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1 **Unexpected diversity in the relictual European spiders of the genus *Pimoa***
2 **(Araneae, Pimoidae)**

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20
21 **Abstract**

22
23 Pimoidae is a small family of araneoid spiders, hitherto represented in Europe by two
24 species with disjunct distribution in the Alps and in the Cantabrian Mountains of northern
25 Spain. Here we report the description of two additional European species of *Pimoa*,
26 discovered within the range of the only former alpine species *P. rupicola*: *P. graphitica* sp.
27 nov. and *P. delphinica* sp. nov. The new species are distinguished from the latter by
28 genitalic characters as well as by molecular characters. Based on the re-examination of
29 old and recent abundant material collected in caves and other subterranean habitats, we
30 revise the distribution patterns of the genus *Pimoa* in the Alps and outline the species
31 distribution ranges. Molecular data suggest the existence of gene flow between
32 populations of the two new species when in sympatry. The different species probably
33 originated in the alpine region as a result of range contractions following dramatic climatic
34 changes in the Alps since the mid Miocene. We interpreted the present-day overlapping
35 distribution in light of a possible postglacial expansion. Finally, we provide insights on the
36 natural history and life cycles of the new species and discuss their phylogenetic
37 relationships within Pimoidae.

38
39 **Running title:** Two new European species of *Pimoa*

41 **Introduction**

42

43 The combination of topographical, geological and glacial factors contribute significantly to
44 the faunistic importance of the Western alpine districts (Schmid and Kissling 2000).

45 Moreover, the particular biogeographical frame in which the area is located, straddling the
46 border between the Mediterranean, alpine and continental zones, makes it an important
47 biodiversity hot-spot in Europe (e.g., Minelli *et al.* 2006; Nagy *et al.* 2012; Villemant *et al.*
48 2015).

49 Such peculiarities also mirror an extraordinary subterranean biodiversity, which has been
50 investigated since the 19th century (Lessona 1878; Fairmaire 1882; Gestro 1885). The
51 Western Alps contain more than 2,500 caves developed in carbonate and non-carbonate
52 substrates (AGSP 2016), plus more than 2,000 artificial hypogean habitats such as
53 bunkers and abandoned mines (Isaia *et al.* 2011a). The arachnid fauna of these caves is
54 particularly well known, thanks to the works by numerous authors (e.g., Brignoli 1971;
55 1972; 1985; Arnò and Lana, 2005; Isaia *et al.* 2007a; 2011b). Yet, as we realized while
56 conducting a phylogeographic study on alpine pimoids (Mammola *et al.* 2015a), there are
57 still surprises in store.

58 Pimoidae currently includes four genera and thirty-eight extant species of araneoid
59 spiders, distributed in Western North America, Southern Europe and Asia (World Spider
60 Catalog, 2016), although new species remain undescribed (Hormiga, unpublished data).
61 Among Pimoidae, *Pimoa* Chamberlin & Ivie, 1943 is the most species-rich genus. After the
62 first revision of the genus (Hormiga 1994), which included 22 species, five more species
63 have been recently described, including three from China (Griswold *et al.* 1999; Xu and Li
64 2007; 2009), one from India (Trotta 2009) and one from California (Hormiga and Lew
65 2014).

66 In Europe, pimoids are represented by *P. rupicola* (Simon, 1884), reported from Italy and
67 France and *P. breuili* (Fage, 1931), from Spain. More specifically, *P. rupicola* ranges from
68 the Graian to the Maritime Alps and Var, down to the Ligurian and Tusco-Emilian
69 Apennine (Brignoli 1971; 1972; 1985; Thaler 1976; Le Peru 2007; Isaia *et al.* 2011b) while
70 *P. breuili* is known from about ten localities in Cordillera Cantabrica (Hormiga 1994).

71 During extensive biospeleological surveys carried out in caves and other subterranean

72 habitats in the Western Italian Alps (Mammola *et al.* 2015a), we collected numerous
73 specimens of *Pimoa* spiders within the alpine range of the genus, from the Graian Alps
74 down to the Ligurian sea (approximately 200 km from the northernmost and the
75 southernmost localities). The morphological examination of this material, as well as the
76 study of old material stored in private collections and Museums, led to the identification of
77 two undescribed species, occurring within the former range of *P. rupicola*.
78 In this paper we describe and illustrate *P. graphitica* sp. nov. and *P. delphinica* sp. nov.,
79 we summarize their phylogenetic affinities and provide insights into their ecology,
80 distribution and natural history.

81

82 **Materials and Methods**

83

84 *Molecular analyses*

85 New sequences for the mitochondrial cytochrome *c* oxidase subunit I gene (hereinafter
86 *cox1*) and the nuclear internal transcribed spacer 2 region (hereinafter *ITS-2*) of two adult
87 individuals of *P. delphinica* sp. nov., two co-occurring juveniles of doubtful identification
88 and one *P. breuili* were obtained following the protocols described in Mammola *et al.*
89 (2015a). All *Pimoa* sequences of the *cox1* available in GenBank® were downloaded, along
90 with those of the species *Nanoa enana* Hormiga, Buckle & Scharff, 2005, which was used
91 to root the inferred trees (Dimitrov *et al.* 2012).

92 Sequences were edited and managed using Geneious R9 (<http://www.geneious.com>,
93 Kearse *et al.* 2012). The alignment of the *cox1* sequences was trivial, as they showed no
94 evidence of indel mutations or stop codons. The *ITS-2* sequences were aligned with the
95 online version of MAFFT v. 7 using the global homology algorithm (G-INS-i). Indels were
96 coded as presence/absence characters according to Simmons and Ochoterena (2000)
97 simple coding, as implemented in SeqState (Müller 2005).

98 We explored the best partitioning schemes and substitution models simultaneously using
99 PartitionFinder v.1.0.1 (Lanfear *et al.*, 2012) under a Bayesian information criterion (BIC).
100 Maximum Likelihood (ML) analysis was conducted in RAxML v.7.4.2 (Stamatakis 2006).
101 We inferred the best ML tree and bootstrap support automatically determining a sufficient
102 number of bootstrap replicates, using the MRE convergence criteria. Bayesian (BI)
103 analysis was conducted in MrBayes v.3.2 (Ronquist *et al.* 2012) with two independent runs

104 of 20 million generations with four Markov chains (one cold, three heated), sampling every
105 1,000 generations. The chain convergence (ASDSF), the correct mixing (EES) and the
106 number of generation to discard as burn-in were monitored with Tracer v.1.6 (Rambaut *et*
107 *al.* 2014). The first 25% of trees in each run were discarded as burn-in. Parsimony analysis
108 was conducted with TNT v.1.1 using 1,000 iterations of Wagner trees followed by tree
109 bisection and reconnection (TBR) branch swapping and clade support assessed with
110 1,000 Jackknife resampling replicates (removal probability 36%).

111 Coalescent clusters in the *cox1* data partition were identified using the splits R package
112 (Ezard *et al.* 2014) and the ultrametric tree obtained with BEAST 1.8.2 (Drummond *et al.*
113 2012) under a constant coalescent tree prior following Monaghan *et al.* (2009) and
114 lognormal relaxed clock arbitrarily fixed to 1. Once coalescent clusters were identified,
115 single representatives of each coalescent group were used to estimate divergence times in
116 the *cox1* gene. Due to the lack of fossil information, we relied on external substitution rates
117 for spiders available in the literature (Bidegaray-Batista and Arnedo 2011). We define a
118 speciation birth-death (BD) tree prior and a strict clock, because the distribution of the
119 standard deviation of the *ucl*d parameter included zero in the preliminary analyses. The
120 mean rate was set to 0.0125 with standard deviation 0.005 (0.005-0.02). Independent TrN
121 evolutionary models with gamma heterogeneity were specified for each codon position, as
122 suggested by PartitionFinder. Three independent chains were run remotely on CIPRES
123 cyber-infrastructure. Chain convergence and mixing were assessed with Tracer (Rambaut
124 *et al.* 2014) and the parameter and tree files were analyzed with the accompanying
125 programs LogCombiner and TreeAnnotator.

126 *ITS-2* allele networks were constructed using the statistical parsimony method (Templeton
127 *et al.* 1992), with a connection limit of 95% as implemented in TCS v.1.21 and with the
128 help of PopArt (online at: <http://popart.otago.ac.nz>).

129 Between and within species uncorrected genetic distances were calculated in MEGA v.7
130 (Kumar *et al.* 2016).

131

132 *Morphological methods*

133

134 Morphological methods are described in detail in Hormiga (2000; 2002). Taxonomic

135 descriptions follow the format of Hormiga (1994) and Hormiga and Lew (2014). Specimens
136 were examined and illustrated using a Leica M205A stereoscopic microscope equipped
137 with a Leica DFC425 camera and LAS software or with a camera lucida. Further details
138 were studied using a Leica DMRM compound microscope with a camera lucida. Single
139 images were combined with Helicon Focus (version 5.3; www.heliconsoft.com) software
140 from Helicon Soft Ltd., to increase depth of field. Left structures are depicted unless
141 otherwise stated. Most setae and macrosetae are not depicted in the final palp and
142 epigynum drawings. All morphological measurements are in millimetres. The position of
143 the metatarsal trichobothrium I (Tml) is expressed according to Denis (1949a; i.e., the
144 distance between the proximal end of the leg article and the trichobothrial base divided by
145 the total length of the leg article). Female genitalia were excised using carbon steel
146 breakable blades mounted on a cotton applicator wood stick (with the cotton end
147 removed). Whenever possible, epigynal plugs were removed after treating the dissected
148 epigynum with a KOH solution for ca. five minutes and transferring it to distilled water.
149 Epigyna and palps were transferred to methyl salicylate (Holm 1979) for examination
150 under the microscope. Label data are reported verbatim.

151 The type series is preserved in 70% ethanol and deposited at Museo Civico di Scienze
152 Naturali "E. Caffi" di Bergamo (MSNB). Additional paratypes are stored at the George
153 Washington University (Gustavo Hormiga laboratory; GH). Unless otherwise stated, all re-
154 examined material is stored in the collection of Marco Isaia (Department of Life Science
155 and Systems Biology, University of Turin). Material is listed in geographical order (north to
156 south). For hypogean localities we report the speleological cadastre code in square
157 brackets [cave number, regional code, provincial code], when available/applicable.

158 The following abbreviations are used: ALE = anterior lateral eyes; AER = anterior eye row;
159 AME = anterior median eyes; PCS = pimoid cymbial sclerite; Pdp = male pedipalp; PME =
160 posterior median eyes; PLE = posterior lateral eyes; Tml = position of metatarsus I
161 trichobothrium.

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171 **Results**

172 *Molecular data*

173

174 The new sequences obtained in the present study are available in GenBank® (KX018995-
175 KX019004).

176 Specimen and sequence information are summarized in Supplementary Materials.

177 Sequences of the *ITS-2* of the two analyzed specimen of *Pimoa delphinica* sp. nov.

178 showed evidence of two alleles of different length. The two alleles were phased by eye.

179 Only unique sequences were used for downstream analyses (i.e. single mtDNA

180 haplotypes and *ITS-2* alleles). PartitionFinder selected three by-codon partitions as the

181 best partitioning scheme, with the following models: HKY+ gamma, TrN+ invariants and

182 F81+gamma and invariants for the first, second and third partition, respectively. There

183 were 96 most parsimonious tree of 1,270 steps. All inference methods recovered similar

184 topologies with different levels of resolution (Fig. 1). The European species were

185 supported (PP>95% or BS>75) as monophyletic in the model-based analyses but not

186 among the 96 most parsimonious trees, but no support for alternative topologies was

187 recovered. All analyses supported *P. graphitica* sp. nov. and *P. delphinica* sp. nov. as

188 sister species and *P. rupicola* as their sister group.

189 Uncorrected genetic distances for *cox1* are summarized in Table I. The *cox1* p-distance

190 between *P. breulli* and the Alpine species was 14.2, 14.1 and 13.8% for *P. rupicola*, *P.*

191 *graphitica* sp. nov. and *P. delphinica* sp. nov., respectively. Genetic divergences between

192 *P. rupicola*, *P. graphitica* sp. nov. and *P. delphinica* sp. nov. were 0.113 and 0.117,

193 respectively. The distance between *P. graphitica* sp. nov. and *P. delphinica* sp. nov. was

194 instead 0.069. The within-divergence in *P. rupicola* and *P. graphitica* sp. nov. was 0.01

195 and 0.009, respectively. The average uncorrected genetic distance between *Pimoa* spider

196 *cox1* available in Genebank was 15.3%.

197 The estimated time of the split according to the *cox1* of *P. rupicola* was 6.1 Ma (95% HPD

198 = 13.2-2.5 Ma) and the split between *P. graphitica* sp. nov. and *P. delphinica* at 2.6 Ma
199 (95% HPD = 5.8-1 Ma).

200 The uncorrected genetic distances for *ITS-2* were generally low: about 0.14 between *P.*
201 *breuili* and the Alpine taxa, 0.16 between *P. rupicola* and the other alpine taxa and 0.24,
202 between *P. graphitica* sp. nov. and *P. delphinica* sp. nov. Because of the low level of
203 variability, an allele network was preferred over the use of phylogenetic inference methods
204 to represent population affinities. The application of the statistical parsimony approach with
205 a connection limit of 8 steps (95% probability of no homoplasy), resulted in three
206 independent networks corresponding to the three nominal species (Fig. 2). The networks
207 revealed a clear geographic structure in the relationships of the alleles. One of the alleles
208 of *P. delphinica* sp. nov. individuals was more closely related to those found in individuals
209 of *P. graphitica* sp. nov. co-occurring in the same caves, suggesting interspecific gene flow
210 (i.e., hybridization).

