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A new widely distributed invasive alien species of *Amasa* ambrosia beetles (Coleoptera: Curculionidae: Scolytinae: Xyleborini)

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Abstract

Amasa parviseta Knížek & Smith, new species is described from Australia, Brazil, Uruguay, France and Spain. The species is native to Australia and appears to have spread widely in association with introduced *Eucalyptus* species.

Key words: ambrosia beetles, new species, *Eucalyptus*

Introduction

Xyleborini ambrosia beetles (Coleoptera: Curculionidae: Scolytinae) are the most diverse of all scolytine tribes with over 1300 species in 43 genera (Ruzzier *et al*. 2022, 2023) distributed in temperate and tropical regions of the world, the vast majority of the which occur in the Paleotropics (Wood & Bright 1992). Xyleborines possess a combination of biological characteristics that have allowed them to diversify and colonize new areas. They are xylomycetophagous ambrosia beetles and adult females bore into wood and cultivate a symbiotic fungal garden using spores stored in cuticular structures termed mycangia on which the female and her offspring feed. Since the beetles feed on ambrosia fungal and not directly on host plant tissues, species are typically strongly polyphagous though some species and genera are specific at the family level (Ruzzier *et al*. 2022, 2023). The beetles have a strongly-female biased haplodiploid reproductive system with extreme inbreeding- diploid females mate with their haploid dwarfed and flightless brother inside of their natal gallery prior to dispersal (Smith & Hulcr 2015; Osborn *et al*. 2023). The beetles' small size and cryptic nature allows them to be easily transported through global trade (Haack & Rabaglia 2013). At least 49 (Johnson & Smith 2023; Osborn *et al*. 2023, but see Smith & Cognato, 2021) xyleborine species have become established outside of their native region. These exotic species have caused significant major economic and ecological damage to trees in forests, orchards, nurseries as well as urban/suburban settings (Hughes *et al*. 2017; Coleman *et al*. 2019).

Taxonomy of xyleborine ambrosia beetles is challenging due to their minute to small size, wood-boring lifestyle, haplodiploid reproductive system and general infrequency of collection. All *Amasa* species possess truncate elytral declivities in which most of the diagnostic characters are present. Most *Amasa* species were historically described from single specimens or very small series, often from traps, which did not allow for a complete assessment of intraspecific morphological variation. Hulcr & Cognato (2013) reviewed the *Amasa* fauna of Papua New Guinea and adopted a broad morphological species concept in which large amounts of intraspecific variation in the antennal club form, body color and size, and sculpturing of the declivity including interstrial form, setal length and density, and the size, density and depth of strial punctures were accepted. *Amasa* currently contains 47 species distributed in tropical Asia and Oceania. An additional two species are reported from Madagascar but these species do not belong in *Amasa* (Smith pers. obs.). The Indo-Chinese and New Guinean *Amasa* fauna was recently revised (Smith *et al*. 2020a, b; Sittichaya & Smith 2022) but the Indo-Malayan and Oceanian faunas had not received a taxonomic treatment beyond that of Wood & Bright's (1992) catalog which moved many Xyleborini species with truncate abdomens to *Amasa*.

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One exotic *Amasa* species first trapped in a *Eucalyptus grandis* plantation in São Paulo, Brazil was initially identified as *A. truncata* by Flechtmann & Cognato (2011) after direct comparison between the holotype and the Brazilian specimens. Hulcr and Cognato's broad morphological species concept was later reexamined using COI and CAD data by Smith *et al*. (2020a, b) and Cognato *et al*. (2020) which showed that *Amasa* species show very little intraspecific morphological variation and that intraspecific variation was discrete rather than continuous. Examination of this Brazilian *Amasa* and the holotype using the revised species concept showed that they were not conspecific but two morphologically similar species (Barnouin *et al*. 2020).

