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Dichotrachelus pesarinii sp.n., a missing link between the species from the central and the western southern Alps (Coleoptera: Curculionidae: Cyclominae)

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Abstract

A new species of *Dichotrachelus* associated with *Saxifraga caesia* is described, *D. pesarinii* sp.n., and a phylogenetic analysis is carried out based on morphological and molecular mtCOI data. The new species resolved as the sister group of the *D. sulcipennis* group, whose members are associated with *Saxifraga oppositifolia*. This placement suggests that this group differentiated in the central southern Alps, and that the new species represents an evolutionary link between the species from the central and eastern southern Alps and those from the western Alps. The evolution of the association of *Dichotrachelus* with particular *Saxifraga* species remains contradictory; scenarios are proposed.

Key words

Alpine fauna, historical biogeography, mtCOI sequences, new species, phylogeny.

1. Introduction

A 15-year-long research in the Alps of Lombardy by the second author allowed the collection of several species of Coleoptera, among which Curculionidae of the genus *Dichotrachelus* Stierlin, 1853, are of great faunistic, biogeographical and phylogenetic interest. In this paper a new species is described, *Dichotrachelus pesarinii* sp.n., found on an isolated calcareous mountain ridge in northern Lombardy and associated with *Saxifraga caesia* L. In a recent paper Meregalli et al. (2013) inferred the phylogeny and discussed the historical biogeography of the *Saxifraga*-associated species of *Dichotrachelus* and proposed a reconstruction of the pattern of differentiation of the phylogenetic lineages, with main emphasis on the alpine species (Meregalli et al. 2013: figs. 54–55). The new species adds important information to this study and identifies some critical aspects of the proposed phylogenetic reconstruction.

2. Materials and methods

2.1. Sample origin

Thirteen specimens of *Dichotrachelus pesarinii* sp.n. were examined, collected on calcareous cliffs and ravines at their base on the north-eastern and north-western slopes

of Mt. Cavallo, near Bocchetta di San Simone, Foppolo (Bergamo province, Lombardy), either by sifting among and below plants of *Saxifraga caesia* or by sight at the base of the plant or below stones near the plants. Two specimens were preserved in ethanol for molecular analysis, the others were mounted dry on cards. Male and female genitalia and terminalia of all specimens were dissected out and mounted dry on the same card of the relative specimen, or on a card pinned below the specimen; the aedeagal sclerites of the males were embedded in resin on a transparent card. The genital apparatuses of one male and one female specimen were preserved in 90% glycerol in a microvial, fixed to the same pin of the relative specimen. Label data are cited *verbatim* in the description, using the following symbols and abbreviations: / – different lines, // – different labels, hw – hand written, pr – printed, square backets – supplementary data not reported on label. Abbreviations for collections are: CMM – coll. Massimo Meregalli, Turin, Italy; CRM – coll. Riccardo Monguzzi, Milan, Italy; MSNM – Museo Civico di Storia Naturale, Milan, Italy; TLMF – Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria.

2.2. Morphological data

The study was carried out on the specimens mounted dry on cards. Characters were scored according to the character list in MEREGALLI et al. (2013: section 2.2.) and added to the matrix compiled in the same paper (table 2 therein). Photographs were taken with a Nikon Coolpix P6000 camera mounted on a Leica S6E stereomicroscope with 10× or 20× oculars. A series of photographs at different focus planes were taken and the stack was combined to a single image with Zerene Stacker 1.04 (Zerene Systems LCC). The final images were processed using Photoshop CS3 (Adobe Systems Inc.). Bayesian Inference (BI) analysis was performed as described in MEREGALLI et al. (2013).

Following a suggestion of Rolf Oberprieler we replaced the term "tectum" as used in MEREGALLI et al. (2013) by "shield". The respective part of the male genitalia Cyclominae is not homologous with the part otherwise called "tectum" in Curculionoidea (an element in the pedotectal type of aedeagus).

2.3. Molecular data

DNA was extracted from two specimens collected in the north-eastern and north-western cliffs of Mt. Cavallo, respectively. Extraction and amplification were performed as described in MEREGALLI et al. (2013), and the resulting mtCOI sequences were added to those used by MEREGALLI et al. (2013: table 3). Analyses were carried out using both the nucleotide sequences and the translated protein sequences. Outgroup taxa were replaced by five species of Cyclominae, whose sequences were retrieved from GenBank: *Gronops lunatus* (Fabricius, 1775), gi_345037138 (Hipporhinini; the only species of Cyclominae from the Palaearctic Region whose mtCOI sequences were available); *Falklandius antarcticus* (Stierlin, 1903), gi_146285142; *Germainiellus salebrosus* (Enderlein, 1907), gi_146285194; *Antarctobius falklandicus* (Enderlein, 1907), gi_146285006; *Puranius championi* (Kuschel, 1952), gi_146285196 (Listroderini, Neotropical region). Bayesian Inference (BI) analysis was performed as described in MEREGALLI et al. (2013) and Maximum Likelihood (ML) analysis with raxmlGUI 1.3 (SILVESTRO & MICHALAK 2012) using a MarkovK + Γ model. Group support was computed with 1000 bootstrap replications. While all outgroup taxa were included in all analyses, either *G. lunatus* or *P. championi* was defined as the outgroup in BI, whereas in ML either *G. lunatus* or all the five Cyclominae together were defined as the outgroup, an option allowed with raxmlGUI 1.3. The analysis tries to force the taxa initially defined as outgroup taxa into one clade forming the sister group of the ingroup; if this cannot be among the set of most parsimonious solutions based on the distribution of character states across the taxa, the program automatically rejects the assumption and shifts back to the use of the first species as the outgroup (see SILVESTRO & MICHALAK 2012 for remarks on applications of their GUI).