211

212 **Discussion**

213 *Phylogeography*

214 Molecular data support the existence of three separate evolutionary lineages within the
215 Alpine *Pimoa* (see Fig. 1). The level of genetic divergence in the *cox1* barcode between *P.*
216 *rupicola* and the two new species (~14%) falls within the range found in other nominal
217 *Pimoa* species (average 16%, maximum 20%, minimum 10%). On the other hand,
218 although showing clear morphological diagnostic characters (see Taxonomy), *P. graphitica*
219 sp. nov. and *P. delphinica* sp. nov. are characterized by lower genetic divergences in the
220 *cox1* (7%) than the average values for other species. It should be noted, however, that
221 some of the nominal species most likely include cryptic or overlooked lineages that may
222 actually constitutes different species. For example, genetic divergences within *P.*
223 *reinformis* and *P. curvata* show similar values to those reported for the two new species
224 here described (Wang *et al.* 2008). Nuclear data indicate that *P. graphitica* sp. nov. and *P.*
225 *delphinica* sp. nov. sharing the same caves show evidence of interspecific gene flow.
226 Although our sample size is low (n=2), in all cases we found clearly distinct mtDNA
227 lineages corresponding to each species, but mixed nuclear alleles in *P. delphinica* sp.
228 nov., which suggests an unidirectional introgression of males of *P. graphitica* sp. nov. into

229 females of *P. delphinica* sp. nov.

230 Although only based on the *cox1* information, time estimates for the divergence of the
231 species are in agreement with those reported in Mammola et al. (2015a) and indicate that
232 the origin of the extant species of alpine *Pimoa* traces back to the middle to late Miocene,
233 and was probably driven by the dramatic climatic changes undergone by the region during
234 those ages. The two new species diverged much later: time estimates are compatible with
235 an isolation of the ancestral populations during the earlier glacial cycles. The present day
236 pattern of overlapping distributions may be the result of postglacial expansion of *P*
237 *graphitica* sp. nov. into the once isolated *P. delphinica* sp. nov. localities. Accordingly, the
238 interspecific gene flow between the two species would be relatively recent, which seems to
239 be supported by the fact that two clearly different alleles with no evidence of recombination
240 are still present in the hybrid individuals.

241 More data will be required to determine the degree of overlapping in the distribution of the
242 two new species and to measure the extent and directionality of the introgression.

243

244 *Natural history*

245 *Pimoa graphitica* sp. nov., *P. delphinica* sp. nov. and *P. rupicola* mainly occur in the
246 twilight zone of natural caves or artificial subterranean habitats such as mines, bunkers,
247 blockhouses, cellars and ruined buildings. In such habitats, populations may be locally
248 very abundant. In addition, specimens were occasionally collected in alpine screes,
249 boulder fields, under big rocks and other superficial (= shallow) subterranean habitats
250 (SSH *sensu* Culver and Pipan 2009; 2014). Several specimens (especially males and
251 immatures) of both *P. graphitica* sp. nov. and *P. rupicola* were also collected in pitfall traps
252 placed in the leaf litter of broad-leaved woods at mid altitudes (600-1300 m a.s.l.).

253 The life cycle is very similar in both *P. graphitica* sp. nov. and *P. delphinica* sp. nov.: males
254 reach the adult stage at the beginning of summer (June), while females and immatures are
255 present all year. We observed deposition of cocoons in June-July. The cocoon is spherical
256 [diameter 8-11 mm (n=3)] and lacks a stalk. Like in *P. edenticulata* Hormiga, 1994, the
257 cocoon is suspended beneath the female web and covered with debris (Hormiga 1994). In
258 *P. graphitica* sp. nov. it contains 90-110 eggs (n=3). Cocoons are usually guarded by
259 females (Fig. 3). First instar spiderlings remain within the cocoon, presumably feeding on

260 the yolk (see Foelix 1996). Subsequently, sibling spiderlings emerge from the cocoon and
261 cluster together in a spherical group near the cocoon.

262 *P. graphitica* sp. nov. shows a general preference for the medium alpine montane belt,
263 from 500 up to 1,500m a.s.l. (mean: 1,082m; n=65), and inhabits cavities characterized by
264 mean annual temperature values ranging from 4 to 11 °C (mean: 8.6°C; n=65) (see also
265 Isaia *et al.* 2007a). Exceptionally, we recorded the species at 2,375 m a.s.l., in military
266 bunkers (Tour Real Blockhouse, Pontechianale, CN).

267 *P. delphinica* sp. nov. was mainly collected in wild caves and military bunkers at an altitude
268 ranging from 1,230 to 2,242 a.s.l. (mean: 1,753m; n=7), and inhabits sites characterized
269 by mean annual temperature values ranging from 2 to 8 °C (mean: 5.5°C; n=7).

270 Both species are able to maintain permanent subterranean populations but seem
271 somewhat related to the outer environment. Accordingly, they do not show particular
272 adaptations to the hypogean life (i.e. troglomorphic traits; *sensu* Christiansen 1962).
273 Following the classical biospeleological nomenclature (Sket 2008) both species can be
274 regarded as troglophiles, as already observed by Brignoli (1971; 1972; 1985) and Thaler
275 (1976) for *P. rupicola*. All alpine species of European *Pimoa* usually inhabit the outermost
276 section of caves (the so-called epigean/hypogean ecotone or twilight zone; Prous *et al.*
277 2004; 2015), where they are generally found on cave walls or among rocky blocks on the
278 ground, hanging on horizontal sheet webs (see web examples in Hormiga 1994: fig. 3, 4,
279 5, 6, 7, 8; Isaia *et al.* 2011b: fig. 2.23).

280 During recent speleological investigations, two of us (MI and SM) have recorded several
281 invertebrates as prey items of *P. graphitica* sp. nov., including flies (*Limonia* spp.),
282 millepedes (Diplopoda), geophilomorph centipedes (Chilopoda) and small-sized
283 earthworms (Oligochaeta). In few occasions we have also observed gastropoda
284 (*Oxychilus* sp.) wrapped in webs, but we have never observed active feeding.

285 *P. graphitica* sp. nov. is usually found in syntopy with similarly sized troglophile orb-
286 weaving spiders, such as *Meta menardi* (Latreille, 1804) and *Metellina merianae* (Scopoli,
287 1763) (Araneae, Tetragnathidae) and, at least in three hypogean sites, with *Meta bourneti*
288 Simon, 1922 (Arnò and Lana 2005; Isaia *et al.* 2011b; Mammola and Isaia 2014). There,
289 they often share similar micro-habitats, which may result in a hypothetical niche overlap
290 (Mammola *et al.*, submitted).

292 *Distribution*

293 The known distribution of *Pimoa graphitica* sp. nov., *P. delphinica* sp. nov. and *P. rupicola*
294 is reported in Fig. 4. *P. graphitica* sp. nov. has to be regarded as steno-endemic Western
295 Alpine species. The known distribution of *P. graphitica* sp. nov. is centered in the Graian
296 Alps, where the species is continuously distributed from Valli di Lanzo (Province of Torino),
297 all along the Cottian Alps down to the river Stura di Demonte (Province of Cuneo), marking
298 the geographical border with Maritime Alps. The only French record of *P. graphitica* sp.
299 nov. refers to rocky debris near Château Queyras (R. Bosmans leg.). The northernmost
300 known locality inhabited by the species is the Pugnetto hypogean complex, well known
301 among biospeleologists for the presence of several steno-endemic elements with point-like
302 distribution such as *Troglohyphantes bornensis* Isaia & Pantini, 2008 (Araneae,
303 Linyphiidae) and *Dellabeffaella roccae* (Capra, 1924) (Coleoptera, Cholevidae) (Isaia and
304 Pantini 2008; Isaia *et al.* 2011b; Mammola *et al.* 2015b). The cave Grotta della Chiesa di
305 Valloriate [1056 Pi/CN] and the cave Buco dell'Aria Calda [1102 Pi/CN], at the very
306 southern section of Cottian Alps, mark the southern border of the distribution of this
307 species. This area represents the observed geographical limit that separates *P. graphitica*
308 sp. nov. (Cottian Alps) from *P. rupicola* (Maritime Alps and Apennines). It is worth noting
309 that the two species have never been recorded in syntopy within the same hypogean
310 habitat. Given their peculiar geographical position, Maritime Alps are regarded by
311 biogeographers as a biodiversity hot-spot (Villemant *et al.* 2015). In our case, the climatic
312 peculiarity of the area (low continentality, namely reduced mean annual temperature range
313 and high precipitations) as well as its complex geological and glacial history seem to
314 represent the most important factors in determining the segregation of the two species
315 (Mammola *et al.* 2015a).

316 South of the southern border of the Cottian Alps down to the Ligurian Alps, we only
317 recorded *P. rupicola*. Additional records are reported in literature for France (Alpes
318 Maritimes and Var; Le Peru 2007) and from the Tuscan Apennine (Tuscany; Brignoli 1971;
319 Thaler 1976; Hormiga 1994). Our record from Central Apennines (Lazio) extends the
320 range of *P. rupicola* of nearly 300 km southward.

321 *P. delphinica* sp. nov. has to be regarded as steno-endemic Italian species with a
322 restricted Western Alpine distribution. Its distribution range appears like a small enclave

323 within the range of *P. graphitica* sp. nov. To date, the species was recorded only in seven
324 nearby localities, in the Varaita and Bellino valleys. We hypothesize that the distribution of
325 this species stretches from the Bellino valley westward to the adjacent French valleys.
326 Additional faunistic investigations are needed to confirm this hypothesis. The presence of
327 immatures of *P. graphitica* sp. nov. (identified by using genetic data) was also detected in
328 two sites inhabited by *P. delphinica* sp. nov. ([1041 Pi/CN] Buco delle Ciaue di
329 Casteldelfino and [1017 Pi/CN] Buco dei Draï). On the contrary, the co-occurrence of
330 adults of the two species was never documented.

331

332 **Taxonomy**

333 **Family Pimoidae Wunderlich**

334 **Genus *Pimoa* Chamberlin & Ivie**

335 Type species *Labulla hespera* Gertsch & Ivie, 1936 (by subsequent designation by
336 Chamberlin & Ivie 1943: 9)

337

338 ***Pimoa graphitica* Mammola, Hormiga & Isaia, sp. nov.**

339 *Louisfagea rupicola* Brignoli, 1971: 162, f. 40-43 (#@)

340 *Pimoa* sp. Jocqué & Dippenaar-Schoeman, 2006: 211, f. 82 a-f (#@)

341 *Pimoa rupicola* Isaia *et al.*, 2011b: 118, f. 2.21A-C, 2.22-23 (#@) (misidentification)

342

343 (Figs 5, 6, 7A-B, 8A-C, 10B, E)

344

345 ***Material examined***

346 *Holotype male*. Italy, Piemonte, Cottian Alps, Chisone valley, Perosa Argentina, Hamlet of Pons, Abandoned
347 graphite mine, 44° 57' 44.6" N, 7° 10' 53.9" E, hand collected, 11.vi.2015, M. Isaia, S. Mammola and J.
348 Dejanaz leg. (MSNB).

349

350 *Paratypes*. 2# and 2@: same as holotype (MSNB); 1@: Chisone valley, Inverso Pinasca, Fornaisa,
351 Abandoned graphite mine, 44° 55' 19.7" N, 7° 14' 12.3" E, hand collected, 11.vi.2015, M. Isaia, S. Mammola
352 and J. Dejanaz leg. (MSNB); 1#, 1@: Chisone valley, S. Germano Chisone, Hamlet of Tornini, Abandoned
353 graphite mine, 44° 54' 29.6" N, 7° 11' 55.2" E, hand collected, 11.vi.2015, M. Isaia, S. Mammola and J.
354 Dejanaz leg.; 1#, 1@: same locality, 20.ix.2014, M. Isaia and S. Mammola leg. (GH1857); 1@: Pramollo

355 Valley, S. Germano Chisone, Abandoned graphite mine of Bonouso-1, 44° 54' 03.1", N 7° 13' 01.3" E, hand
356 collected, 6.v.2015, S. Mammola, G. Marangoni and E. Piano leg. (MSNB); 1@: same locality, hand
357 collected, 11.vi.2015, M. Isaia, S. Mammola and J. Dejanaz leg. (MSNB).

358

359 *Etymology*

360 The species was firstly identified studying material collected in abandoned graphite mines
361 of Chisone and Pramollo Valleys (Cottian Alps, Italy). The species epithet is an adjective
362 referring both to the localities of the type series and to the metallic grey coloration of the
363 abdomen (Figs. 5F, G).

