First Report of Nathrius brevipennis (Mulsant) (Coleoptera: Cerambycidae: Cerambycinae) in Australia, with Notes on Diagnostic Characters, Biology and Habits, Distribution, and Hosts

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First Report of *Nathrius brevipennis* (Mulsant) (Coleoptera: Cerambycidae: Cerambycinae) in Australia, with Notes on Diagnostic Characters, Biology and Habits, Distribution, and Hosts

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Abstract

We report the first biosecurity surveillance detections of the adventive cerambycid beetle *Nathrius brevipennis* (Mulsant) by the Australian Government Department of Agriculture, Fisheries and Forestry. The detections in panel traps near the port of Melbourne, Victoria, Australia are a result of ongoing pest monitoring by the department's National Border Surveillance program. *Nathrius brevipennis* adults were detected at three separate trap sites over three successive summers (2019–2022), which suggests that a localized population is established. Apparently native to the western Mediterranean, *N. brevipennis* has been introduced to other countries via the trade of manufactured wicker work and basketry articles and is now almost cosmopolitan. The species is highly polyphagous, recorded from at least 42 genera across 22 plant families. There are earlier records of *N. brevipennis* from the 1920s in Melbourne and Adelaide. These were misidentified as *Molorchus* sp., and the source of these detections is unclear. Diagnostic characters and photographs of both sexes of *N. brevipennis* are presented together with an extensive review of host associations and DNA barcode data based on the mitochondrial cytochrome c oxidase subunit I (COI) gene.

Keywords: new country record, panel trapping, timber pest, woodborer

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Introduction

The longhorn beetle family Cerambycidae is a biologically and economically important group of about 36,000 described species (Haack 2017). They are phytophagous, and many species are polyphagous, with their larvae developing on a wide variety of host plants in either live, dead, or decaying tissue. Cerambycids play an important role in nutrient recycling, as the larvae and adults possess specialized chisel-like mandibles, and the inclusion of metal in their composition allows them to process hard plant tissues (Martínez *et al.* 2020).

Some non-native longhorn beetles are of significant biosecurity concern to Australia, as they could damage timber-in-service as well as forestry, orchard, and amenity trees (Lawson *et al.* 2018). These beetles may be introduced via trade in infested nursery stock, infested wood packaging (*e.g.*, pallets, crates), sawn timber and manufactured wooden articles, or even as hitchhikers on cargo and conveyances (Eyre and Haack 2017). While items of international trade are subject to border controls and import conditions, surveillance at first points of entry and beyond provides additional opportunities for early detection of accidental introductions (Carnegie and Nahrung 2019; Carnegie *et al.* 2022).

A small number of exotic longhorn beetle species have established in Australia as adventive species through international trade or have been deliberately introduced. Two species of *Arhopalus* Audinet-Serville have established in pine plantations in southeastern Australia—*Arhopalus syriacus* (Reitter, 1895) near Sydney since the 1950s and

Arhopalus rusticus (Linnaeus, 1758) in Melbourne since the late 1990s (Wang and Leschen 2003; Webb and Eldridge 1997). *Chlorophorus annularis* (Fabricius, 1787) was introduced with bamboo into many countries, including Australia, and remains common in southern Queensland in bamboo plantings (Ślipiński and Escalona 2013). *Lagocheirus funestus* (Thomson, 1865) was introduced from Mexico in 1935 as a biological control agent for prickly pear cactus (*Opuntia* spp.; Cactaceae). Dense stands of prickly pear have since been eradicated, but this beetle was last collected in January 1984 and may have died out in Australia (Ślipiński and Escalona 2013). The European house borer, *Hylotrupes bajulus* (Linnaeus, 1758), was probably imported into Australia in pine construction timber in the late 1940s (Howick 2014). *Hylotrupes bajulus* remains a regulated pest in southwest Western Australia following its detection in 2004 in the Perth suburb of Parkerville (Grimm 2005; Howick 2014). The basket beetle, *Gracilia minuta* (Fabricius, 1781), is a minor pest of European origin, with larvae that develop in branches or twigs of various trees and shrubs and can cause damage to wicker work, casks, or other rustic wood products (Duffy 1953). There are historic records and old specimens from the Sydney and Melbourne regions, but the species does not appear to have established in Australia (Ślipiński and Escalona 2016).