3. Results

The two *D. pesarinii* mtCOI sequences differed by 0.78% (five single-nucleotide substitutions and one 4-bases inversion). The resulting trees are shown in Fig. 1 (morphology) and Fig. 2 (mtCOI, nucleotide sequences). In all molecular analyses the *Dichotrachelus* species formed a fully supported clade (100% posterior probability in BI and 100% bootstrap in ML). When *P. championi* was defined as the outgroup, *G. lunatus* clustered in a clade together with *F. antarcticus* (BI). The assumption of a multi-taxon outgroup forming a clade sister to the *Dichotrachelus* clade was not rejected in ML. The branching sequence of the *Dichotrachelus* clade was the same in trees from all analyses. It closely matched that presented by MEREGALLI et al. (2013) and is therefore not discussed further here, except for the placement of *D. pesarinii*. In both the morphological and molecular analyses *D. pesarinii* formed the sister group of the *D. sulcipennis* group (i.e. *D. sulcipennis* Stierlin, 1853 + *D. margaritae* Osella, 1967 + *D. doderoi* Solari & Solari, 1905, the latter species only included in the morphological analysis), with strong support in the morphological analysis (92% posterior probability in BI) but lower support in the molecular analysis (85% pp in BI and 66% bootstrap in ML for the nucleotide sequences and 67% pp in BI for the translated protein sequences). The tree resulting from the translated protein sequences was similar to that resulting from the nucleotide sequences. However, in the translated protein sequences *D. manueli* + *D. bischoffi* formed a

clade, sister group of *D. pesarinii* + *D. sulcipennis* group, with moderate support (75% pp).

4. Discussion

4.1. *Dichotrachelus pesarinii*

The mtCOI divergence of 0.78% between the two specimens examined is slightly larger than the 0.4 and 0.5% intrapopulation divergence detected in *G. sulcipennis* and *G. margaritae*, respectively (Meregalli et al. 2013). However, the two specimens of *D. pesarinii* sequenced were not collected together, as were those of the other two species, but on different slopes of Mt. Cavallo, separated by about 450 m. This suggests the existence of isolated populations of *D. pesarinii* occurring on the same mountain, rather than a single panmictic population, perhaps due to the limited vagility of the species and its very strict association with a particular micro-niche.

Both the morphological and the molecular analyses based on the mtCOI sequences indicate that the new species forms the sister group of the western-alpine *D. sulcipennis* group and thus occupies an "intermediate" position between the evolutionary grade of *D. manueli* Marseul, 1871 – *D. bischoffi* Stierlin, 1878 – *D. baudii* (Seidlitz, 1875) and species of the *D. sulcipennis* group. In contrast to *D. pesarinii*, all these species are not exclusively associated with calcareous habitats and feed on various species of *Saxifraga*, mostly *S. oppositifolia* L., but have not been recorded from *S. caesia.*

4.2. Morphology

Figs. 3–23

Meregalli et al. (2013) showed that the aedeagal sclerite of the male bears significant phylogenetic information. This is confirmed in the present study. The general structure of the sclerite of *D. pesarinii* is intermediate between those of the species of the *D. sulcipennis* group and of the complex of *D. manueli* + *D. bischoffi*, being more similar to the former. All these species share a particular differentiation of this genital sclerite, with distinct, long setae directed forward, covered by a broad shield with prominent antero-lateral arms and a narrow, bifid median horn. However, the shape of these parts varies depending on the species (see Meregalli et al. 2013: figs. 45–53 for *D. manueli*, *D. bischoffi* and the *D. sulcipennis* group, and Figs. 18–20 herein for *D. pesarinii*). The shield in *D. bischoffi* and *D. manueli* is rectangular, almost reaching the apical part of the sclerite, with the median horn and lateral arms only slightly produced forward, whereas in the *D. sulcipennis* group the shield is subquadrate, with the median horn and lateral arms distinctly produced forward; in *D. pesarinii* the shield is similar to that of the latter species but longer than wide, broadened in the basal part. The arms in *D. bischoffi* are short, relatively thickened and curved downward; in *D. manueli* they are fang-shaped, long and curved downward, reaching the underside of the sclerite; in *D. pesarinii* and the *D. sulcipennis* group they are very slender, distinctly produced forward and not curved downward, in *D. pesarinii* slightly shorter and thicker and in the *D. sulcipennis* group narrower and more or less tapering distad. The bifid median horn is very short, barely produced forward in *D. bischoffi* and *D. manueli* and longer, thinner, strongly produced forward in *D. pesarinii* and the *D. sulcipennis* group. In *D. bischoffi* the valves are strong, broadened distally, reaching the apex of the genital sclerite and in lateral view very thick and distinctly lobed; in *D. manueli* the valves are narrow, slender, indistinctly lobed; in *D. pesarinii* they are shorter, in lateral view thick, but not lobed, and the apex is distinctly denticulate; in the *D. sulcipennis* group the valves are quite similar to those of *D. pesarinii* but shorter, reaching only the middle of the length of the sclerite. The long tuft of prominent setae is hidden beyond the distal part of the shield in *D. bischoffi* and *D. manueli* but exposed (visible from above) in *D. pesarinii* and the *D. sulcipennis* group. *Dichotrachelus baudii* shares an almost identical shape of the genital sclerite with *D. bischoffi* and is possibly its sister species, but its relationships are not yet fully understood, mainly due to the conflicting results between molecular and morphological analyses (Figs. 1–2). In contrast to the male genital sclerite, sternite VIII of the *D. pesarinii* female resembles more closely that of *D. bischoffi*. In the species of the *D. sulcipennis* group it is as long as or longer than the apodema, only slightly broadened apicad, and most of the surface is slightly sclerotized, except a narrow median stripe. In *D. pesarinii*, as in *D. bischoffi* and *D. manueli*, sternite VIII is shorter than the apodema, its sides are rather linearly broadened distad and the sclerotization is limited to the margins.