364

365 *Diagnosis*

366 Morphologically *Pimoa graphitica* sp. nov. is most similar to *P. rupicola* and *P. delphinica*
367 sp. nov. Males of *P. graphitica* sp. nov. can be easily distinguished from those of the latter
368 two species by the shape of the PCS, especially in ventral and ectal views. In *P. rupicola*
369 the PCS bears an acute, falciform apophysis (Fig. 11; see also Hormiga 1994: fig. 15, 16),
370 less pointed in *P. delphinica* sp. nov (Figs. 9, 10F) absent in *P. graphitica* sp. nov. (Figs.
371 7A-B, 10E). In addition, *P. graphitica* sp. nov. has a small cluster of (ca. six) cymbial
372 cuspules (Figs. 6A-B, 7A-B), adjacent to the PCS-cymbium connection, which is absent in
373 *P. rupicola* (Fig. 11) or restricted to one or two (or no) isolated cuspules in *P. delphinica*
374 sp. nov. (Figs. 7C-D, 9A-B). The median apophysis of *P. rupicola* (Fig. 11A-B, D) is longer
375 and thinner than that of *P. graphitica* sp. nov. (Fig. 6A-B) and *P. delphinica* sp. nov. (Fig.
376 9B-C). Females are best diagnosed by a caudal view of the epigynum, although
377 differences across these three *Pimoa* species can be subtle and the relevant features are
378 often occluded by hard epigynal plugs that are difficult to remove. In caudal view the
379 epigyna of *P. graphitica* sp. nov. (Figs. 5B, 8B, 10B), *P. rupicola* (Fig. 10C-D) and *P.*
380 *delphinica* sp. nov. (Figs. 8E, 10A) differ in the shape of both the epigynal septum that
381 connects the dorsal and ventral epigynal plates and the openings on either side. The mid
382 region of the septum is narrowest in *P. delphinica* sp. nov. and *P. graphitica* sp. nov., but
383 these two can be differentiated by the longitudinally narrower openings of the former
384 species. The mid region of the septum of *P. rupicola* is wider than in the other two species.

385

386 *Description*

387 Male (holotype). Total length 7.18. Cephalothorax 3.43 long, 2.81 wide, 2.87 high.

388 Sternum 1.81 long, 1.62 wide. Abdomen 4.84 long, 2.50 wide. AER diameter 1.06. PER
389 diameter 1.12. AME diameter 0.17. PLE 1.09, PME 1.09, ALE 1.09 times one AME
390 diameter. AME separation 0.18 times their diameter, PME separation 0.5 times their
391 diameter. PME-PLE separation 0.72 times one PME diameter, AME-ALE separation 0.58
392 times one ALE diameter. Clypeus height 2.90 times one AME diameter. Carapace with
393 deep longitudinal fovea (Fig. 5F). Chelicerae with three prolateral and two retrolateral
394 teeth; 18 cheliceral stridulating files; striae subtle, scaly. Legs uniform, light brown. Leg
395 measurements as in Table II. Femur I 2.81 times length of cephalothorax. Tml: 0.60.
396 Metatarsus IV trichobothrium present (medial). Pedipalp as in Figs. 6, 7A-B, 10E.
397 Pedipalpal tibia with five lateral trichobothria (Fig. 7A-B).

398

399 Female (paratype from Bonouso-1, San Germano Chisone). Total length 8.59.

400 Cephalothorax 3.75 long, 2.65 wide, 2.43 high. Sternum 1.75 long, 1.87 wide. Abdomen
401 5.93 long, 4.06 wide. AER diameter 1.00. PER diameter 1.06. AME diameter 0.15. PLE 1,
402 PME 1, ALE 1 times one AME diameter. AME separation 0.4 times their diameter, PME
403 separation 0.8 times their diameter. PME-PLE separation 1.2 times one PME diameter,
404 AME-ALE separation 1 times one ALE diameter. Clypeus height 2.6 times one AME
405 diameter. Carapace with deep longitudinal fovea. Cheliceral teeth, stridulating files and
406 legs like in male. Leg measurements as in Table II. Femur I 2.05 times the length of
407 cephalothorax. Tml: 0.60. Metatarsus IV trichobothrium present (medial). Epigynum as in
408 Figs. 5A-C, 8A-B, 10B. Vulva as in Figs. 5D-E, 8C.

409

410 *Additional material examined*

411 *Original data*

412 ITALY, Piemonte: Gran Bosco di Salbertrand, Salbertrand, 18.ix.2000, G. Della Beffa leg. 1# (MSNB);
413 Devejs, in screes and boulder fields, Gravera, 13.vi.2014, S. Mammola & E. Piano leg. 2# 2@; Miniera
414 Argentifera di Rouget, Gravera, 19.ii.2016, M. Isaia & S. Mammola leg. 4@; [1597 Pi/TO] Balma Fumarella,
415 Gravera, 11.v.2012, M. Isaia & S. Mammola leg. 1@; [1569 Pi/TO] Grotta della Testa di Napoleone, Borgone
416 di Susa, 05.xii.2011, M. Isaia & S. Mammola leg. 1@; [1616 Pi/TO] Grotta delle Meta Inferiore e Superiore,
417 Borgone di Susa, 04.v.2012, M. Isaia & S. Mammola leg. 1@; Barmarola, in a ruined building, Coazze,
418 20.ii.2011, M. Isaia & R. Galindo leg. 1@; Miniera di Garida, Giaveno, 20.ii.2011, M. Isaia 2@; [1620 Pi/TO]
419 Boira dal Farfujet (=Balma dei Folletti), Novalesa, 23.i.2015, M. Isaia, E. Piano & D. Giuliano leg. 2@;
420 Bonouso-1, abandoned graphite mine, S. Germano Chisone, 6.v.2015, S. Mammola, G. Marangoni & E.
421 Piano leg. 1@; same locality, 06.v-11.vi.2015, pitfall trap, 1juv; Tornini mine, Pramollo, 11.vi.2015, M. Isaia,

422 S. Mammola & J. Dejanaz leg. 2# 1@; Fortino a ovest della Balma di Rio Martino, Opera 372 Rocca di
423 Granè, Crissolo, 13.xi.2014, M. Isaia, S. Mammola & M. Paschetta leg. 7@; [1009 Pi/CN] Buco di Valenza,
424 Crissolo, 13.ix.1995, E. Lana leg. 1@; same locality, 13.xi.2014, M. Isaia, S. Mammola & M. Paschetta leg.
425 4@; [1250 Pi/CN] Grotta delle Pimoa, Oncino 18.vi.2015, M. Isaia & S. Mammola leg. 2@; Private cellar in
426 Chianale, Pontechianale, 28.vi.2012, S. Mammola leg. 1@; Tour Real blockhouse, Pontechianale,
427 29.vii.2014, S. Mammola leg. 2@; [1041 Pi/CN] Buco delle Ciaue di Casteldelfino, Casteldelfino, 16.vii.2015,
428 M. Isaia & S. Mammola leg. 1 juv (PK717; sequenced); [1017 Pi/CN] Buco del Draï (=Pertus dal Draï),
429 Sampeyre, 16.vii.2015, M. Isaia & S. Mammola leg. 1 juv (PK718; sequenced); [1195 Pi/CN] Grotta e forra
430 della Marmorera, Busca, 18.vi.15, M. Isaia & S. Mammola leg. 5@; [1122 Pi/CN] Grotta dello Scoiattolo,
431 Valgrana, 21.xi.2005, M. Isaia leg. 1@ (GH1859), same locality, 13.i.2015, M. Isaia, S. Mammola & M.
432 Paschetta leg. 3# 3@; [1102 Pi/CN] Buco dell'Aria Calda, Vignolo, 03.x.2014, M. Isaia, S. Mammola & M.
433 Paschetta leg. 2@; [n.c. Pi/CN] Barmo Scuro, Roccabruna, 14.vii.2014, M. Isaia & R. Galindo leg. 2@; [n.c.
434 Pi/CN] Balma Castlas, Roccabruna, 25.vii.2015, M. Isaia & R. Galindo leg. 1# 1@; [1056 Pi/CN] Grotta della
435 Chiesa di Valloriate, Valloriate, 13.i.2015, M. Isaia, S. Mammola & M. Paschetta leg. 2@; Miniera di Barite,
436 Pontebernardo, 28.ix.2003, E. Lana leg. 1@.

437

438 *Re-examined material*

439 Former literature records (sub *P. rupicola*) are here revised and assigned to *P. graphitica* on the base of
440 morphological examination. The identification of juveniles is based on the identification of adults occurring in
441 the same locality.

442 FRANCE, Hautes Alpes: rocky debris near Château Queyras, 09.viii.1980, Bosmans R. leg. 2# 6@ (Jocqué
443 and Dippenaar-Schoeman 2006 sub *Pimoa* sp.); ITALY, Piemonte: [1563 Pi/TO] La Bûra, Gravere,
444 26.x.2002, E. Lana leg. 1@ (Lana *et al.* 2003; Arnò and Lana 2005), same locality, 19.xii.2006, M. Isaia leg.
445 1@ (Isaia *et al.* 2011b); [1620 Pi/TO] Boira dal Farfujet (=Balma dei Folletti), Novalesa, 11.viii.2002, E. Lana
446 leg. 1@ (Isaia *et al.* 2011b); [1666 Pi/TO] Balma di Sant'Antonio, Chiomonte, 16.viii.2001, E. Lana leg. 1@;
447 18.xii.2006, E. Lana leg. 1 juv (Lana *et al.* 2002; Arnò and Lana 2005; Isaia *et al.* 2011b); Buco di Romean
448 (=Grand Pertus), Chiomonte, 21.x.2007, M. Isaia and R. Galindo leg. 1@ 1 juv (Isaia *et al.* 2011b); Miniera
449 della Colletta, Giaveno, VII.2001, E. Lana leg. 2# 2@ 3 juv (Lana *et al.* 2001; 2002; Arnò and Lana 2005);
450 15.vii.2001, E. Lana leg. 1@ (Isaia *et al.* 2011b); Ex miniera di pirite dei Gai, Giaveno, 12.iii.2000, E. Lana
451 leg. 4@ 4 juv (Arnò and Lana 2005); Cave di Marra, Villarfocchiardo, 22.iv.2008, M. Isaia and M. Motta leg.
452 2 juv (Isaia *et al.* 2011b); Ex miniera di S. Pietro Val Lemina, S. Pietro, 23.xi.2000, E. Lana leg. 1@ 1 juv
453 (Isaia *et al.* 2011b); Prospetto di miniera di Bocchetto, Perrero, 21.ii.2007, M. Isaia leg. 1@ (Isaia *et al.*
454 2011b); [1591 Pi/TO] Tana del diavolo, Roure, 11.xi.2006, M. Isaia leg. 1@ (Isaia *et al.* 2011b); [1621 Pi/TO]
455 Tuna dal Diau (=Grotta di Chiabrano), Perrero, 2010, M. Isaia leg. 1@ (Isaia *et al.* 2011a); Fortino militare
456 presso Bout du Col, Prali, 20.vii.2006, M. Isaia leg. 1@ (Isaia *et al.* 2011b); Galleria Gianfranco, Miniere di
457 talco di Fontane, Prali, 2010, M. Isaia leg. 2# (Isaia *et al.* 2011a); Galleria Gianna, Miniere di talco di
458 Fontane, Prali, 30.viii.2009, M. Isaia leg. 1@ (Isaia *et al.* 2011a); Galleria Santa Barbara, Miniere di talco di
459 Fontane, Prali, 2010, M. Isaia and M. Paschetta leg. 1@ (Isaia *et al.* 2011b); Galleria Paola, Miniere di talco

460 di Fontane, Prali, 20.vii.2006, M. Isaia leg. 1@ (Isaia *et al.* 2011b); [1623 Pi/TO] Grotticella 4, Cavour,
461 15.vi.2006, E. Lana leg. 1@ 3juv (Isaia *et al.* 2011b); [n.c. Pi/CN] Il Fringuello, Crissolo, 21. XII.2001, E.
462 Lana leg. 1@ 2juv (Arnò and Lana 2005), same locality, 16.vi.2002, T. Pascutto leg. 6@ (Isaia *et al.* 2011b);
463 [1001 Pi/CN] Grotta di Rio Martino, Crissolo, 02.iv.2000, E. Lana leg. 1juv; 08.x.2000, T. Pascutto and S.
464 Bugalla leg. 3@ 1juv; VI.2006, M. Isaia leg. 2# 2juv (Isaia *et al.* 2011b); [1250 Pi/CN] Grotta delle Pimoa,
465 Oncino, 27.viii.2000, E. Lana leg. 2# 2juv (Lana *et al.* 2001; Lana 2005; Arnò and Lana 2005); Fortino a
466 ovest della Balma di Rio Martino, Opera 372 Rocca di Granè, Crissolo, 21.xii.02, C. Arnò and E. Lana leg.
467 1# 1@ 7juv (Arnò and Lana 2005), same locality, 10.vi.2006, M. Isaia leg. 1#, 7juv (Isaia *et al.* 2011b); [1062
468 Pi/CN] Tana del Tasso, Sanfront, 01.v.2000, E. Lana leg. 3@ 5juv (Lana *et al.*, 2001; Arnò and Lana 2005);
469 [1251 Pi/CN] Pertui de l'Oustanetto, Oстана, E. Lana leg. 1#, 4juv (Lana *et al.* 2002; Lana 2005; Arnò and
470 Lana 2005); Miniera della Quagna, Monterosso Grana, 21.xi.2006, M. Isaia leg. 1@ 4juv (Isaia *et al.* 2011b);
471 [1010 Pi/CN] Grotta delle Fornaci, Rossana, 13.viii.1995, G. Cormotti and A. Baldan leg. 1# (Isaia *et al.*
472 2007b; MSNB); [1024 Pi/CN] Grotta dei Partigiani, Rossana, 05.viii.2000, E. Lana leg. 1@ (Lana 2001; Arnò
473 and Lana 2005); 03.ii.2007, M. Isaia and E. Lana leg. 5 juv (Isaia *et al.* 2011b); [1035 Pi/CN] Buco della
474 Lausiera, Acceglio, 15.viii.2000, E. Lana leg. 1@ (Isaia *et al.* 2011b); [1040 Pi/CN] Pozzo fessura di Greguri,
475 Acceglio, 08.x.2006, E. Lana leg. 1@, 1juv (Isaia *et al.* 2011b); [1200 Pi/CN] Buco 2 della Lausiera, Acceglio,
476 15.viii.2000, E. Lana leg. 1@ (Lana *et al.* 2001; Lana 2005; Arnò and Lana 2005); [1203 Pi/CN] Grotta 3 di
477 Saretto, Acceglio, 17.iii.2000, E. Lana leg. 4@ 2juv (Arnò and Lana 2005); Pertus del Chargiù (=Buco del
478 Caricatore), Acceglio, 13.x.2003, E. Lana leg. 1@ 1juv (Arnò and Lana 2005); Sotterranei dei forti N e S del
479 bivio di Elva, Opera 319-320, Stroppo, 16.iv.2000, E. Lana leg. 5@ 2juv; 26.xi.2000, E. Lana and C. Arnò
480 leg. 1@, 3juv 11.iv.2006, M. Isaia leg. 1@, 2 juv (Isaia *et al.* 2011b); [1195 Pi/CN] Grotta e forra della
481 Marmorera, Busca, 12.viii.2000, E. Lana leg. 2# 1@ (Arnò and Lana 2005); [1188 Pi/CN] Pertus del Bec,
482 Pradleves, 13.x.1999, E. Lana leg. 1@ (Arnò and Lana 2005); [1015 Pi/CN] Buco della Mena'd Mariot,
483 Bernezzo, 14.v.2000, E. Lana leg. 1@ (Arnò and Lana 2005).