Amasa near *truncata* spread across South American *Eucalyptus* plantations and was reported in Minas Gerais, Brazil in 2015 (Rainho *et al*. 2018), Tacuarembó, Uruguay in 2015 (Gómez *et al*. 2017), Valparaíso, Chile in 2016 (Kirkendall 2018), and Argentina in 2018 (Córdoba *et al*. 2023). The species also became established in Europe-first appearing in Cádiz, Spain in 2009 (Viñolas & Verdugo 2011 as *Amasa resecta* (Eggers)), Antibes, France in 2018 (Barnouin *et al*. 2020), and Lisbon, Portugal in 2019 (Marchioro *et al*. 2022). The barcoding region of mitochondrial COI of a French specimen was sequenced by Barnouin *et al*. (2020) and found to be 100% identical to an undetermined *Amasa* from New South Wales, Australia (see Barnouin *et al*. 2020 for more details) which suggested that the species is native to Australia. Efforts to identify *Amasa* near *truncata* were hampered because of a lack of comprehensive taxonomic resources for the genus. This study reexamines the identity of *A*. near *truncata* in reference to types of all *Amasa* species. We conclude that *A*. near *truncata* is a species new to science as is described herein.

Materials and methods

Type specimens and original species descriptions were examined for all previously described *Amasa* species and synonyms and no species was found to be conspecific with *Amasa* near *truncata*. Pronotal and antennal types and characters follow those of Hulcr *et al*. (2007) and elaborated by Smith *et al*. (2020b). Length was measured from pronotal apex to the apex of the declivity and width was measured at the widest part of the specimen. Pronotal length included the anterior serrations and elytral length was measured from the anterior margin to the apex along the elytral medial suture. Measurements were taken using a WILD stereomicroscope (M5-97602) equipped with a reticle (eyepiece micrometer) in a 20x eyepiece and calibrated at magnification of 12. Photographs were taken by a Canon EOS 90D digital camera equipped with a Canon Macro Photo Lens MP-E 65 mm, 1:2.8, 1–5×, different sizes of extension tubes and led ring light with diffusor, mounted on a StackShot automated macro rail for focus stacking. Final photos assembled using by Helicon Focus 7. Verbatim label data is given for specimens.

The following abbreviations are used for collections mentioned in the text:

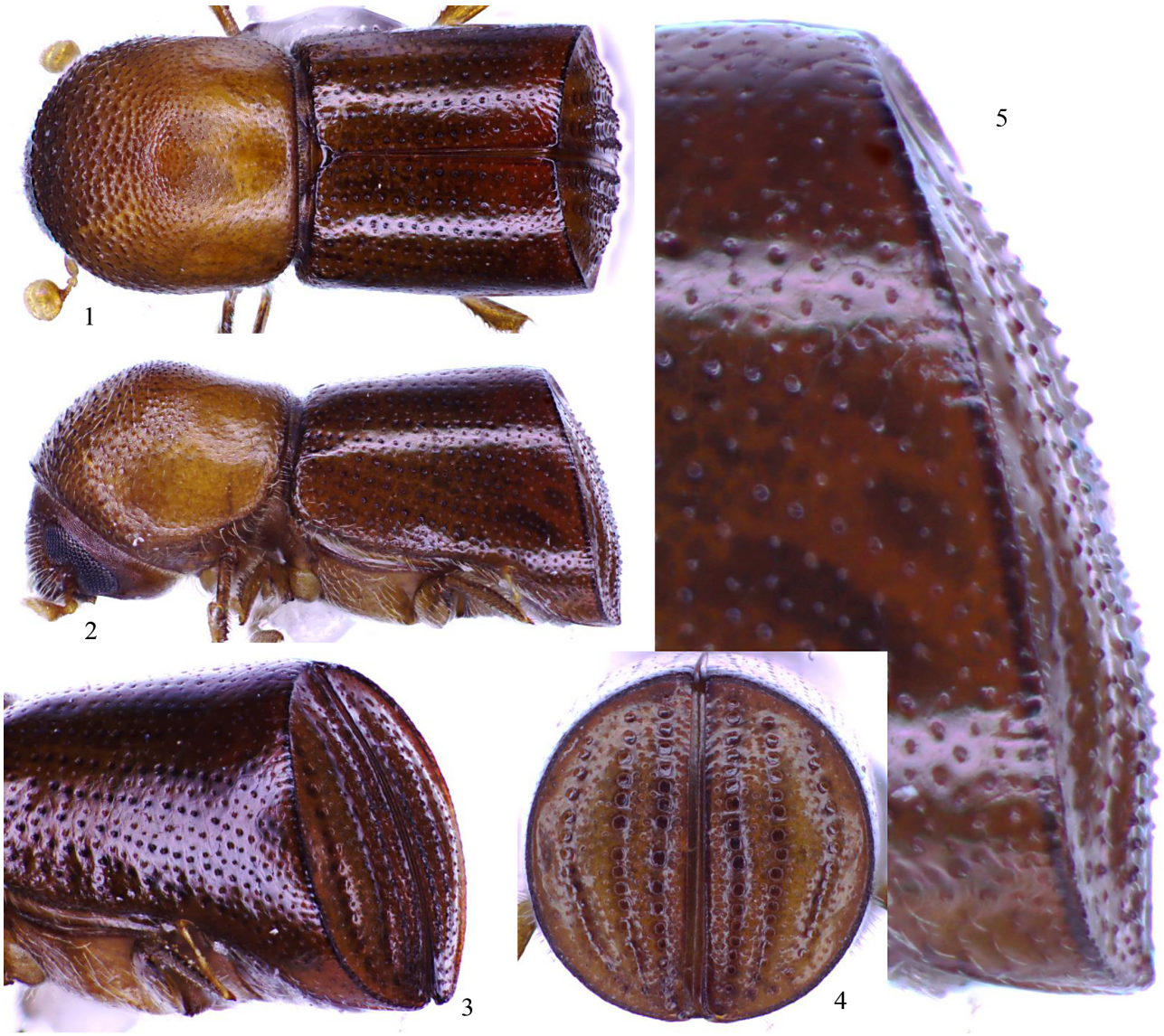
ANIC	Australian National Insect Collection, Canberra, Australia;
MK	Miloš Knížek private collection, Prague, Czechia;
MSUC	Albert J. Cook Arthropod Research Collection, Michigan State University, East Lansing, USA;
NHMUK	The Natural History Museum, London, United Kingdom;
QM	Queensland Museum, South Brisbane, Australia.

Amasa parviseta Knížek & Smith, new species

http://zoobank.org/urn:lsid:zoobank.org:act:71D2B606-9E48-41E0-A86B-C6B874D1F903
Figs 1–5

Type material. ***Holotype***, female, AUSTRALIA: 35.30S 150.24E, NSW [New South Wales], Bawley Point, 5 April 1997, D.C.F. Rentz (ANIC). ***Paratypes***, AUSTRALIA: 1 female, ACT [Australian Capital Territory] Black Mt. light trap, 4.iii.[19]68, M.S. Upton (ANIC); 1 female, 35.16S 149.06E, Black Mtn. nr. light trap, 12 Sept. 1994, T. Weir & W. Dressler, ANIC 1910, Berlesate, dry *Eucalyptus* litter (ANIC); 1 female, [Queensland], Brisbane, Banyo, Kennedy's Timber, 8 Aug 2006, W. Roe, in static trap 1514, MSUC_ARC_5000; 1 female, N. Qld, 31-X-1986, J.D. Brown, light trap (QM); 1 female; 7 km NE of Tolga, Feb 1988, Storey & De Faveri, light trap (QM); 1 female, as previous except: Dec 1988, NHMUK014189218; NSW [New South Wales] Wentworth Falls, 13.i.1955, K.M.