Also in its non-genital characters *D. pesarinii* is intermediate. The pronotum of the species of the *D. sulcipennis* group is transverse, with a very broad median furrow and short and broad setae that are scarcely raised. In *D. pesarinii*, however, the pronotum is as long as wide or even slightly longer than wide, with a moderately broad median furrow, and has dense erect setae, being rather similar to that of *D. manueli.* In *D. bischoffi* the pronotum is subquadrate, with rather short, scarcely raised setae. The elytra of the new species are broadly oval, with the maximum width beyond the middle of their length and narrowly raised odd intervals, as they are in the *D. sulcipennis* group and in *D. bischoffi*, whereas *D. manueli* usually has elytra scarcely broadened. The elytral pattern of *D. pesarinii*, with patches of light and dark scales, does not occur in the other species here considered; this pattern seems to be a plesiomorphic trait, resembling that of *D. grignensis* Breit, 1902 and the species from the eastern southern Alps.

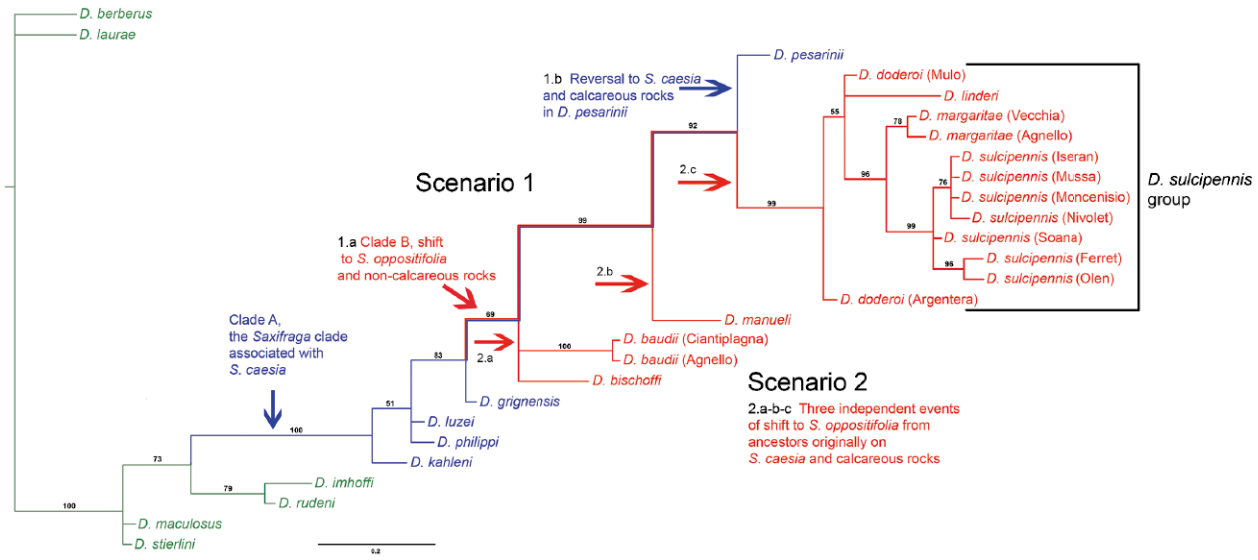


Fig. 1. Phylogram of *Dichotrachelus* generated from morphological characters. Bayesian consensus tree (majority rule 50%), support values (posterior probability) reported on branches. Taxa and clade stems distinguished by colour according to ecological characteristics: green – associated with mosses; blue – associated with *Saxifraga caesia* and calcareous rocks; red – associated with *Saxifraga oppositifolia* and non-calcareous rocks. Scenarios 1 (with events 1.a, 1.b) and 2 (with events 2.a, 2.b, 2.c) explained in text section 4.3.

4.3. Phylogeny and biogeography

Dichotrachelus pesarinii from the central southern Alps ("p" in Fig. 24) appears to be a relict species that has become isolated in the calcareous ridges of Mt. Cavallo during its most recent uplift. It proves to be a key-species in discussing evolutionary relationships and historical biogeography of the alpine *Saxifraga*-associated species of *Dichotrachelus*. It partly confirms the scenario suggested by MEREGALLI et al. (2013: fig. 57), and partly contradicts it, adding further information – and questions.

The alpine *Saxifraga*-associated species of *Dichotrachelus* (Clade A in Fig. 1) fall into two ecologically and regionally divergent groups: those associated with *Saxifraga caesia* on calcareous habitats in the central and eastern southern Alps (blue terminals in Fig. 1), and those associated with other *Saxifraga* species (especially *S. oppositifolia*) on non-calcareous habitats in the western Alps (red terminals; see MEREGALLI et al. 2013: figs. 58–60 for distribution of species). Whereas the former was resolved as a paraphyletic group in the analysis of MEREGALLI et al. (2013), thus appearing as the plesiomorphic biotype by parsimony, the latter emerged as a monophyletic group. *Dichotrachelus pesarinii* disturbs this picture by showing the life-history characteristics of the former assemblage but falling amidst the latter clade in our reconstruction, as sister group of the *D. sulcipennis* group (see Figs. 1 and 2). On this basis, two conflicting evolutionary scenarios appear now possible (summarized in Fig. 1); both have in common that the ancestor of the large *Dichotrachelus* Clade A first became adapted to *Saxifraga caesia* in calcareous habitats of the eastern southern Alps.