484

485 *Verified citations*

486 List of the former records (sub *P. rupicola* or otherwise specified) now assigned to *Pimoa graphitica* sp. nov.
487 on the basis of examination of fresh material collected at the same locality (see original material and re-
488 examined material).

489 ITALY, Piemonte: [1597 Pi/TO] Balma Fumarella (Isaia *et al.* 2011b); Giaveno, Torino, (Thaler 1976 sub
490 *Louisfagea rupicola*; Hormiga 1994); Ex miniera di S. Pietro Val Lemina, S. Pietro Val Lemina (Arnò and
491 Lana 2005); [1591 Pi/TO] Tana del Diavolo, Roure (Lana *et al.* 2003; Arnò and Lana 2005); [1621 Pi/TO]
492 Tuna dal Diau (=Grotta di Chiabrano), Perrero (Arnò and Lana 2005); [1538 Pi/TO] Ghieisa d'la Tana,
493 Angrogna, (Isaia *et al.* 2011b); [1001 Pi/CN] Grotta di Rio Martino, Crissolo (Brignoli 1975; 1985 sub
494 *Louisfagea rupicola*; Lana *et al.* 2001; Lana 2001; Arnò and Lana 2005); [1148 Pi/CN] Buco del Maestro,
495 Paesana (Lana *et al.* 2001; Lana 2005; Arnò and Lana 2005); [1024 Pi/CN] Grotta dei Partigiani, Rossana
496 (Brignoli 1975; 1985 sub *Louisfagea rupicola*); [1248 Pi/CN] Grotta della cava Nord di Rossana (Lana *et al.*
497 2003; Lana 2005; Arnò and Lana 2005); Sotterranei dei forti N e S del bivio di Elva, Opera 319-320, Stroppo

498 (Arnò and Lana 2005); [n.c. Pi/CN] Barmo Scuro, Roccabruna (Isaia *et al.* 2011b); [1195 Pi/CN] Grotta e
499 forra della Marmorera, Busca (Morisi, 1969 sub *Labulla ripicola* (*sic!*); Morisi, 1971 sub *Louisfagea rupicola*;
500 Brignoli 1971; 1972 sub *Louisfagea rupicola*; Casale 1971 sub *Lonifagella r.* (*sic!*); Arnò and Lana 2005;
501 Lana *et al.* 2003; Lana 2005; Isaia *et al.* 2011b); [1122 Pi/CN] Grotta dello Scoiattolo, Valgrana (Isaia *et al.*
502 2011b); [1056 Pi/CN] Grotta della Chiesa di Valloriate, Valloriate (Isaia *et al.* 2011b).

503

504 *Unverified citations*

505 Former records (sub *Pimoa rupicola* or otherwise specified) that we were not able to verify, likely to be
506 assigned to *P. graphitica* sp. nov. on the basis of geography.

507 ITALY, Piemonte: [1501 Pi/TO] Grotta del Pugnetto (=Borna Maggiore del Pugnetto), Mezzenile (Isaia *et al.*
508 2011b); Ex miniera di Cudine, Corio (Isaia *et al.* 2011b); [1532 Pi/TO] Le Voute sup., Bussoleno (Isaia *et al.*
509 2011b); Sotterranei del Forte Serre Marie, Fenestrelle (Brignoli 1975; 1985 sub *Louisfagea rupicola*; Arnò
510 and Lana 2005); [1579 Pi/TO] Fessura de l'Enfer, Exilles (Isaia *et al.* 2011b); Bagnolo Piemonte, Saluzzo
511 (Thaler 1976 sub *Louisfagea rupicola*; Hormiga 1994); [1265 Pi/CN] Pertus d'la Tundo, Isasca (Isaia *et al.*
512 2011b); [1205 Pi/CN] Tana della Volpe di Dronero, Dronero (Lana *et al.* 2002; Lana 2005; Arnò and Lana
513 2005); [1242 Pi/CN] Abissotto della Fauniera, Demonte (Isaia *et al.* 2011b); Miniera di Carbone di Monfieis,
514 Demonte (Lana 2005).

515

516 *Misidentifications*

517 As far as we are concerned, the first individuals of *Pimoa graphitica* sp. nov. were
518 collected by Augusto Vigna Taglianti in the hypogean locality of Grotta e Forra della
519 Marmorera [1195 Pi/CN], municipality of Busca, Province of Cuneo [28.viii.1969, leg. 2#
520 1juv; Morisi, 1969 sub *Labulla ripicola* (*Sic!*)]. The same material was later examined by
521 Brignoli (1971). Although no locality is specified, the illustration provided (Brignoli 1971: p.
522 162, f. 40-43) likely depicts the material collected by Vigna Taglianti in 1969 given that all
523 other localities provided by Brignoli (1971) are likely assigned to *P. rupicola* on the basis of
524 geography. Further citations of Vigna Taglianti's material appear in Morisi (1971), Casale
525 (1971), Lana *et al.* (2003), Arnò and Lana (2005), Lana (2005) and Isaia *et al.* (2011b).
526 Unfortunately, we were not able to re-examine this material, but we collected several
527 specimens in the same locality and identified them as *P. graphitica* sp. nov.
528 Similarly, we re-assigned to *P. graphitica* sp. nov. part of the material examined by
529 Hormiga (1994).
530 The so far unidentified species illustrated by Jocqué and Dippenaar-Schoeman (2006: p.
531 211, f. 82 a-f sub *Pimoa* sp.) on material collected by Robert Bosmans in Queyras

532 (France), is now assigned to *Pimoa graphitica* sp. nov.

533 Finally, the male and female illustrated in Isaia *et al.* (2011b: p. 118, f 2.21 A-C; p. 119, f.
534 2.23 sub *P. rupicola*) are in fact *Pimoa graphitica* sp. nov.

535

536 ***Pimoa delphinica* Mammola, Hormiga & Isaia, sp. nov.**

537

538 (Figs. 7C-D, 8D-F, 9, 10A, F)

539

540 *Material examined*

541 *Holotype male.* Italy, Piemonte, Cottian Alps, Varaita Valley, Casteldelfino, Military bunker, 44° 35' 2.28" N,
542 7° 4' 32.8" E, hand collected, 16.vii.2015, M. Isaia and S. Mammola leg. (MSNB).

543

544 *Paratypes.* 3#, 1@: same as holotype (MSNB); 1# 1@: Varaita valley, Casteldelfino, Buco delle Ciaue di
545 Casteldelfino [1041 Pi/CN], 44° 34' 52.0" N, 7° 04' 20.9" E, hand collected, 16.vii.2015, M. Isaia and S.

546 Mammola leg. (MSNB); 1# 1@: same locality, same collection data (GH1900); 5@: Varaita valley,

547 Sampeyre, Buco del Draï (=Pertus dal Draï) [1017 Pi/CN], 44° 36' 48.2" N, 7° 13' 22.8" E, hand collected,

548 16.vii.2015, M. Isaia and S. Mammola leg. (MSNB).

549

550 *Etymology*

551 The species was first identified from specimens collected in the municipality of
552 Casteldelfino (Varaita Valley, Piedmont, Italy), an area that was formerly included in the
553 province of Dauphiné (Delfinato) of the French *ancien régime*, before to the French
554 revolution. The species epithet is an adjective referring to this historical region. Moreover,
555 the shape of the PCS falciform apophysis in frontal view recalls the shape of the dorsal fin
556 of a dolphin (PCS in Fig. 7C).

557

558 *Diagnosis*

559 *Pimoa delphinica* sp. nov. is most similar to *P. rupicola*. Males of the new species can be
560 easily distinguished from *P. rupicola* by the shape of the PCS, especially in ventral and
561 ectal views. In *P. rupicola* the PCS bears an acute, falciform apophysis (Fig. 11; see also
562 Hormiga 1994: fig. 15, 16, 36), less pointed in ectal view (Figs. 7D, 9A-B) and more
563 pronounced in ventral view (Figs. 7C, 10F) in *P. delphinica* sp. nov.; this process is absent

564 in *P. graphitica* sp. nov. (Figs. 6, 7A-B). For female diagnosis see the relevant section
565 under *P. graphitica* sp. nov.

566

567 *Description*

568 Male (holotype). Total length 7.09. Cephalothorax 2.65 long, 2.34 wide, 2.18 high.
569 Sternum 1.56 long, 1.65 wide. Abdomen 4.06 long, 1.93 wide. AER diameter 0.84. PER
570 diameter 0.96. AME diameter 0.15. PLE 1, PME 1, ALE 1 time one AME diameter. AME
571 separation 0.4 times their diameter, PME separation 0.6 times their diameter. PME-PLE
572 separation 0.8 times one PME diameter, AME-ALE separation 0.7 times one ALE
573 diameter. Clypeus height 3 times one AME diameter. Carapace with deep longitudinal
574 fovea. Chelicerae with three prolateral and two retrolateral teeth; 17 cheliceral stridulating
575 files; striae subtle, scaly. Legs uniform, light brown. Leg measurements as in Table II.
576 Femur I 2.82 times length of cephalothorax. Tml: 0.60. Metatarsus IV trichobothrium
577 present (medial). Pedipalp as in Figs. 7C-D, 9, 10F. Pedipalpal tibia with five lateral
578 trichobothria (Fig. 7C -D).

579

580 Female (paratype from Buco delle Ciuaiie di Casteldelfino [1041 Pi/CN]). Total length
581 10.62. Cephalothorax 4.21 long, 2.81 wide, 2.87 high. Sternum 2.00 long, 1.87 wide.
582 Abdomen 7.18 long, 5.00 wide. AER diameter 0.87. PER diameter 0.96. AME diameter
583 0.12. PLE 1, PME 1, ALE 1 times one AME diameter. AME separation 0.5 times their
584 diameter, PME separation 0.75 times their diameter. PME-PLE separation 1 time one PME
585 diameter, AME-ALE separation 1.25 times one ALE diameter. Clypeus height 3.75 times
586 one AME diameter. Carapace with deep longitudinal fovea. Cheliceral teeth, stridulating
587 files and legs like in male. Leg as described in Table II. Femur I 2.02 times the length of
588 cephalothorax. Tml: 0.60. Metatarsus IV trichobothrium present (medial). Epigynum as in
589 Figs. 8D-E, 10A. Vulva as in Fig. 8F.

590

591 *Additional material examined*

592 *Original data*

593 ITALY, Piemonte: Meire Rua, Becetto, Sampeyre, 10.xii.2006, G. Gardini leg. 1@ (GH0743; GHandDD DNA
594 sequence voucher); same locality, 1.ix.2007, G. Gardini leg. 2# 1@ (A. Trotta private collection); same
595 locality, 2.xi.2010, G. Gardini leg. 1@ (A. Trotta private collection); same locality, 01.i.2012, G. Gardini leg.
596 1@ (A. Trotta private collection); [1017 Pi/CN] Buco del Draï (= Pertus dal Draï), Sampeyre, 01-20.viii.2003,

597 G. Gardini leg. 1@ 3juv. (A. Trotta private collection); same locality, 03.ix.2005, G. Gardini leg. 3@ 3juv. (A.
598 Trotta private collection); same locality, 01.x.2006, G. Gardini leg. 5@ (A. Trotta private collection); same
599 locality, 16.viii. 2015, M. Isaia & S. Mammola leg. 5@ 3juv.; Sotterranei del forte sotto Rocca Senghi, Opera
600 12 Grange Cruset, Bellino, 29.vi.2012, S. Mammola leg. 1@; same locality, 03.viii.2015, S. Mammola & G.
601 Marangoni leg. 2# 2@; [n.c. Pi/TO] Unknown cave near Rocca Senghi, 29.vi.2012, S. Mammola leg. 1@,
602 same locality, 03.viii.2015, S. Mammola & G. Marangoni leg. 1# 1@; [1023 Pi/CN] Caverna sotto Rocca
603 Senghi, Bellino, 28.vii.2014, S. Mammola leg. 1@.