Moore, ex *E. piperita* (ANIC). FRANCE: 2 females, Villa Thuret, Antibes, summer 2021, 7,125216 E, 43,563919N, MK coll., 6 females, Paradou Park, Cannes, summer 2021, 7,05809 E, 43,56056 N, MK coll.; SPAIN: 15 females, Pontevedra, Vilagarcía de Arousa, "Monte Xiabre", 17. IV. 2008, Lindgren trap, in *Eucalyptus globulus* and *Pinus pinaster* mixed stand, MK coll.; BRAZIL: 2 females, SP [São Paulo], Lençóis Paulista, Duratex S.A., α-pinene + ethanol baited multiple funnel FIT, *Eucalyptus grandis* stand, Flechtmann, C.A.H. coll, 02/III/2007, MSUC_ARC_321578, MSUC_ARC_321579; URUGUAY: 3 females, Tacuarembó, Estación Experimental La Magnolia, 31°42'49.27" S, 55°49'20.95" W, June 2015, D. Gomez, extracted from basal area of dying *Eucalyptus grandis*, MSUC_ARC_320246, MSUC_ARC_320247, MSUC_ARC_320248.



FIGURES 1–5. *Amasa parviseta* paratype female from Ponteverda Spain (MK collection) 1) habitus dorsal view; 2) habitus lateral view; 3) elytral declivity part; 4) elytral declivital face; 5) lateral detail of elytral declivity with microscopic hair-like setae visible on the lateral edge of the declivity and on the apices of tubercles on the declivital face. Photographs by Antonín Knížek.

Diagnosis. 2.38–3.00 mm long (n = 35); 2.06–2.40× as long as wide. The species is distinguished by the pronotum appearing basic (type 2) when viewed dorsally, anterior margin serrate; declivity slightly convex, surface shining, smooth, nearly glabrous; declivital interstriae 1–4 multiseriate granulate, granules confused; and declivital interstriae convex.

Similar species. *Amasa truncata, A. resecta, A. versicolor* (Sampson)

Description (female). 2.38–3.00 mm long (n = 35) (2.70 mm in HT); 2.06–2.40× as long as wide (2.25× in HT).

Body usually bicolored: pronotum, head, legs, antennae and abdomen light brown, elytra darker. ***Head*****:** epistoma entire, transverse, with a row of hair-like setae. Frons weakly convex to upper level of eyes; surface strongly shagreened, impunctate, granulate; granules slightly longitudinal, rounder, denser above epistoma, increasing in size and length and decreasing in density dorsally and laterally; whole surface with very sparse, fine and rather long hair-like setae, their length similar to the maximum width of eyes. Eye emarginate to half its width just above antennal insertion, upper part smaller than lower part. Submentum triangular, deeply impressed. Antennal scape as long as club. Pedicel as wide as scape, shorter than funicle. Funicle 4-segmented, segment 1 shorter than pedicel. Club approximately circular and flat, type 4; segment 1 corneous, transverse on anterior face, occupying basal 1/4; segment 2 narrow, larger than segment 1, corneous; segments 1–3 present on posterior face. ***Pronotum*****:** 0.93–1.17× as long as wide (1.04 in HT). In dorsal view basic and parallel-sided, type 2, sides parallel in basal 1/2, rounded anteriorly; anterior margin with a row of 10–14 serrations. In lateral view basic, type 0, disc flat, summit at midpoint. Anterior slope shagreened, shining, with densely spaced, fine transversal asperities, becoming lower, smaller and denser towards summit, bearing long, fine, semi-recumbent, hair-like setae. Disc shiny, shagreened, sparsely fine punctate in posterior part, sparsely granulate in anterior part to the summit, with microscopic hair-like setae. Lateral margins obliquely costate. Base transverse, posterior angles broadly rounded. ***Elytra*****:** 1.14–1.44× as long as wide (1.21× in HT), 1.00–1.50× as long as pronotum (1.16× in HT). Scutellum moderately sized, broad, linguiform, flush with elytra, flat, shiny. Elytral base transverse, edge oblique, humeral angles rounded, parallel-sided in basal 3/4, then sharply angulate to apex. Disc ascending posteriorly, shiny, with very short fine semirecumbent hair-like setae in punctures; striae and interstriae laterally diverging from base to declivital summit; striae not impressed, punctures separated by two diameters of a puncture; interstriae flat, finely punctate, punctures fine, up to 1/2 the size of strial punctures, uniseriate, becoming confused and biseriate posteriorly. Declivity truncate, face slightly convex, smooth, shining, nearly glabrous; three striae present, striae moderately impressed, especially the first one, the third one evenly curved laterally in the middle and more distant from the others, strial punctures shiny, very large, shallow, with visible bottom, much larger than on disc, punctures subcontiguous to separated by one diameter of a puncture; interstriae smooth, semishining, impunctate, convex, sutural interstriae narrower than others, interstriae 1–4 multiseriate granulate, granules strongly confused, biggest on the interstriae 1 and 2, becoming smaller and sparse on lateral interstriae, bearing very fine and short microscopic hair-like setae. Posterolateral margin forming a circumdeclivital carina, carina almost glabrous, with very fine and short microscopic sparse hair-like setae. ***Legs*****:** procoxae contiguous; prosternal coxal piece bulging. Protibiae slender, broadest at apical 1/3; posterior face inflated, coarsely granulate; apical 1/2 of outer margin with 6–8 small socketed denticles, their length as long as basal width. Meso- and metatibiae broad, flattened, outer margins evenly rounded with 10 small and nine small to minute socketed denticles, respectively; posterior faces unarmed; anterior faces finely granulate.