Scenario 1: As supposed by MEREGALLI et al. (2013), a switch to species of *Saxifraga* other than *S. caesia* and to non-calcareous habitats occurred only once (event 1.a at base of Clade B in Fig. 1), as a secondary differentiation in the central or central-western southern Alps. Then a shift back to calcareous habitats and *S. caesia* had to occur in *D. pesarinii* (event 1.b). Such a scenario does not seem to be very likely. Firstly, if the shift to non-calcareous mountains (event 1.a) and to different species of *Saxifraga* occurred in the central southern Alps, then some species associated with this kind of habitat in the central southern Alps should still be present, whereas none is known, despite suitable habitats and host plants being quite widespread (Meregalli, personal observation in Lombardy) and these species being usually quite easy to find. The alternative of such a shift (event 1.a) having occurred in the western southern Alps, where all species associated to non-calcareous habitats are present today, is even more unlikely, as it would require both an eastward geographical movement of *D. pesarinii* (or its ancestor) and a "reversal" to the previous habitat.

Scenario 2: Another, perhaps more plausible, possibility is that the ancestor of clade B was associated with calcareous habitats and *Saxifraga caesia*, but not strictly so and had (or gradually obtained) a wider range in the area corresponding to the present-day central and western southern Alps. Gene flow in these low-vagility weevils decreases with increasing distance, so that fragmentation may have arisen in various parts of the range. In such a context, regional populations of the Clade B ancestor may have given rise to the lineages of *D. bischoffi* (possibly + *D. baudii*) and *D. manueli* in western parts of the range, and a species in the central southern Alps that

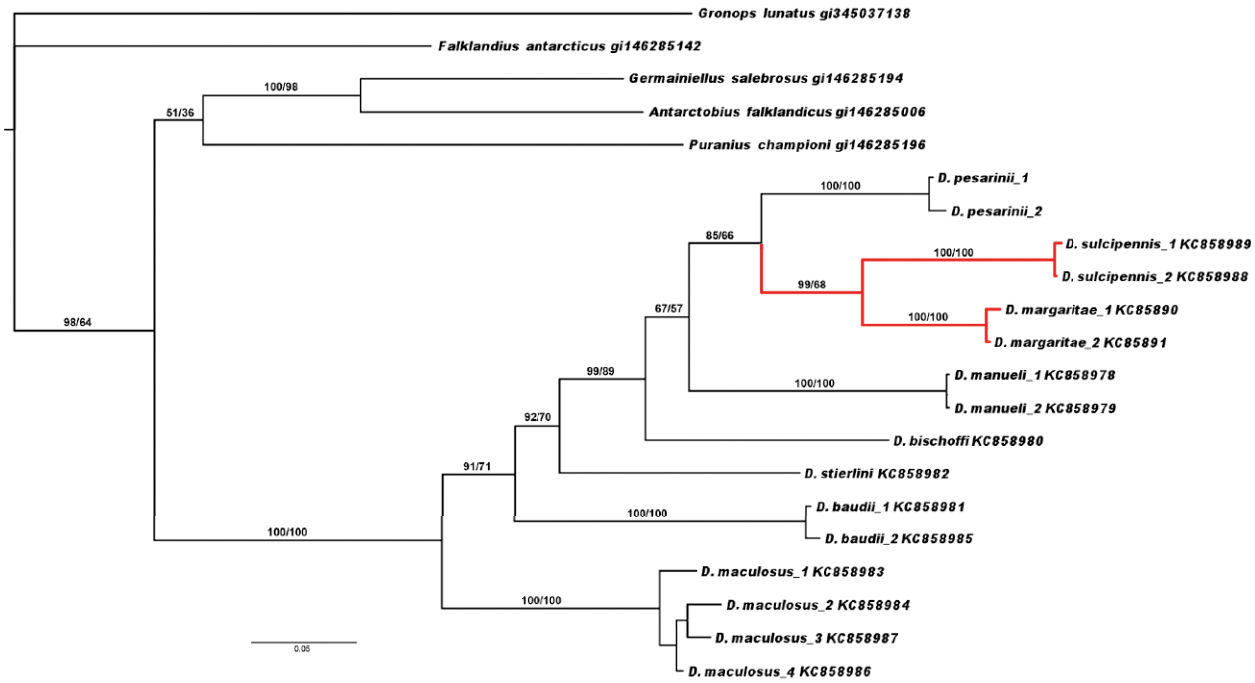


Fig. 2. Phylogram of *Dichotrachelus* generated from molecular characters (mtCOI). Bayesian consensus tree (majority rule 50%), support values in following order: posterior probability (BI) / bootstrap value (ML). *Dichotrachelus sulcipennis* group highlighted in red. Scale bar unit: expected substitutions per site.

later divided into *D. pesarinii* and the ancestor of the *D. sulcipennis* group. Shifts in preference to *Saxifraga oppositifolia* and non-calcareous habitats developed independently in *D. bischoffi* (+ *D. baudii*?) (event 2.a in Fig. 1), *D. manueli* (event 2.b) and the *D. sulcipennis* group (event 2.c). The presence of apparently plesiomorphic traits in *D. pesarinii*, such as the elytral pattern similar to that of the species in the eastern southern Alps, would support this scenario.