604

605 *Re-examined material*

606 Former records (sub *P. rupicola*) are here revised and assigned to *P. delphinica* sp. nov. on the basis of
607 morphological examination. The identification of juveniles is based on the identification of adults occurring at
608 the same locality.

609 ITALY, Piemonte: Meire Rua (1,600 m a.s.l., Becetto), Sampeyre, 20.vii-16.viii.2001, pitfall trap, G. Gardini
610 leg. 1# 4@ (Isaia *et al.* 2007b; MSNB); [1017 Pi/CN] Buco del Draï (= Pertus dal Draï), Sampeyre,
611 25.viii.2001 E. Lana leg. 1@ (Lana *et al.* 2002; Lana 2005; Arnò and Lana 2005); [1041 Pi/CN] Buco delle
612 Ciaue di Casteldelfino, 29.viii.2004, E. Lana leg. 1# 1juv. (Lana 2005; Isaia *et al.* 2011b; GH1860)

613

614 *Verified citations*

615 List of the former records (sub *P. rupicola*) now assigned to *Pimoa delphinica* sp.nov. on the basis of
616 examination of fresh material collected at the same locality (see original material).

617 ITALY, Piemonte: Sotterranei del forte sotto Rocca Senghi, Opera 12 Grange Cruset, Bellino (Arnò and Lana
618 2005; Isaia *et al.* 2011b).

619

620 *Unverified citations*

621 Former records of *Pimoa rupicola* that we were not able to corroborate, likely identified as *P. delphinica* sp.
622 nov. on the basis of geography.

623 ITALY, Piemonte: Miniera di Casteldelfino, Casteldelfino (Isaia *et al.*, 2011b); [1158 Pi/CN] Buco del Nebin 1,
624 Sampeyre (Isaia *et al.*, 2011b); [1159 Pi/CN] Buco del Nebin 2, Sampeyre (Isaia *et al.*, 2011b).

625

626 *Misidentification*

627 As far as we are concerned, the first specimens of *Pimoa delphinica* sp. nov. were
628 collected by Giulio Gardini in pitfall traps near Meire Rua, hamlet of Becetto, municipality
629 of Sampeyre (20.vii-16.viii.2001, leg. 1# 4@). This material was identified as *P. rupicola* in

630 Isaia *et al.* (2007b). Additional specimens were collected by Enrico Lana in the cave Buco
631 del Draï (=Pertus dal Draï) [1017 Pi/CN] in the nearby of the previous locality (25.viii.2001,
632 leg. 1@ 3juv; sub *P. rupicola* in Lana *et al.* 2002, Arnò and Lana 2005; Isaia *et al.* 2011b).
633 Further material was later collected by Enrico Lana in a cave near Casteldelfino (Buco
634 delle Ciaie di Casteldelfino [1041 Pi/CN]; sub *P. rupicola* in Lana 2005; Isaia *et al.* 2011b)
635 and in a military bunker near S. Anna di Bellino (sub *P. rupicola* in Arnò and Lana 2005;
636 Isaia *et al.* 2011b).

637

638 ***Pimosa rupicola* (Simon, 1884)**

639 *Labulla rupicola* Simon, 1884: 264 (#@)

640 For nomenclatural history and taxonomic references see World Spider Catalog (2016)

641 (Figs. 10C-D, 11)

642

643 *Material examined*

644 *Original data*

645 FRANCE, Alpes Maritimes: Tende, 30.vi-11.viii.2007, K. Wolf-Schwenninger leg. 1# 1@; ITALY, Piemonte:
646 [3303 Pi/CN] Grotta Beppe Bessone (= Lo Zucco), Frabosa Soprana, 22.v.2015, M. Isaia and S. Mammola
647 leg. 1@; [113 Pi/CN] Tana di Camplass, Roburent, M. Isaia and S. Mammola leg. 2@ 5 juv; Liguria: Molini di
648 Triora, 19.vii.2001, Museo Caffi BG leg. 1# (MSNB); Inferno stream, San Lorenzo al Mare, 03.vi.2006, R.
649 Fabbri leg. 1@ (MSNB); [619 Li/IM] Sgarbu du Ventu, Pieve di Teco, 27.xii.2014, M. Isaia and S. Mammola
650 8@ (GH1858); same locality, 9.xii.2015, M. Isaia and S. Mammola 6@; [104 Li/IM] Tana di Bertrand,
651 Badalucco, 27.xii.2014, M. Isaia and S. Mammola leg. 1@; Ponte dell'Isola, Tanarello valley, 15.ix.1985,
652 MSS trap, D. Vailati leg. 1@ (MSNB); Passo Cento Croci, Varese Ligure, IV-VIII.1991, pitfall trap, R. Cerbina
653 and M. Valle leg. 1@ (MSNB); Marina di Andorra, Andorra (SV), 2.vi.2006, R. Fabri leg. 1@ (MSNB);
654 Varazze (Savona), IV.1956, unknown leg. 1@ (MSNB); Emilia Romagna: Tarsogno, Tornolo, 23.vi.1992, G.
655 Buttarelli, P. Pantini and M. Valle leg. 1@ (MSNB); Grotta 1 di Cà Boschetti, Borgo Rivola, 02.vi.2012, F.
656 Papi leg. 1@ (MSNB); Mugnano, Sasso Marconi, 17.v.2014, A. Cherubini leg. 1@ (Alba Cherubini personal
657 collection); Pietrapazza (National Park Foreste Casentinesi), Santa Sofia, VI.1997, Bertozzi M. leg. 1#
658 (MSNB); Corniolo (National Park Foreste Casentinesi), Santa Sofia, 26.viii.1997, Bertozzi M. leg. 1#
659 (MSNB); La Quercia, Prignano sulla Secchia, 05-18.vii.2006, pitfall trap, R. Fabbri R. leg. 1@ (MSNB);
660 Toscana: Badia Valle, Marradi, 12.i.1998, A. Usvelli leg. 1 juv.; same locality, 30.ix.2002, A. Usvelli leg. 1@
661 (MSNB); Lazio: Pezze della Macchia, Campo Buffone, 31.vii.2009, F. La Casella leg. 2# 1@; SCI Bosco
662 Pago, Vacone (Rieti), 06.vi-2.vii.2013, pitfall traps, R. Fabbri leg. 3# 1@ (MSNB); 509 La Pozzo Cornetto,
663 Vallepietra, 01.x.2003, F. Papi leg 1@ (MSNB); SAN MARINO: Monte Cucco (380 m a.s.l.), Castle of San

664 Marino, 25.v-12.vii.2010, pitfall traps, R. Fabbri leg. 2#; same locality, 11.viii-17.xi.2019, pitfall trap, R. Fabbri
665 leg. 1@; same locality, 12.vii-11.viii.2010, pitfall trap, R. Fabbri leg. 1#1@ (MSNB); fosso di Canepa (300 m
666 a.s.l.), Mulini, Castle of San Marino, 25.v-13.vii.2010, pitfall trap, R. Fabbri leg. 3# 1@ (MSNB); same
667 locality, 13.vii-25.viii.2010, pitfall trap, R. Fabbri leg. 1# 1juv (MSNB).

668

669 *Re-examined material*

670 FRANCE, Alpes Maritimes: Forêt de Châtaignier, Tende, M. Isaia and M. Paschetta leg. (www.gbif.org);
671 Cagnes, Berland leg. 1# 3@ (GH1861) (Hormiga 1994); Menton, 22.iii.1915, 1# 8@ (Museum National
672 d'Histoire Naturelle de Paris) (Hormiga 1994); ITALY, Piemonte: Entracque, 1989, G. Buttarelli and M. Valle
673 leg. 1@ (Isaia *et al.* 2007b; MSNB); Vallone del Bousset, Entracque, 21.ix.2008, M. Isaia, M. Paschetta and
674 Vinals leg. 1# (Isaia *et al.* 2015; GH1901); pathway to Pian del Valasco, Valdieri, 23.ix.2009, M. Isaia and M.
675 Paschetta leg. 2@ (Isaia *et al.* 2015); Pian del Valasco, Valdieri, 29.vi.2009, 1@ (Isaia *et al.* 2015); Natural
676 Reserve of Rocca San Giovanni-Saben, 22.ix.2009, M. Paschetta leg. 1@ (Isaia *et al.* 2015); Palanfrè,
677 Vernante, 09.ix.2011, M. Isaia and M. Paschetta 1@ (Isaia *et al.* 2015); same locality, 11.viii.2011, M. Isaia
678 and M. Paschetta 1# (Isaia *et al.* 2015); same locality, 13.x.2011, M. Isaia and M. Paschetta 1# 1@ (Isaia *et*
679 *al.* 2015); same locality, 13.x.2011, A. Chiarle and M. Stassi leg. 1#, 2 juv (Isaia *et al.* 2014; 2015); 1153
680 Pi/CN] Grotta di Andonno, Valdieri, 26.xi.2000, E. Lana and C. Arnò leg. 1@ 1juv (Arnò and Lana 2005, Isaia
681 *et al.* 2011b); Sotterranei del forte di Tetti Cialombard, Opera 9 Andonno, Valdieri, 16.iv.2000, E. Lana leg.
682 1# (Isaia *et al.* 2011b); Pian della Casa, Alpi Marittime Natural park, 21.viii-20.ix.2008, pitfall trap, M. Isaia
683 and M. Paschetta leg. 1@ (Paschetta *et al.* 2013); [1128 Pi/CN] Pozzo di Montevocchio, Limone Piemonte,
684 19.xi.2006, E. Lana leg. 1# 1juv (Isaia *et al.* 2011b); [1166 Pi/CN] Grotta di Tetto Verna, Vernante,
685 25.vi.2006, E. Lana leg. 1# (Isaia *et al.* 2011b); Sotterranei del forte (A) di Vernante, Opera 11 Tetto Ruinas,
686 Vernante, 26.iv.2003, C. Arnò and E. Lana leg. 1@ (Isaia *et al.* 2011b); [197 Pi/CN] Abisso Artesinera,
687 Frabosa Sottana, 07.v.1995, E. Lana leg. 2@ (Arnò and Lana 2005); 28.vi.2008, M. Isaia and E. Lana leg. 3
688 juv (Isaia *et al.* 2011b); [697 Pi/CN] Grotta del Sorso, Torre Mondovì, 30.iv.2006, E. Lana leg. 1@ (Isaia *et*
689 *al.* 2011b); 18 Pi/CN] Grotta dell'Orso, Ponte di Nava, 25.x.2008, M. Isaia leg. 1@ (Isaia *et al.* 2011b);
690 Liguria: [n.c. Li/IM] Tana Rossa, Margheria dei Boschi, 07.ix.1971, J. Wunderlich leg. 1# (Hormiga 1994);
691 Lombardia: beech forest near Albergo Colletta, Santa Margherita di Staffora, 31.vii.2001-19.ix.2001, P.
692 Pantini leg. 2@ (Isaia *et al.* 2007b).

693

694 *Verified citations*

695 List of the former records of *P. rupicola* verified on the basis of our recent collection of fresh material at the
696 same localities (see original or re-examined material).

697 ITALY, Piemonte: [113 Pi/CN] Tana di Camplass, Roburent (Isaia *et al.* 2011b); [118 Pi/CN] Grotta dell'Orso
698 (=Caverna del Poggio), Ormea (Brignoli 1985 sub *Louisfagea rupicola*; Bologna and Vigna Taglianti 1985
699 sub *L. r.*; Hormiga 1994; Arnò and Lana 2005); FRANCE, Alpes Maritimes: Menton (Simon 1884 sub *Labulla*
700 *rupicola*).

