m (B.L.Fisher et al.) (CASC); Montagne d'Anjanaharibe, 18.0 km 21° NNE Ambinanitelo, -15.18833, 49.615, 470 m (Fisher, Griswold et al.) (CASC); Montagne d'Anjanaharibe, 19.5 km 27° NNE Ambinanitelo, -15.17833, 49.635, 1100 m (Fisher, Griswold et al.) (CASC); Parc National de Zahamena, Besaky River, -17.75244, 48.85321, 760 m (B.L.Fisher et al.) (CASC); Parc National de Zahamena, Sahavorondrano River, -17.75257, 48.85725, 765 m (B.L.Fisher et al.) (CASC); Parc National Mananara-Nord, 7.1 km 261° Antanambe, -16.455, 49.7875, 225 m (B.L.Fisher et al.) (CASC); Réserve Nationale Intégrale Betampona, Betampona 35.1 km NW Toamasina, -17.91801, 49.20074, 500 m (B.L.Fisher et al.) (CASC); Réserve Naturelle Betampona, 34.1 km 332° Toamasina, -17.916135, 49.20185, 550 m (B.L.Fisher) (CASC).

***Camponotus longicollis* sp. n.**

<http://zoobank.org/61EB2C24-CB44-4B54-B98F-AEE4CCE18ABC>

Figures 6A, 7A, 16, 17, 18

Type material investigated. Holotype worker: MADAGASCAR, Province Antsiranana, Galoko chain, Mont Kalabenono, -13.63999, 48.67374, 498 m, 15.xi.2013, rainforest, ex rotten log. (B.L. Fisher et al.). Collection code: BLF32079. Unique specimen identifier: CASENT0370614 (CASC).

Paratype workers: Two workers with the same data as holotype but collection code: BLF32133, Unique specimen identifier: CASENT0370620; CASENT0370621 (CASC).

Diagnosis. The following character combination distinguishes *Camponotus longicollis* from *Camponotus karaha* and *Camponotus jodina*: petiole relatively low and nodiform. NOH/CS 0.126 [0.091, 0.181]. Dorsal margin of clypeus weakly convex in lateral view.

Description of minor worker. Head longer than wide, posterior region of head extended into an elongate neck, sides of the head narrowed anteriorly, absolute cephalic size: 2.035 mm [1.74, 2.26] ($n = 22$). Erect, short, filiform setae present on head. Eyes located posterior to the midlength of head capsule in full-face view, postocular distance vs. cephalic length. PoOC/CL 0.428 [0.364, 0.475]. Frontal carina convex. FR/CS 0.216 [0.191, 0.229]. Scape distinctly surpassing posterior margin by almost half of its length. SL/CS 1.608 [1.434, 1.681]. Prominence on anteromedial clypeal margin projecting as a triangular spur, and dorsal outline of clypeus smoothly convex in profile; masticatory margin with 6 teeth, palps long with respect to head size.

Pronotum weakly undulant. Anterior region of mesonotum (immediately posterior of the promesonotal suture) in profile rising above pronotum. Mesonotum straight and elongate, distinctly compressed laterally anterior to mesothoracic spiracles. MPD/CS 1.473 [1.345, 1.580]. Suberect filiform setae present except on propodeum, which is covered with dense pubescence. Mesothoracic spiracles prominent; propodeal dorsum convex, mesonotum, and dorsum of propodeum meet at a right angle. ML/CS 2.202 [2.106, 2.280].

Petiole low and nodiform. Posterior face of petiole meets its dorsum at a rounded angle. PEW/CS 0.201 [0.170, 0.230].

Entire body dark brown to black; femora and tibiae dark brown, basitarsus of second and third legs light brown, funicular segments light brown becoming dark brown apically. Head and pronotum microreticulate, mesonotum smooth and shiny, propodeum and fore-coxae moderately reticulate-punctate.

Description of major worker. Head suboval, posterolateral sides of head tapering to rear, absolute cephalic size: 2.427 mm [2.418, 2.444] ($n=3$). Erect, short, filiform setae present on head. Eyes located close to the cephalic midlength. PoOC/CL 0.399 [0.392, 0.409]. Frontal carina convex. FR/CS 0.247 [0.240, 0.256]. Scape surpassing posterior margin by more than one third of its length. SL/CS 1.318 [1.264, 1.345]. Anterior margin of clypeus projecting to an obtuse angle, dorsal outline of clypeus smoothly convex in profile; masticatory margin with 6 teeth, palps long with respect to head size.