The main difference between scenarios 1 and 2 is that the former strictly follows the phylogenetic dichotomies and assumes monophagy throughout, whereas scenario 2 interprets weakly resolved tree nodes as representing gradual fragmentation, and some degree of potential oligophagy (within *Saxifraga*) is conceded to species. Indeed, *Dichotrachelus* species are not (always) strictly monophagous, some having been recorded also from saxifrages other than *S. caesia* or *S. oppositifolia*, among others *S. bryoides* for *D. bischoffi* and *S. paniculata* for *D. sulcipennis* (Meregalli et al. 2013; Meregalli, personal observation) and for *D.* sp. cf. *kahleni* on Mt. Plauris (Kahlen, personal observation). Also, ancestral taxa may have had an even higher degree of oligophagy, depending on habitat constraints. In this scenario, no shift back to *S. caesia* and/or to the central southern Alps needs to be postulated, but much parallel shifting or (near-)fixation of ecological preference has to be assumed. In the phylogram generated from the molecular data, only the *D. sulcipennis* group is fully supported, whereas support for relationships between this group and the other species is only moderate. On this basis, the hypothesis of gradual fragmentation in scenario 2 (versus well-defined sister-group relationships) may appear plausible. Beyond this, a further alternative hypotheses, such as the complex *D. bischoffi* + *D. manueli* being a real clade and the sister group of the *D. sulcipennis* group + *D. pesarinii*, is suggested by the results of the translated protein sequence. In this case, scenario 2 would be even more likely, since the shift to saxifrages other than *S. caesia* and non-calcareous habitats would have occurred only once in the lineage of *G. bischoffi* + *G. manueli*.

We are fully aware that the data base for our phylogenetic reconstruction can be considered not yet very strong, especially with regard to the use of a single mitochondrial gene sequence. However, the tree based on the translated amino acid sequence shows the same structure, particularly regarding the placement of *D. pesarinii*, an indication that the signal that builds the tree is not based on random substitutions on the 3rd codon positions. Some of the morphological characters used in our reconstruction (and also those used by Meregalli et al. 2013) can be questioned as possibly homoplasious, very plastic and with little phylogenetic significance. We have generally tried to avoid using characters that showed similar conditions randomly appearing in evidently unrelated species. The shape of tarsomere 3 could be considered adaptive, related to the substrate on which the species live, hence varying independently from the phylogenetic affinities. However, it often differs between species that have the same life style, and species that share a certain shape of the tarsomere often show similarities in several other

morphological characters, non-genital as well as genital. These species are usually considered to be related and part of the same species group (for example, the species of the *D. maculosus* group have a narrow tarsomere 3, those of the *D. stierlini* group have a broadly lobed tarsomere 3, yet they share the same niches). It appears thus that this is a neutral character, modified in the ancestor of various lineages and conserved in the species derived from that ancestor.

The convergence between reconstructions based on morphological and on mtCOI data, obtained with the implementation of different methods of analysis, makes us quite confident of the credibility of the proposed hypotheses on the phylogeny and evolutionary history of these species, at least regarding their general aspects.

Obviously, further research on the other alpine *Dichotrachelus* species associated with *Saxifraga caesia*, for which no molecular data are available yet, is required to reconstruct a more precise picture of the evolutionary history of the genus and understand its association with the final uplift of the central and western southern Alps.

4.4. The Curculionoidea coenosis of Mt. Cavallo

The Curculionoidea coenoses of Mt. Cavallo and Bocchetta San Simone, at about 2000 m a.s.l., were described by PEDRONI (2013). He listed 29 species from this area, some of which have a restricted distribution. Two other species of *Dichotrachelus* are present there: *D. imhoffi* Stierlin, 1858, relatively abundant, and a new species currently under study, related to *D. pygmaeus* Stierlin, 1888 (which was not listed by Pedroni). Both species feed on mosses; the indication of *Saxifraga* as the host of the former by PEDRONI (2013) is erroneous, caused by the presence of saxifrages near the stones under which specimens were found. GERMANN & BAUER (2010) clarified the biology of *D. imhoffi*. The great interest in the calcareous ridges of this sector of the Alps is underlined by the presence of another undescribed species of Curculionidae, belonging to the genus *Orthochaetes* (referred to *O. alpicola* by PEDRONI 2013).

5. Description

***Dichotrachelus pesarinii* Meregalli & Monguzzi sp.n.**

Diagnosis. A *Dichotrachelus* species (Figs. 3–23) characterized by the following characters: rostrum strongly curved, with distinctly converging sides and scrobes completely visible from above; pronotum as long as wide, with almost parallel sides; elytra ovate, with patches of pale and dark grey-brown scales; penis short, evenly curved, barely tapered apicad in lateral view, with short lamella, genital sclerite of the "*D. sulcipennis*" type, with distinctly prominent arms, a median horn, a long tuft of prominent setae and with shield longer than wide.