701

702 *Unverified citations*

703 Former records of *Pimoides rupicola* assigned on the basis of geography.

704 ITALY, Piemonte: Ovada (Thaler 1976 sub *Louisfagea rupicola*); [1130 Pi/CN] Grotta G-4 di Costa Lausea,
705 Vernante (Lana *et al.*, 2003; Arnò and Lana 2005; Isaia *et al.* 2011b); [1131 Pi/CN] Grotta G-5 di Costa
706 Lausea (=Grotta delle Ossa), Vernante (Lana *et al.* 2003; Lana 2005; Arnò and Lana 2005, Isaia *et al.*
707 2011b); [1233 Pi/CN] Grotta G-7 della Lausea (=Grotta dei Vecchietti), Vernante (Lana *et al.* 2003; Arnò and
708 Lana 2005; Isaia *et al.* 2011b); Caverna del Comando di Limone Piemonte (Isaia *et al.* 2011b); [112 Pi/CN]
709 Tana delle Fontanelle (=Tana di S. Luigi), Roburent (Isaia *et al.* 2011b); [181 Pi/CN] Garbo della Donna
710 Selvaggia (=Caverna della Donna), Garessio (Lana *et al.* 2002; Lana 2005; Arnò and Lana 2005); 273
711 Pi/CN] Pozzo del Villaretto, Garessio (Isaia *et al.* 2011b); Ormea-Viozene (Thaler 1976 sub *Louisfagea*
712 *rupicola*); Isola Perosa, Ormea (Hormiga 1994); Liguria: San Remo (Bertaku 1890 sub *Labulla rupicola*;
713 Brignoli 1971 sub *Louisfagea r.*); Bordighera (Jackson 1929 sub *Labulla rupicola*; Brignoli 1971 sub
714 *Louisfagea r.*); Consevola river, Altare (Brignoli 1971 sub *Louisfagea rupicola*); Varazze (Brignoli 1971 sub
715 *Louisfagea rupicola*); [66 Li/SP] Grotta di Cassana, Borghetto Vara (Brignoli 1971; 1972 sub *Louisfagea*
716 *rupicola*); [n.c. Li/IM] Grotta P 39, Pian Cavallo (Brignoli 1975; 1985 sub *Louisfagea rupicola*); Conca
717 Giavetti, Massimino-Bagnasco (Thaler 1976 sub *Louisfagea rupicola*; Hormiga 1994); Murialdo (Thaler 1976
718 sub *Louisfagea rupicola*); Giusvalla (Thaler 1976 sub *Louisfagea rupicola*); [n.c. Li/IM] Tana Rossa,
719 Margheria dei Boschi (Brignoli 1985 sub *Louisfagea rupicola*; Hormiga 1994); [618 Li/IM] Tana da Valle,
720 Borgomaro (Brignoli 1985 sub *Louisfagea rupicola*); [714 Li/IM] Voragine di Ciaura (Brignoli 1975; 1985 sub
721 *Louisfagea rupicola*); [n.c. Li/SV] Tana da Bordaira, Bardiato (Brignoli 1979; 1985 sub *Louisfagea rupicola*);
722 Toscana: Montemignaio-Pratomagno (Thaler 1976 sub *Louisfagea rupicola*); Passo di Cerreto (Thaler 1976
723 sub *Louisfagea rupicola*; Hormiga 1994); Grondola-Pontremoli (Thaler 1976 sub *Louisfagea rupicola*); Turrite
724 Secca, Castelnuovo (Thaler 1976 sub *Louisfagea rupicola*); Fornovolasco (Brignoli 1971 sub *Louisfagea*
725 *rupicola*); FRANCE, Alpes Maritimes: Gorbio (Simon 1929 sub *Labulla rupicola*); Nice (Simon 1929 sub
726 *Labulla rupicola*); Monaco (Simon 1929 sub *Labulla rupicola*); Sospel (Simon 1929 sub *Labulla rupicola*); Les
727 Mèscles (Maurer and Thaler 1988 sub *Louisfagea rupicola*); Gias des Pasteurs (Maurer and Thaler 1988 sub
728 *Louisfagea rupicola*); Mount Mengiabo, Sospel (Simon 1884 sub *Labulla rupicola*); Saint Martin Lantosque
729 (Simon 1884 sub *Labulla rupicola*); Saint Martin Vésubie (Simon 1929 sub *Labulla rupicola*); Var: Var (Simon
730 1884; 1829 sub *Labulla rupicola*; Denis 1949b sub *L. r.*).

731

732

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749

750 **Supplementary Materials:** Specimens analyses in the present study with geographic and
751 sequence information; *cox1* accession #: GeneBank accession code; *cox1* haplo: *cox1*
752 haplotypes arbitrarily named with one of the sequences; GMYC: GMYC clusters; *ITS2*
753 Accession #: GeneBank accession code, *ITS2* alleles: arbitrarily named after one of the
754 sequences; Locality #: locality number as seen in Fig. 2.

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1037 **Table and Figure captions**

1038

1039 **Table I.** Pairwise p-distances of *cox1* gene between and within (bolded values on the
1040 diagonal of the matrix) nominal and unidentified species.

1041

1042 **Table II.** Leg measurements (mm) of *Pimonia graphitica* sp. nov. (male holotype and female
1043 paratype) and *Pimonia delphinica* sp. nov. (male holotype and female paratype).

1044

1045 **Figure 1.** Bayesian tree. White circles indicate independent GMYC clusters, which were
1046 collapsed. Circles on internal nodes denote support values as follow: upper left: Bayesian
1047 posterior probabilities (PP); upper right: maximum likelihood bootstraps (BS), bottom:
1048 parsimony jackknifing (JS). Filled box: PP>95% or BS>75 or JS>0.75. Grey boxes: clades
1049 recovered with support values below former thresholds. Empty sectors: clades not
1050 recovered. The tree was rooted using *Nanoa enana* Hormiga, Buckle & Scharff, 2005
1051 (Pimoidae).

1052

1053 **Figure 2.** Statistical parsimony networks for the Alpine *Pimonia ITS2* alleles (Alleles network
1054 1: *P. rupicola*; Alleles network 2: *P. delphinica* sp. nov.; Alleles network 3: *P. graphitica* sp.
1055 nov.). Allele names and locality numbers as listed in Supplementary Materials. The size of
1056 each circle is proportional to the number of sampled individuals with each allele (see scale
1057 above the legend). Unsourced and/or extinct alleles are represented by small black
1058 circles.

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1060 **Figure 3.** Female and cocoon of *Pimonia graphitica* sp. nov. (A-C) and *Pimonia delphinica* sp.
1061 nov. (D). A, graphite mine of Pons, Perosa Argentina; B, Grotta e Forra della Marmorera,
1062 Busca; C, Grotta delle *Pimonia*, Oncino; D) Pertus d'le Ciaue, Casteldelfino.

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1064 **Figure 4.** Range of distribution of *Pimonia graphitica* sp. nov., *P. delphinica* sp. nov. and *P.*
1065 *rupicola*.

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1067 **Figure 5.** A-E, *Pimonia graphitica* sp. nov., female from Italy, Province of Torino, Vallone di

1068 Pramollo, Hamlet of Tornini (GH1857). A, Epigynum, ventral. B, Epigynum, caudal. C,
1069 Epigynum, lateral. D, Epigynum (cleared), anterior. E, Epigynum (cleared), anterodorsal
1070 (arrow points to copulatory opening). F, Habitus, dorsal. G, Habitus, lateral. Scale bars: A-
1071 E, 0.2 mm; F-G, 2.0 mm.

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1073 **Figure 6.** A-D, *Pimoa graphitica* sp. nov., male from Italy, Province of Torino, Vallone di
1074 Pramollo, Hamlet of Tornini (GH1857). A, B, Palp, ectal (arrow points to median
1075 apophysis). C, Palp, mesal. D, Palp, dorsal. Scale bars: 0.5 mm. Abbreviations: C =
1076 conductor; CDP = cymbial denticulate process; E = embolus; MA = median apophysis;
1077 PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum.

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1079 **Figure 7.** A-B, *Pimoa graphitica* sp. nov., male from Italy, Province of Torino, Vallone di
1080 Pramollo, Hamlet of Tornini (GH1857); C-D, *Pimoa delphinica* sp. nov., male from Italy
1081 Province of Cuneo, Varaita valley, Casteldelfino (GH1900). A, C, Palp, ventral (arrow up
1082 points to embolus; arrow down points to pimoid embolic process; arrow right points to
1083 alveolar sclerite). B, D, Palp, ectal. D, Palp, dorsal. Scale bars: 0.5 mm. Abbreviations: C =
1084 conductor; CDP = cymbial denticulate process; E = embolus; MA = median apophysis; P =
1085 paracymbium; PCS = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum.

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1087 **Figure 8.** A-C, *Pimoa graphitica* sp. nov., female from Italy, Province of Torino, Vallone di
1088 Pramollo, Hamlet of Tornini (GH1857); D-F, *Pimoa delphinica* sp. nov., female from Italy
1089 Piemonte, Cottian Alps, Varaita valley, near Casteldelfino (GH1900). A, D, Epigynum,
1090 ventral. B, E, Epigynum, caudal. C, F, Epigynum (cleared), dorsal (arrow points to
1091 copulatory opening). Scale bars: 0.5 mm. Abbreviations: CD = copulatory duct; FD =
1092 fertilization duct; S = spermatheca.

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1094 **Figure 9.** A-D, *Pimoa delphinica* sp. nov., male from Italy, Province of Cuneo, Varaita
1095 valley, Casteldelfino (GH1860). A, B, Palp, ectal. C, Palp, mesal. D, Palp, dorsal (arrows in
1096 B and C point to median apophysis). Scale bars: 0.5 mm. Abbreviations: C = conductor;
1097 CDP = cymbial denticulate process; E = embolus; MA = median apophysis; PCS = pimoid
1098 cymbial sclerite; PEP = pimoid embolic process; T = tegulum.

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1100 **Figure 10.** A, F, *Pimoa delphinica* sp. nov.; B, E, *Pimoa graphitica* sp. nov. C, D, *Pimoa*

1101 *rupicola*. A, Female from Italy, Province of Cuneo, Varaita valley, Sampeyre (GH0743),
1102 epigynum, caudal. B, Female from Italy, Piemonte, Valgrana Valley, Valgrana (GH1859),
1103 epigynum, caudal. C, Female from Italy, Province of Imperia, Pieve di Teco (GH1858),
1104 epigynum, caudal. D, Female from France, Alps Maritimes (GH1861), epigynum, caudal
1105 (note epigynal plugs). E, Male from Italy, Province of Torino, Vallone di Pramollo, Hamlet
1106 of Tornini (GH1857), male palp, ventral. F, Male from Italy, Province of Cuneo, Varaita
1107 valley, Casteldelfino (GH1860), male palp, ventral. Scale bars: A-D, F, 0.2 mm; E, 0.5 mm.
1108

1109 **Figure 11.** A-D, *Pimoa rupicola*, male from Italy, Province of Cuneo, Vallone del Bousset,
1110 Entracque (GH1901). A, B, Palp, ectal (arrow points to median apophysis). C, Palp, mesal
1111 (note that the distal part of lower branch of PEP is broken off). D, Palp, ventral (arrow up
1112 points to median apophysis, left pointing arrow points to paracymbium). Scale bars: 0.5
1113 mm. Abbreviations: C = conductor; CDP = cymbial denticulate process; E = embolus; PCS
1114 = pimoid cymbial sclerite; PEP = pimoid embolic process; T = tegulum.

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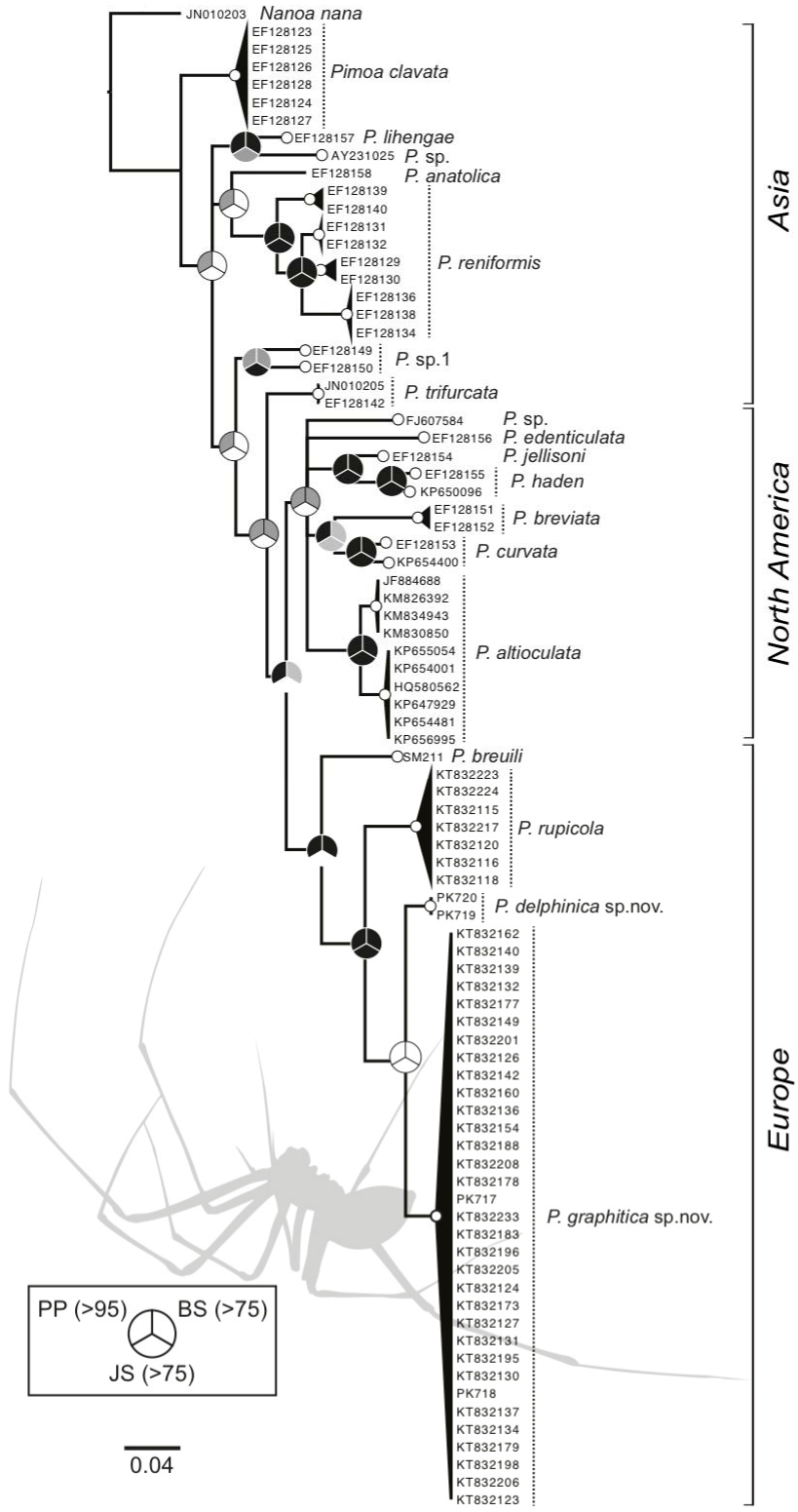
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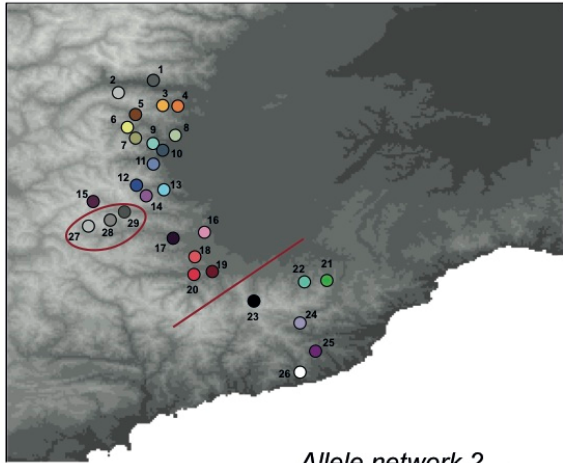
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1141 **Figure 1**

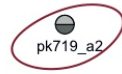


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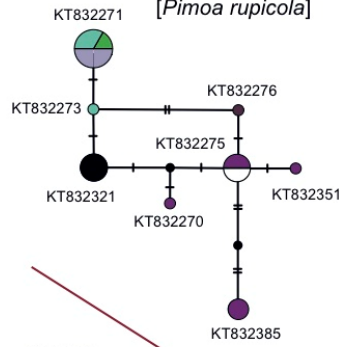
1143 **Figure 2**



Allele network 2
[*P. dephinica* sp. nov.]