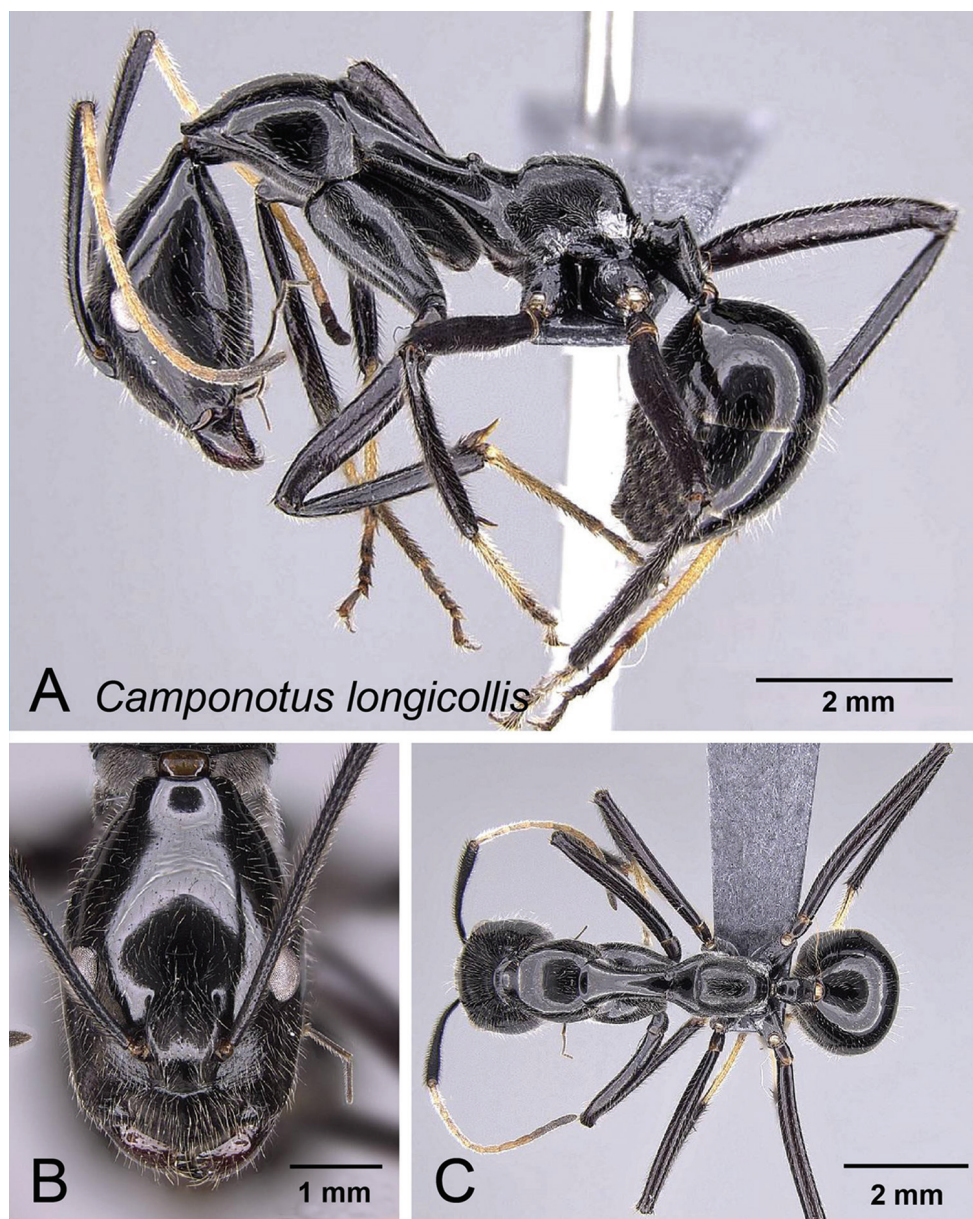


Figure 17. *Camponotus longicollis* major worker CASENT0763008. **A** Lateral view **B** Head in full-face view **C** Dorsal view.