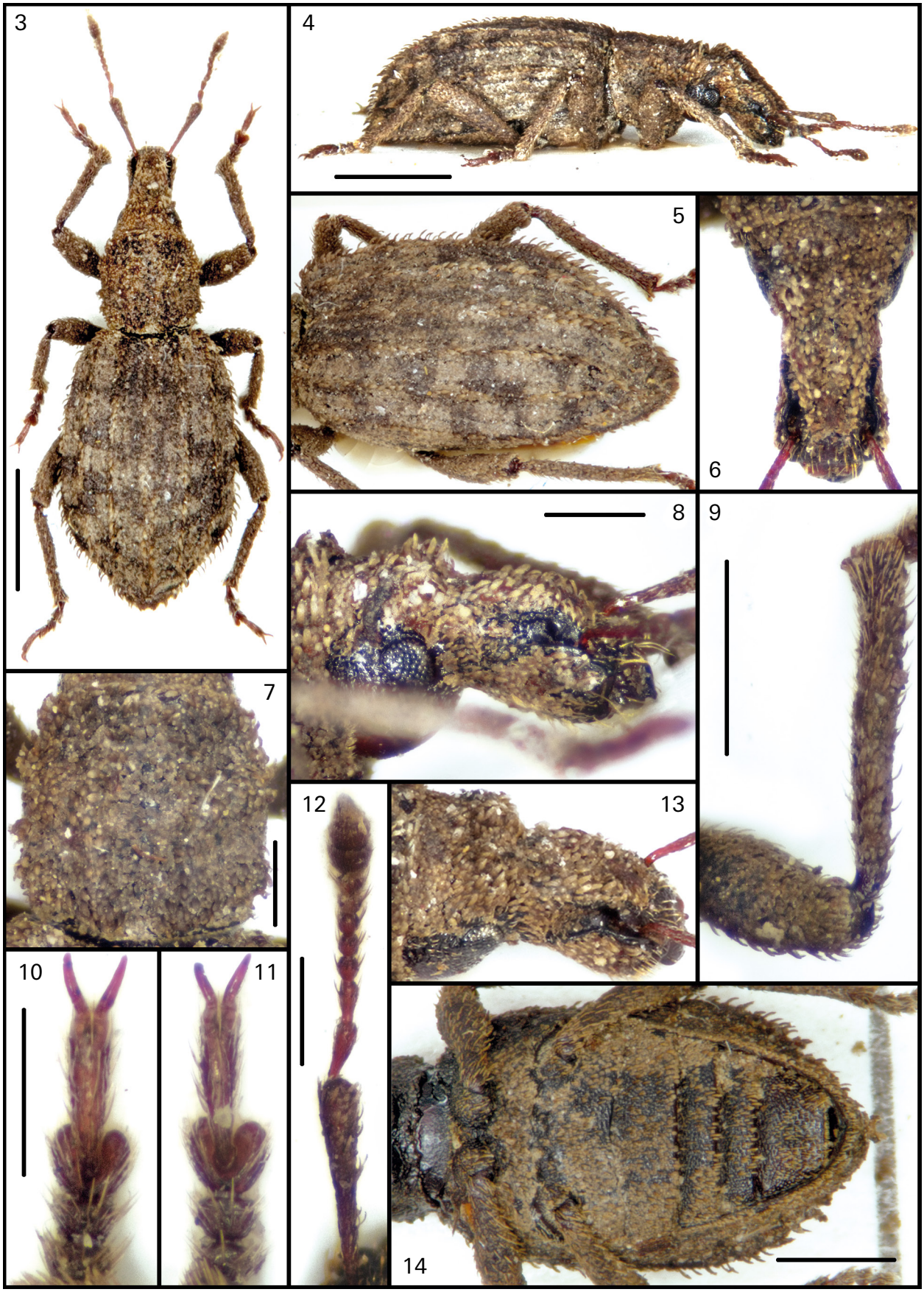
Dichotrachelus pesarinii differs from the sympatric (but not strictly syntopic) *D. imhoffi* by its oval elytra, 1.5 × longer than wide (elliptical, almost 2 × longer than wide in *D. imhoffi*); the small, subquadrate pronotum with almost parallel sides (sides curved, broadest near middle of length); elytral suture behind middle with regularly spaced raised setae (setae very dense, broad, tightly packed); legs with short and narrow setae (with long, dense and relatively broad setae); penis much shorter, with lamella not strongly extended distally, genital sclerite very differently shaped.

Specimens examined. ***Holotype*** ♂: [Italy, Lombardy, BG] V. Brembana, Foppolo / M. Cavallo m 2100 / (Bocch. di San Simone) [46°02′N 09°41′E] / 20.VII.2002 – R. Monguzzi [hw] // *Saxifraga* / *caesia* [hw] // *Dichotrachelus* / *pesarinii* / Meregalli & Monguzzi / HOLOTYPUS [red, pr] (CRM). — ***Paratypes***: same data, 2♂ 2♀ (1♂ CMM, 1♂ 1♀ CRM, 1♀ TMLF); same locality and collector, 26.VII.1999, 2♂ 1♀ (1♂ CMM, 1♀ CRM, 1♂ MSNM); same locality and collector, 16.VI.2013, 1♀ (CRM); same locality and collector, 26.VI.2013, 1♂ (CRM); same locality and collector, northwestern cliffs of Mt. Cavallo / 46°02.183′N 09°41.341′E / 2170 m 11.VIII.2014, 2♀ (1♀ CMM, preserved in ethanol, 1♀ CRM); same locality / north-eastern cliffs of Mt. Cavallo / 46°02.115′N 09°41.663′E / 2080 m, 11.VIII.2014 Meregalli & Kahlen, 1♂ (CMM, preserved in ethanol). All paratypes labelled *Dichotrachelus* / *pesarinii* / Meregalli & Monguzzi / PARATYPUS [red, pr].

Measurements (holotype). Body length (from anterior margin of eye to apex of elytra in lateral view) 6.24 mm. Rostrum length (from base to apex of epistoma) 1.08 mm; width at base 0.51 mm; width at antennal insertion 0.38 mm. Pronotum length at midline 1.50 mm; maximum width 1.49 mm. Elytral length at suture 4.18 mm; maximum width 2.56 mm.

Description. Body oval (Fig. 3), vestiture composed of dense dark and pale grey-brownish scales almost completely covering integument, including on legs, and raised setae, shorter, oval on rostrum and pronotum and longer, elliptical on elytra.