Differential diagnoses. The species is the morphologically most similar to *Amasa truncata*, from which it differs mainly in the form of the elytral declivity, which is "hairy" in *A. truncata* with hair-like setae of nearly equal length present in all interstriae of declivital face and also on the posterolateral circumdeclivital carina, these are rather long, longer than the diameter of the strial punctures on the declivity. Granulation of the declivital interstriae is not so conspicuous or abundant as in the new species. *Amasa resecta* is remarkably bicolored with light pronotum and dark elytra and has dull glabrous elytral declivity with sparse granules on declivital interstriae, which are completely missing on interstriae 4. *Amasa versicolor* has also dull elytral declivity and with short hair-like setae on both the interstriae and on the posterolateral circumdeclivital carina (interstrial setae shorter than in *A. truncata*).

Etymology. L. *parvi* = small, L. *seta* = hair, in reference to the nearly glabrous elytral declivity and its posterolateral carina, with microscopic fine setae only, contrary to the morphologically most similar species *A. truncata*.

Distribution. Australia (Australian Capital Territory, New South Wales, Queensland). Europe: France (incl. Corse, A. Roques pers. comm.), Portugal, Spain. South America: Argentina (Tucumán), Brazil (Minas Gerais, São Paulo), Chile (Valparaíso), Uruguay.

Host plants. Specimens were collected from *Eucalyptus piperita* and *Eucalyptus* leaf litter in Australia and *Eucalyptus* in Chile, Uruguay and France (Gómez *et al*. 2017; Kirkendall 2018, A. Roques pers. comm.), otherwise all known specimens were collected in traps located in areas of *Pinus* and *Eucalyptus* trees.

Remarks. This species was initially determined to be *Amasa truncata* in the following publications: Cognato & Flechtmann (2011), Gómez *et al*. (2017), Raihno *et al*. (2018), Kirkendall (2018); *Amasa resecta* (Viñolas & Verdugo 2011); *Amasa* near *truncata* in Barnouin *et al*. (2020); and *Amasa* sp. in Marchioro *et al*. (2022) and Córdoba *et al*. (2023).

Discussion

Amasa parviseta highlights the need for continued taxonomic research on scolytines and xyleborines in particular. *Amasa parviseta* along with *Coptoborus ricini* (Eggers), *Cyclorhipidon californicum* (Wood), *Euwallacea kuroshio* Gomez & Hulcr, *Cyclorhipidion nemesis* Smith & Cognato (Gomez *et al*. 2018; Smith & Cognato 2021; Smith & Cognato 2022) were all well-established outside of their native ranges prior to their description. The lack of taxonomic resources for xyleborines hinders species identification which is further compounded by the sheer diversity of the xyleborine fauna. Years of research, including literature review, examination of types and generation of DNA data, were spent to identify each species. During this time, ecological and biological research proceeded on these species however impeded by a lack of a scientific name to effectively communicate the species identity. As a consequence, knowledge of each species is obscured by a convoluted literature record.

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