Similar appearance as minor worker. Anterior region of mesonotum (immediately posterior to the pro-mesonotal suture) in profile rising above pronotum. Mesonotum straight and elongate, distinctly compressed laterally anterior to mesothoracic spiracles. Suberect filiform setae present, propodeum covered with dense pubescence, pubescence generally sparse elsewhere. Mesothoracic spiracles feebly produced laterally;

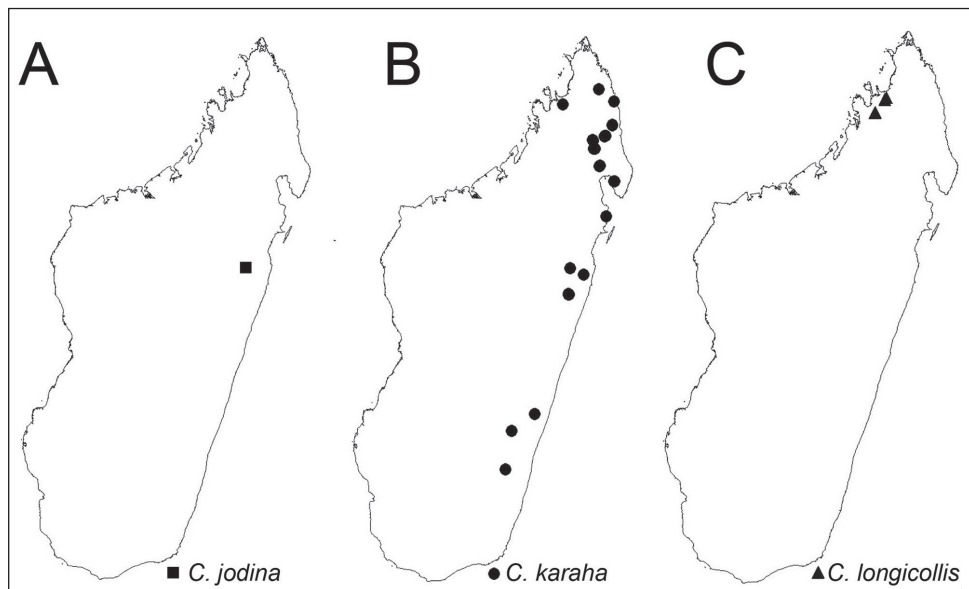


Figure 18. Distribution maps of the three new species. **A** *Camponotus jodina* **B** *Camponotus karaha* **C** *Camponotus longicollis*.

propodeal dorsum convex, mesonotum and propodeum dorsum meet at a right angle. ML/CS 1.922 [1.853, 1.997].

Petiole low and nodiform. Posterior face of petiole meeting its dorsum at rounded to acute angle. PEW/CS 0.206 [0.190, 0.215].

Overall color black; basal funicular segments yellowish brown and becoming dark apically; basitarsus of second and third legs light brown. Color of filiform setae whitish. Head and pronotum finely reticulate, mesonotum smooth and shiny, clypeus, gena, propodeum and fore-coxae moderately reticulate punctate.

Queen. Unknown.

Male. Unknown.

Distribution and biology. *C. longicollis* has only been collected at two localities in the northwest Sambirano region of Madagascar, Réserve Spéciale de Manongarivo and Mont Kalabenono and Mont Galoko on the Galoko mountain chain (Fig. 18C). It has been collected via litter sifting and hand collecting on a rotten log.

Etymology. This species name is based on the Latin terms for long, “longi”, and collis, “neck”.

Additional material examined. Province **Antsiranana:** Galoko chain, Mont Galoko, -13.58487, 48.71818, 520 m (B.L. Fisher et al.) (CASC); Galoko chain, Mont Kalabenono, -13.63999, 48.67374, 498 m (B.L. Fisher et al.) (CASC); R.S. Manongarivo, 10.8 km 229° SW Antanambao, -13.96167, 48.43333, 400 m (B.L. Fisher et al.) (CASC); R.S. Manongarivo, 12.8 km 228° SW Antanambao, -13.97667, 48.42333, 780 m (B.L. Fisher et al.) (CASC).

Acknowledgments

We are especially grateful to our friends and colleagues at the Madagascar Biodiversity Center, who have contributed to this study by collecting large numbers of samples in the field and processing them in the lab. Thanks to the Madagascar Ministry of Environment, Ecology and Forests for permit issuance. We are also thankful to Michele Esposito for help with database management and imaging. Michele Esposito and Bob Zuparko provided helpful comments on earlier drafts. We are grateful to Rodrigo Feitosa and Lech Borowiec who provided suggestions to improve this manuscript. This research was supported in part by the Norvig Family Foundation and Lakeside Foundation.

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Supplementary material I

Ratios of morphometric data for all specimens

Authors: Nicole Rasoamanana, Sándor Csósz, Brian L. Fisher

Data type: species morphometric data

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