It is important to document new detections of pests to facilitate their eradication or management at lowered cost and to minimize environmental damage (Cuthbert *et al*. 2022; Diagne *et al*. 2021; Nahrung and Carnegie 2020). In 2017, the Science and Surveillance Group within the (then) Australian Government Department of Agriculture, Water and the Environment (DAWE) initiated the National Border Surveillance (NBS) program to conduct surveillance at high-risk sites such as Australian first points of entry (*e.g.*, Australian ports) and importers' premises.

Here we report the first detections of *Nathrius brevipennis* (Mulsant, 1839) (Cerambycidae: Cerambycinae) in panel traps deployed by the NBS in Melbourne, Australia. We also present historical records of *N. brevipennis* in Australia and provide an overview of the biology, habits, host records, and distribution together with diagnostic characters and photographs to aid in the identification of *N. brevipennis* adults.

Material and Methods

Panel traps (Alpha Scents, Inc., Canby, OR) were placed at multiple sites in Melbourne starting in 2017 as part of ongoing surveillance activities. Traps (approximately 800 mm high × 220 mm wide) were baited with an ultra-high release (UHR) α-pinene lure (product code: IP037-75, IP037-CT75 I002B by Chemtica™) and a slow-release formulation of 2-(n-undecyloxy) ethanol, 2-methyl-3-buten-2-ol and Ipsenol lure [product code: P333-Lure by Chemtica, targeting the pine sawyer beetle, *Monochamus galloprovincialis* (Olivier)]. Suspended below the panel trap was a catch container filled with a 50:50 mixture of propylene glycol and water used to preserve collected specimens. In 2017 and 2018, eight traps were deployed in total, seven of which were suspended from tree branches approximately 1–2 m above the ground (one at Station Pier was attached to a building because there was no suitable vegetation from which to suspend the trap). The Station Pier trap was decommissioned in 2019, *i.e.*, seven traps were run since then, except for when two additional traps were deployed from 7 February–1 March 2022. Traps were checked weekly. Catch containers were removed and the contents poured through a sieve in the field to collect specimens. Starting in September 2019, the contents were brought back to the laboratory, where they were run through muslin cloths and then examined using a microscope. Lures were replaced approximately every eight weeks, or earlier if dry.

Photographs of the beetles were taken on a BK Plus Lab System (Visionary Digital, USA) and subsequently combined using stacking software, Zerene Stacker (Zerene Systems LLC). Some structural illustrations of adults were made from dissected specimens using a Leica MZ20 microscope with various attached digital cameras.

DNA extraction was performed using a DNeasy® blood and tissue kit (QIAGEN), following the manufacturer's protocol for animal tissues using spin columns. The whole body of the specimen was suspended in homogenization buffer and subjected to lysis for 2 h. The final elution volume was 80 µL. PCR primers LCO1490/HCO2198 were used. The PCR conditions were as follows: 2 min at 95 °C; followed by 38 cycles of 30 s at 95 °C, 30 s at 47 °C, and 1 min at 72 °C; and 7 min at 72 °C. The PCR product was sequenced by Australian Genome Research Facility (AGRF) in Melbourne. The sequence data was lodged in the Barcode of Life Database (BOLD) and GenBank.

In the preparation of this manuscript, we conducted an extensive review of the literature to find host records, but our review should not be regarded as complete. Host plant names have been updated in accordance with the World Flora Online website (WFO 2022) or Hassler (2022). Specimens collected in the panel traps are deposited in the Department of Agriculture, Fisheries and Forestry invertebrate collection, Melbourne.