Rostrum (Figs. 6, 8, 13) about 1.5 × longer than wide at base, dorsolateral margins converging from base to apex, scrobes completely visible from above, dorsum 1.4 × wider at base than at antennal insertions, base with a transverse impression beyond forehead; in lateral view dorsum strongly curved, at middle of length 1.5 × thicker than at base. Vestiture composed of pale brownish striated setae, raised on sides, above dorsolateral margins, ovate-elliptical and directed anteriad in proximal half, narrower and directed posteriad beyond middle; scales shortly ovate, nearly appressed onto integument along median part of rostrum; setae smaller, narrow, appressed onto integument in front of eyes. Scrobes short and very broad, upper and lower margins in lateral view nearly parallel behind antennal insertion, lower margin in dorsal view distinctly sinuate, broadened in distal part, towards apex of rostrum. ***Antennae*** (Fig. 12) with scape dark ferrugineous, straight, regularly thickened from base to



Figs. 3–14. Morphological structures of *Dichotrachelus pesarinii*. Holotype, ♂: **3–4**: Habitus in dorsal and lateral views. **5**: Elytra, dorsolateral view. **6**, **8**, **13**: Rostrum in respectively dorsal, lateral and dorsolateral views. **7**: Pronotum, dorsal view. **9**: Protibia, dorsal view. **10**: Right protarsus, dorsal view. **12**: Left antenna. Paratype, ♀: **11**: Right protarsus, dorsal view. **14**: Ventrites. Scale bars: Figs. 3, 4: 2 mm; Figs. 9, 14: 1 mm; Figs. 7, 8, 10, 12: 500 µm.

apex, with round scales and sparse elliptical setae; funicle segment 1 (pedicel) 2.8 × longer than wide, slightly curved, moderately and regularly thickened distally, 1.5 × longer than funicle segment 2, this twice as long as wide, segments 3–5 globose, segments 6–7 transverse; club oval, each segment distinct. ***Forehead and vertex*** transverse, occipital prominences distinct, with a tuft of raised setae, vertex slightly impressed in median part, with short, oval scales; eyes round, flat, each comprising about 60 ommatidia, aligned in rows of 7–8 ommatidia each.

Pronotum (Fig. 7) subquadrate, as long as wide or very slightly longer than wide, base weakly and regularly curved, apex nearly truncate, sides subparallel, moderately convergent anteriorly; anterior margin in lateral view moderately raised and prominent above head, ocular lobes barely distinct; dorsum with a moderately broad median furrow, broader in anterior half, lateral borders of median furrow thickened towards posterior margin; dorsolateral surface with two obtusely raised transverse ridges connecting borders of median furrow to sides, one near posterior margin and one in front of middle; surface between ridges and next to anterior margin slightly transversely impressed, forming two more or less distinct dorso-lateral shallow transverse furrows, the posterior one deeper and better distinct. Vestiture composed of oval scales and oval-elliptical setae, not well differentiated from scales, weakly raised, usually recumbent, inserted on transverse ridges and borders of median furrow.

Elytra (Fig. 5) ovate, at base slightly wider than base of pronotum, sides broadened laterally at base, then linearly and moderately broadened, maximum width beyond or at middle, sharply and linearly converging apicad; weakly convex in lateral profile, declivity sharp, shortly oblique; suture and intervals 3, 5, 7 acutely convex, nearly keeled near base, narrower than intervals 4 and 6, interval 2 narrower than other even intervals, particularly near base; vestiture composed of very dense oval pale and dark grey-brown scales, appressed onto integument, in moderately contrasting patches, and slender, elliptical setae nearly vertically inserted in two irregular rows on odd intervals, very dense from base to apex, slightly curved in profile; striae narrow, their punctures indistinct.

Legs (Fig. 9) slender; femora scarcely thickened at middle, densely covered with scales and with elliptical, moderately raised setae on upper side and sparse, very narrow setae on underside; tibiae slender, nearly straight, weakly broadened at apex, with dense ovate scales and sparse, slender, spaced elliptical setae, slightly thicker on external side; tarsi (Figs. 10, 11) short, with hair-like yellowish setae; tarsomere 1 triangular, as long as wide, tarsomere 2 transverse, tarsomere 3 moderately bilobed, in foretarsi inner (anterior) lobe barely longer than outer (posterior) lobe, this very slightly broader, in meso- and metatarsi longer lobe on the outside; tarsomere 5 subcylindrical, as long as tarsomeres 1–3 together; claws thin, elongate.

Ventrites (Fig. 14) densely punctate; 1 and 2 covered with dense oval scales and a few semi-erect setae, scales on ventrites 3 and 4 scarce, on ventrite 5 nearly absent, replaced by slender setae.

Male genitalia: Penis (Figs. 15–17) tubular, in ventral view regularly and moderately broadened towards lamella, apodemes nearly as long as body of penis, ventral side with incomplete sclerotization, sclerotized sides of penis converging in proximal part, leaving a narrow membranous median part, regularly broadened towards ostium; ostium broad, transverse, apical lamella as long as wide, at base half as wide as maximum width of penis, rounded at apex; penis in profile moderately and regularly curved, thickness relatively uniform from base to middle, strongly narrowed distad, lamella weakly curved with respect to penis curvature. Genital sclerite (Figs. 18–20) with shield longer than wide, at apex with distinctly produced lateral arms, 0.25 × as long as total length of sclerite (excluding basal membrane), median horn bifid throughout length, reaching apex of lateral arms; arms relatively broad, not curved laterally, in lateral view moderately and regularly curved forwards; anterior setae present, dense, prominent beyond margin of shield; valves broad, broadened towards proximal part, almost as long as complete sclerite and almost reaching apex of arms and median horn in distal part, not lobed below, apical part more strongly sclerotized and minutely denticulate, fused in proximal part near base of sclerite.

Female terminalia: Sternite VIII (Fig. 21) with basal piece shorter than apodeme, median part almost membranous, sclerotization restricted to near lateral margin towards apex, sides almost linearly broadened from base to apex, apex convex, with a few setae. Gonocoxites (Fig. 23) bottle-shaped, narrowed distally, apex rounded; styli short, sub-apically inserted, with a few long setae. Spermatheca (Fig. 22) strongly curved, corpus cylindrical, sinuate, cornu perpendicular to ramus, regularly narrowed distad, apex acutely pointed and curved, nodulus undifferentiated, ramus cylindrical.