Allele network 1
[*Pimonia rupicola*]



Pimonia graphitica sp. nov.

- 1 - Seineria mine
- 2 - Dravejs screes
- 3 - Coazze (ruined house)
- 4 - Gariola mine
- 5 - Tana del Diavolo
- 6 - Bocetto mine
- 7 - Tuna du Diau
- 8 - S. Pietro Vallemina mine
- 9 - Tornini mine
- 10 - Germanno Chisone mine
- 11 - Gheisa d'la Tana
- 12 - Rio Martino fort
- 13 - Buco del Maestro
- 14 - Buco di Valenza
- 15 - Tour Real blockhouse
- 16 - Grotta di Rossana
- 17 - Grotta del Partigiano
- 18 - Grotta dello Scoiattolo
- 19 - Buco dell'Aria Calda
- 20 - Grotta di Valloriate

Pimonia rupicola

- 21 - Grotta Rio dei Corvi
- 22 - Tana di Camplass
- 23 - Vernante dungeons
- 24 - Grotta dell'Orso
- 25 - Sgarbu du Ventu
- 26 - Tana di Bertrand

Pimonia delphinica sp. nov.

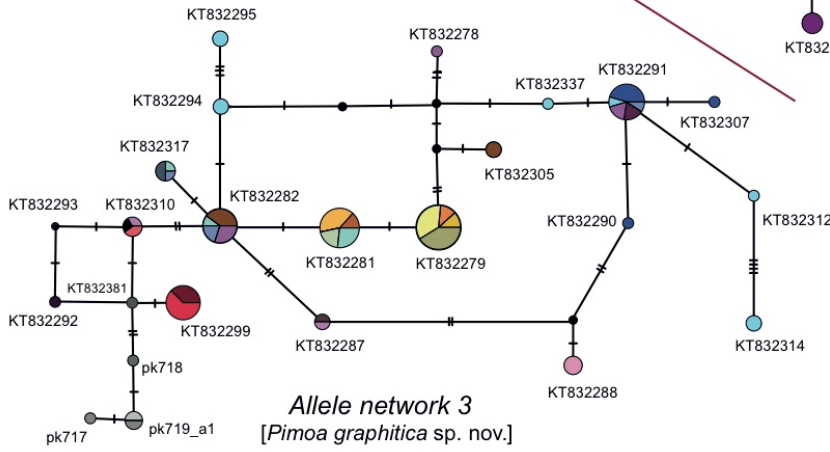
- 27 - Rocca Senghi (bunker)
- 28 - Buco delle Ciuaie
- 29 - Pertus dal Draï

● unsampled/extinct haplotype

10 samples



1 sample



Allele network 3
[*Pimonia graphitica* sp. nov.]

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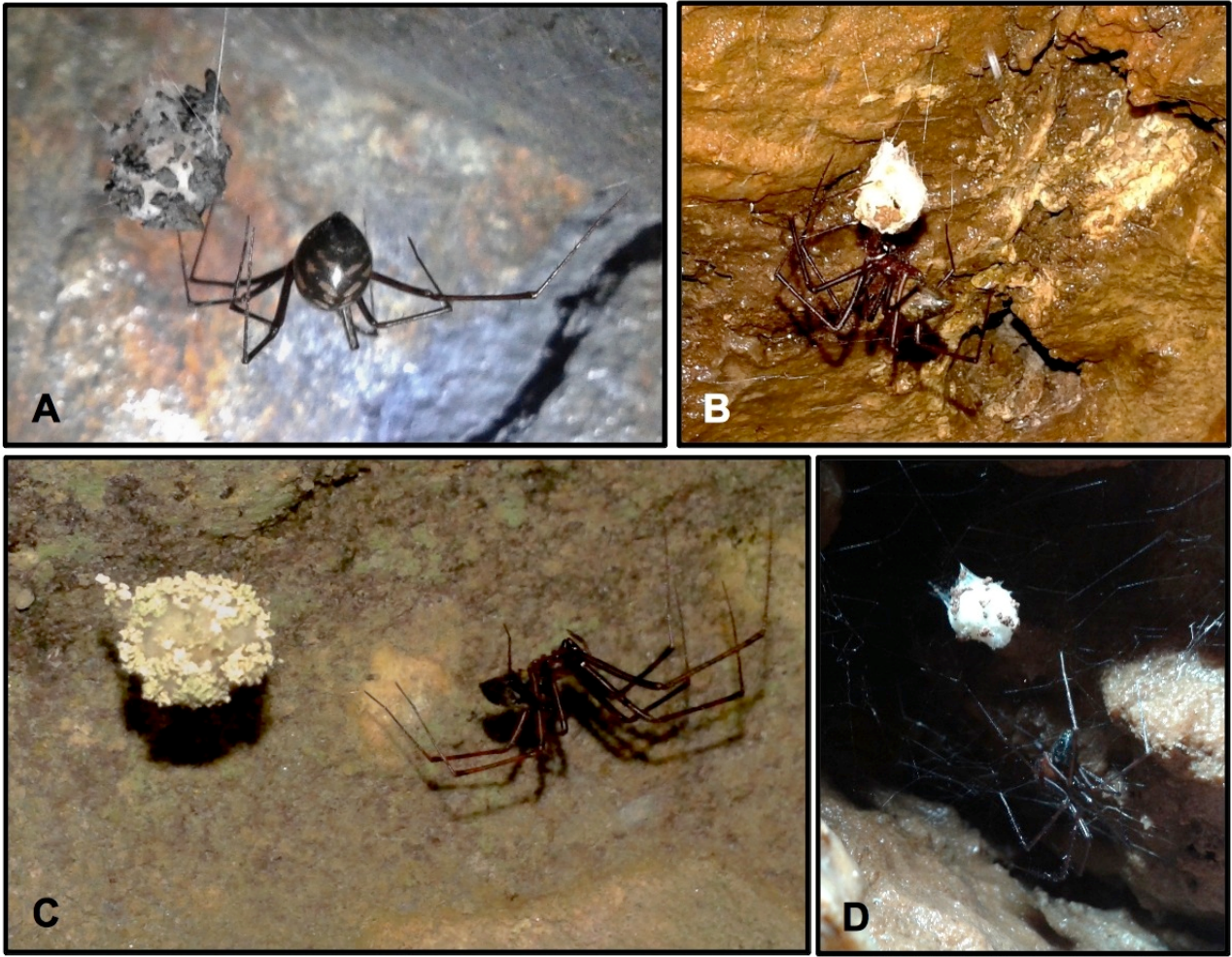
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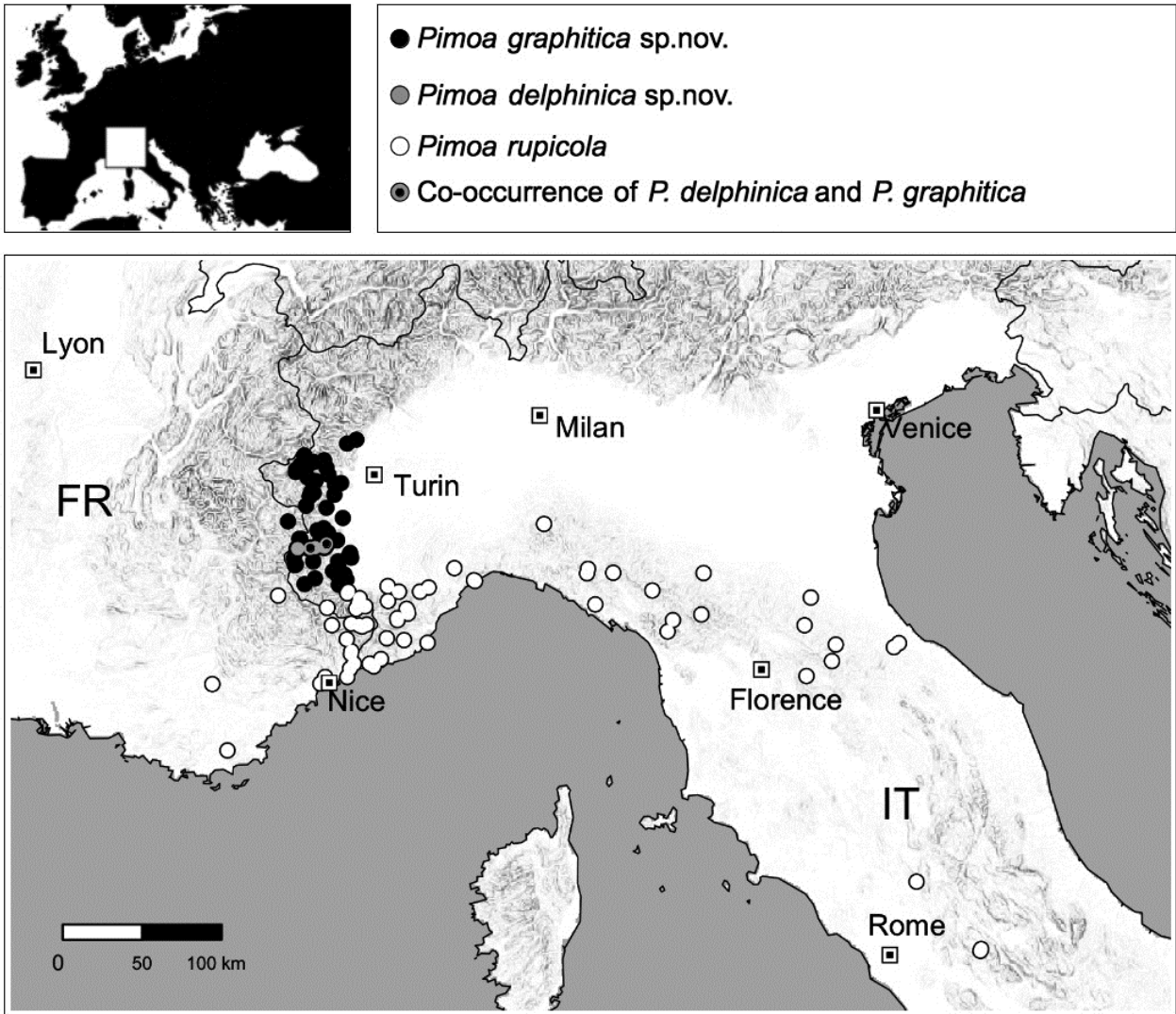
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1167 **Figure 4**



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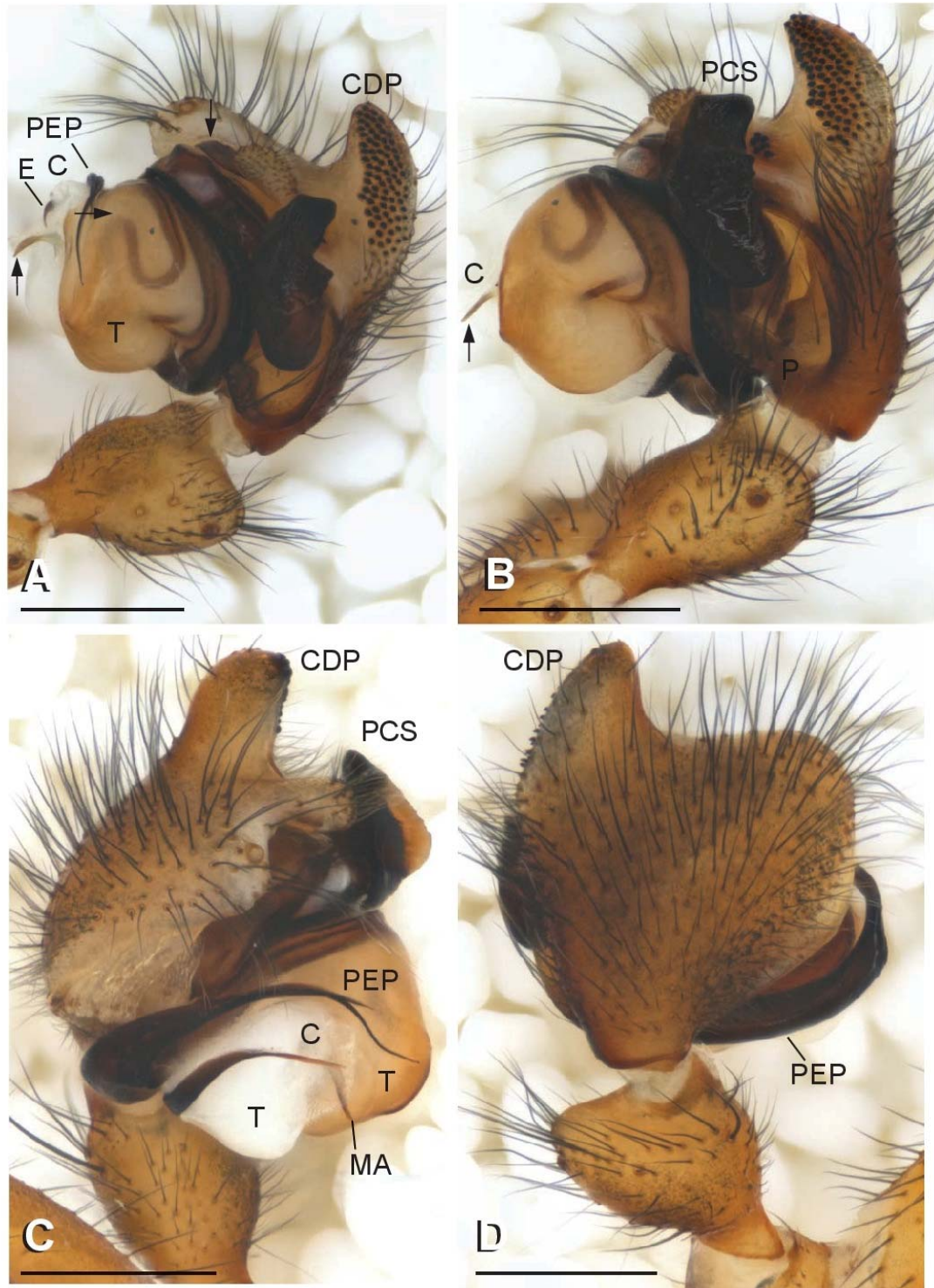
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1175 **Figure 5**