Museums and collections:

BIOUG = Centre for Biodiversity Genomics, University of Guelph, Ontario, Canada
MVMA = Museum of Victoria, Melbourne, Victoria, Australia
SAMA = South Australian Museum, Adelaide, Australia

Results

Detections in Panel Traps in Melbourne. The first specimen, a male, was collected from panel trap No. 8 (PT8) on 11 December 2019 at "Yarraville Gardens" (37°50′15″S 144°53′37″E) (BISS 402756). This trap was suspended from a *Cupressus macrocarpa* Hartw. ex Gordon (Cupressaceae) tree approximately 2 m above the ground. A female specimen was collected on 9 February 2021 from PT7 ("Wildlife Reserve") (37°50′08″S 144°55′02″E), suspended from a *Bursaria spinosa* Cav. (Pittosporaceae) shrub (BISS 420254). Another two males were collected from PT3 ("Qube Logistics") on 30 December 2021 (37°48′39″S 144°55′58″E) (BISS 446495). This trap was suspended from a Norfolk Island pine, *Araucaria heterophylla* (Salisb.) Franco (Araucariaceae). Finally, a female specimen was collected from the same trap (PT3) on 17 January 2022 (BISS 435846). A COI barcode was obtained from this specimen, which confirmed the morphological identification of *N. brevipennis* (see Molecular Data below).

Historical Records. The literature lists earlier Australian records. The online "Titan" database (Tavakilian and Chevillotte 2022) for *N. brevipennis* includes a reference to a misidentification of "*Molorchus* sp." (Matthews 1997). Matthews (1997: fig. 7) shows a *N. brevipennis* male, and characters in the pictorial key (Matthews 1997: plate 4) are consistent with *N. brevipennis*, *i.e.*, the eye rounded, not excised or divided, frontoclypeus without pit-and-tongue organ, small body size (3–4 mm), and shortened elytra. The text states "the only SA examples are a series of specimens collected in the 1920's or earlier in Adelaide which appear to be an introduced species (illustrated), probably not established. They are included here and in the key because a native species of the genus (*Molorchus sidus* Newman) has been described, but its description does not agree with these specimens." A search of the SAMA collection failed to locate these specimens. However, there is one specimen in MVMA that was collected in Melbourne by F. E. Wilson during December 1921, tentatively identified as *Molorchus* Fabricius sp. by A. Ślipiński (Coll. 38238). On the Pest and Disease Image Library (PaDIL) website (PaDIL 2022) we also found images of both sexes of *N. brevipennis*. These specimens, which had also been misidentified as "*Molorchus* sp.", were collected from a hawthorn (*Crataegus*; Rosaceae) lamp stand in March 2008. The lamp stand probably came from a retail store and was likely imported, but we cannot confirm this because records of the detection no longer exist (K. Walker, personal communication). Attempts to locate these specimens were also unsuccessful.