Variation [n = 7♂, 6♀]**.** The body length varies between 5.10 and 6.29 mm, only three specimens as examined being shorter than 5.60 mm. Females usually have slightly broader elytra, and in males the sides of the elytra can be slightly narrower, with maximum width at middle. Ventrites 1 and 2 are very shallowly impressed in the middle in males, and flat in females. The pronotum can have a distinctly broader median furrow, particularly beyond the middle (not sex-specific). The lamella of the penis can be subtruncated, thus appearing slightly shorter. The basal margins of sternite VIII of the females can be almost linear or slightly sinuate near the junction with the apodema.

Ecology. *Dichotrachelus pesarinii* appears to be strictly associated with *Saxifraga caesia* growing in crevices of calcareous cliffs and ravines (Fig. 25). No specimens were found on the other species of *Saxifraga* present at the type locality, such as *Saxifraga paniculata* Mill. No specimens of *S. oppositifolia* were found either at the

Figs. 15–23. Genital structures of *Dichotrachelus pesarinii*, paratypes. **15–17**: Penis, dorsal (15) and lateral (16) views, and dorsal view of tip (17). **18–20**: Male genital sclerite, dorsal (18), ventral (19) and lateral (20) views. **21**: Female, sternite VIII. **22**: Spermatheca. **23**: Gonocoxites, ventral view. Scale bars: Figs. 15, 16, 21: 1 mm; Fig. 23: 500 μm; Figs. 18–20: 250 μm; Fig. 22: 200 μm.

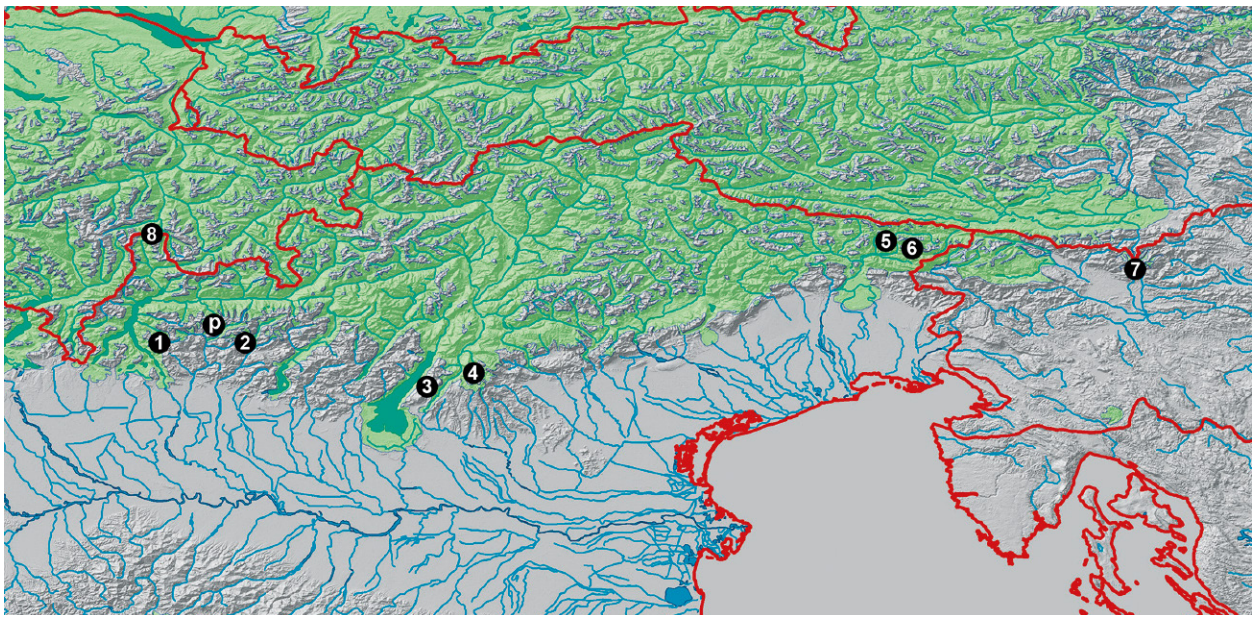


Fig. 24. Distribution of *Dichotrachelus pesarinii* (labeled "p") plotted on distribution map of the *Dichotrachelus* species from the southern central and eastern Alps: 1, Mt. Grigna: *D. grignensis*; 2, Pizzo Arera: *D.* cf. *grignensis*; 3, Mt. Baldo: *D.* cf. *philippi*; 4, Mt. Pasubio: *D. philippi* Osella, Bellò & Pogliano-Osella, 1983; 5, Mt. Sernio: *D. kahleni* Meregalli & Osella, 2007; 6, Mt. Plauris: *D.* cf. *kahleni*; 7, Mt. Grintavec: *D. luzei* Ganglbauer, 1895; 8, Mt. Spluga: *D. imhoffi*. Map after Ehlers et al. (2011), modified by H. Kühtreiber (Tiroler Landesmuseum Ferdinandeum, Innsbruck, Austria) and further modified. Final image processed using Photoshop CS3 (Adobe Systems Inc.).

Fig. 25. Mt. Cavallo, view from Bocchetta San Simone. *Dichotrachelus pesarinii* was found on the calcareous cliffs on the foreground (Photo G. Pedroni).

type locality or on the surrounding Orobian Alps between Val Brembana and Valtellina.

Distribution. As presently known, *D. pesarinii* is probably endemic to the massif of Mt. Cavallo in the Orobic Alps (Figs. 24, 25), Lombardy, Italy; it was found at 2080–2170 m a.s.l..

Etymology. We are pleased to name this interesting species after our friend Carlo Pesarini, in acknowledgement for his life-long activity devoted to the study of the Curculionoidea and his continuous support of all entomologists who required his advice.

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