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1177 **Figure 6**

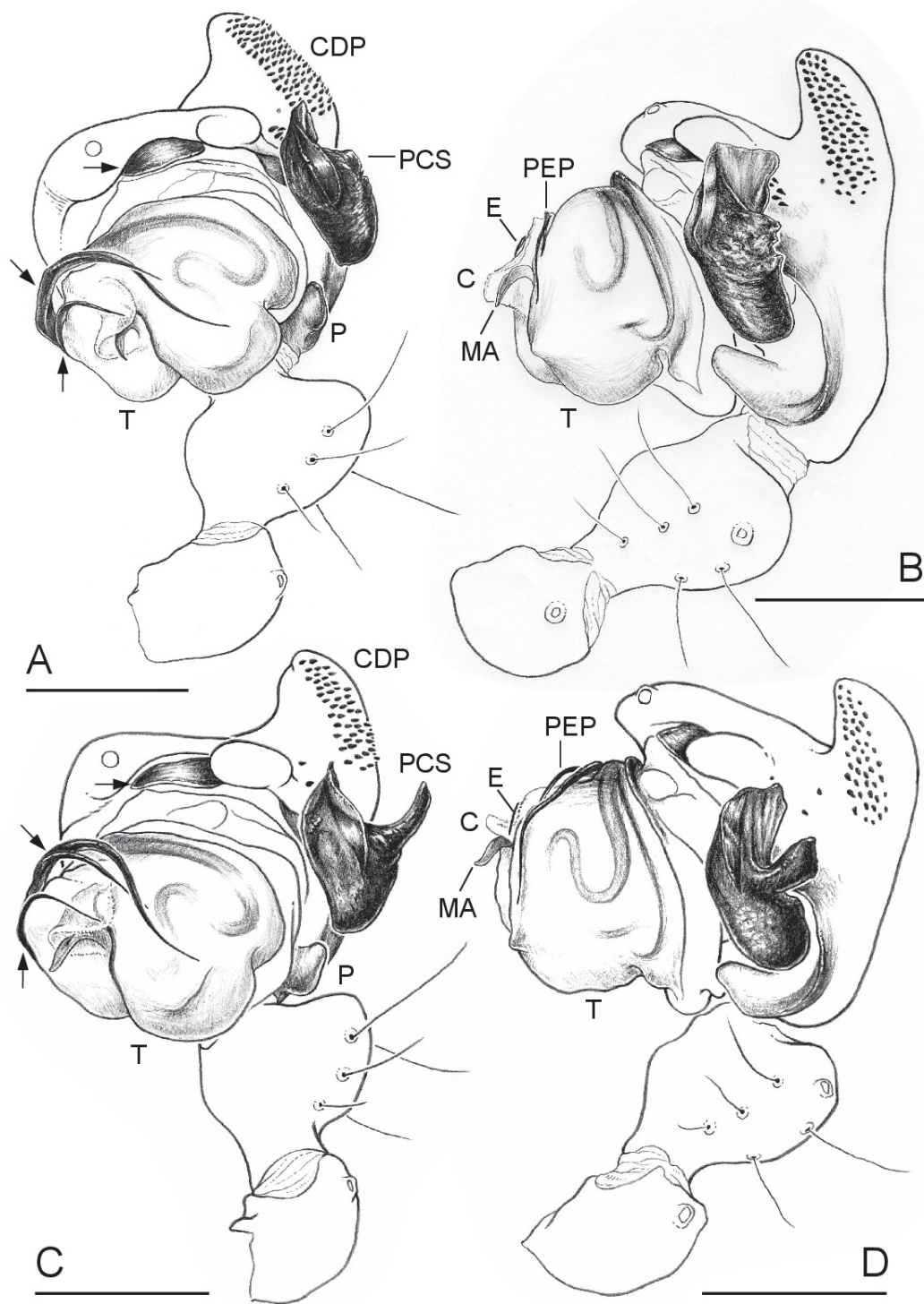


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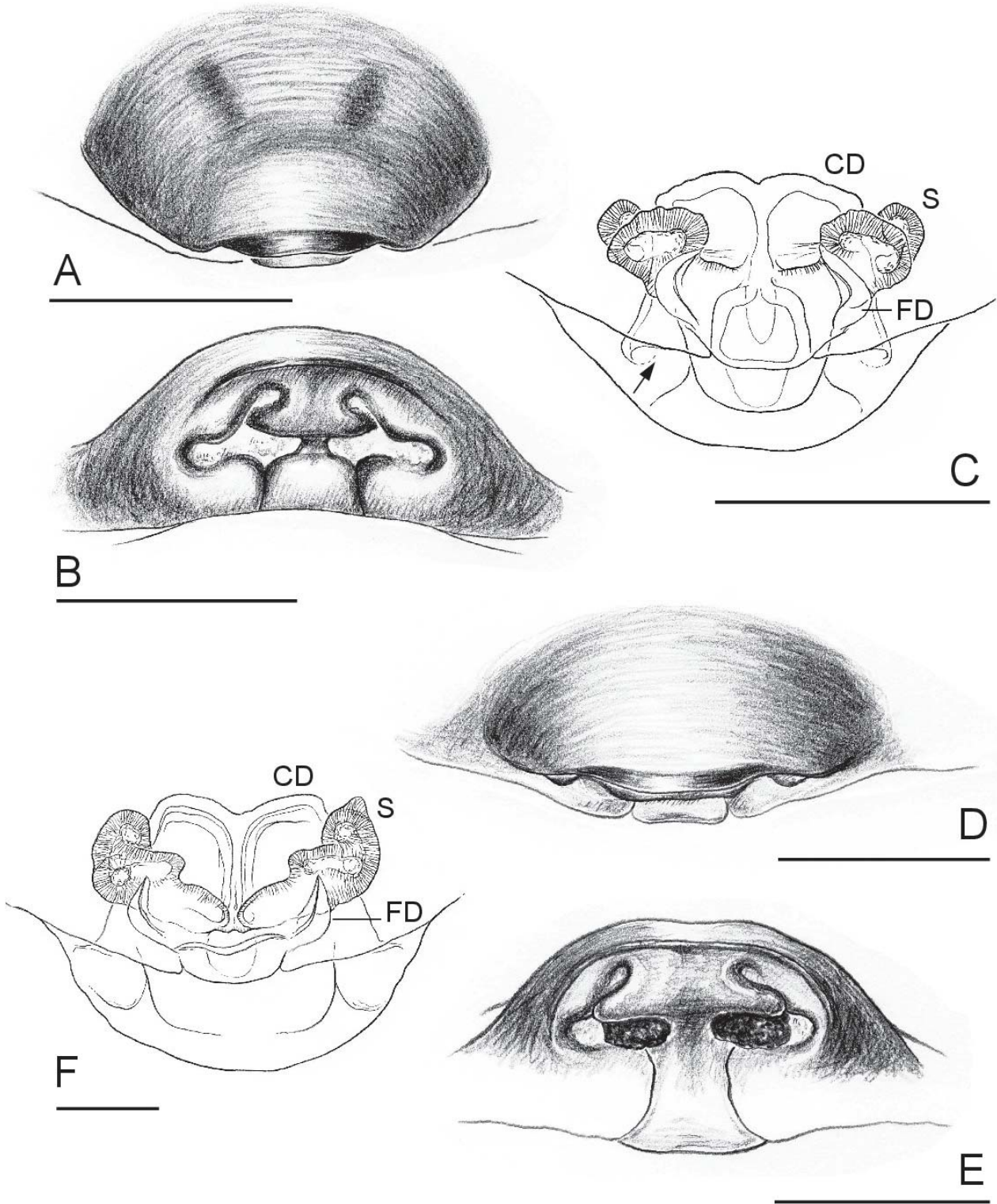
1181 **Figure 7**

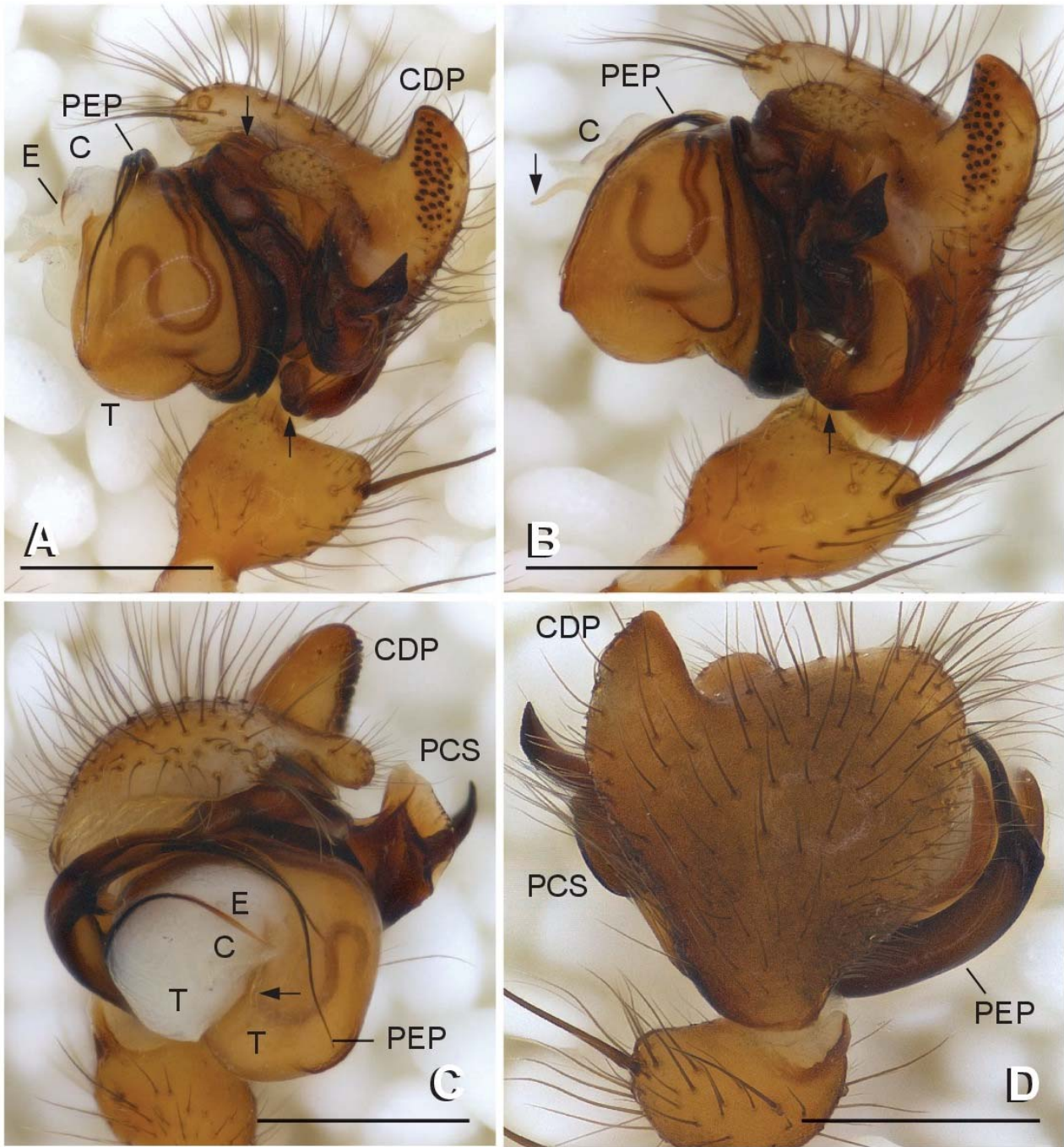


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1184 **Figure 8**





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1193 **Figure 10**