Diagnosis and Description

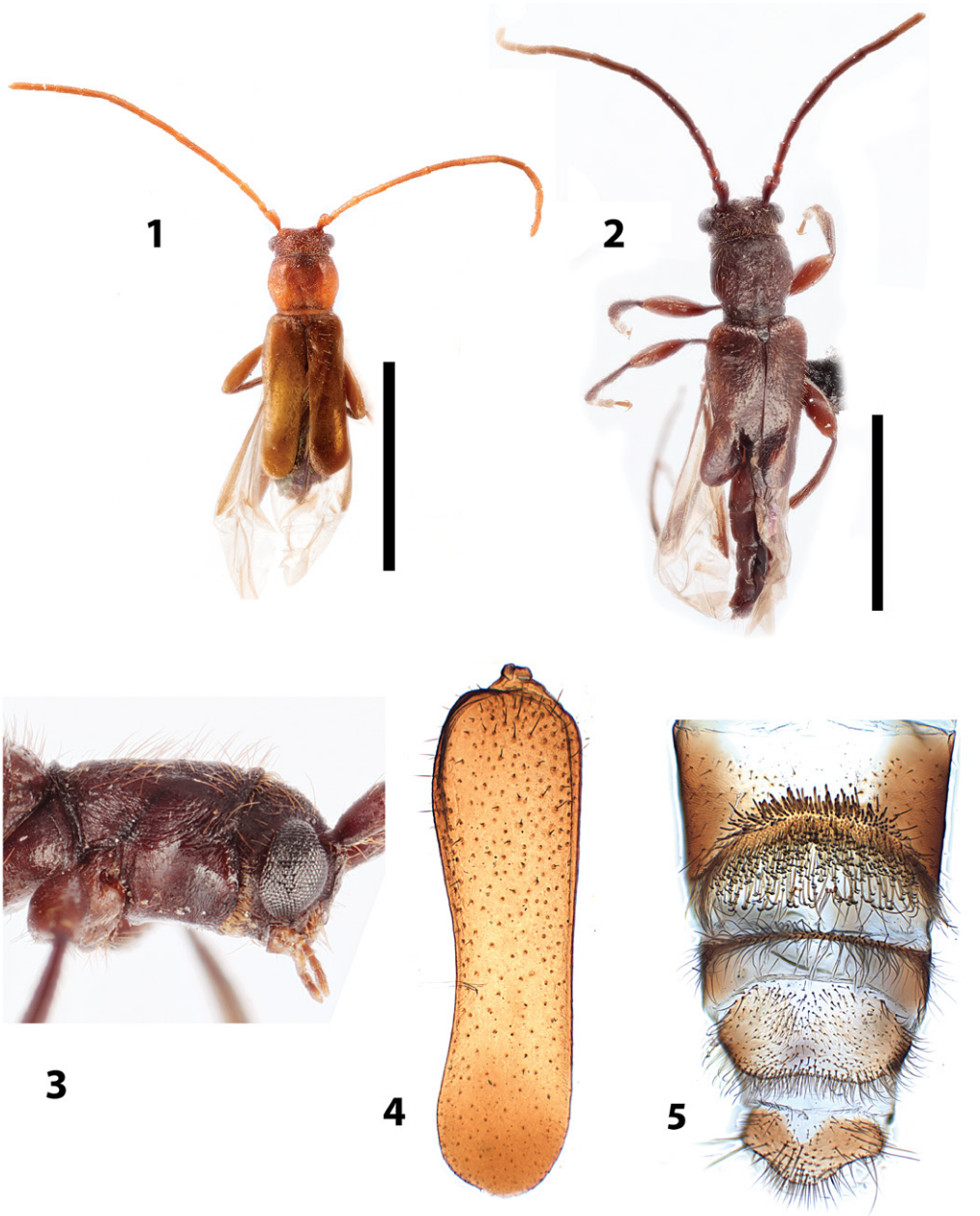
Tribe Psebiini
Nathrius Brèthes, 1916

Nathrius Brèthes 1916: 76. Type species: *Nathrius porteri* Brèthes, 1916, by monotypy.
Leptidea Mulsant 1839: 105. Type species: *Leptidea brevipennis* Mulsant, 1839, by monotypy. Junior homonym.

Nathrius brevipennis (Mulsant, 1839)
(Figs. 1–5)

Leptidea brevipennis Mulsant 1839: 105.
Leptidea minuta Motschulsky 1845: 84.
Gracilia manca LeConte 1850: 24.
Gracilia rufipennis Dufour 1851: 351.
Nathrius porteri Brèthes 1916: 77.
Leptideela brevipennis (Mulsant, 1839): Strand 1936: 169.
Deuteroleptidea brevipennis (Mulsant, 1839): Paclt 1946: 169.

Diagnosis. Small brown beetles with antennae nearly as long as the body. Frontoclypeus transverse. Eyes large, ovoid, coarsely faceted, weakly emarginate near antennal insertion; larger in male than in female. Antennal tubercles broadly separated, distant from mandibular articulation. Antennal foramen in shallow depression with external articulation. Antennal scape expanded towards apex, distinctly shorter than pronotum; pedicel longer than wide; antennomere 3 subequal to scape; antennomere 5 in male slightly longer than antennomeres 3 and 4 combined, in females antennomere 5 as long as, or nearly as long as, antennomere 3 and 4 combined. Prothorax broadly rounded, wider than long, lateral margins smooth; pronotal disc without callosities or tubercles. Prosternal process incomplete between coxae. Procoxal cavities with lateral angular extension exposing protrochantin; open externally. Procoxae projecting below level of prosternum. Mesoventrite flat anteriorly; mesoventral intercoxal process narrow. Mesocoxal cavities open to mesepimeron; mesotrochantin exposed. Elytra short, dehiscent, apices acutely rounded, exposing abdomen and wings. Femora distinctly expanded distally; hind femur almost reaching apex of abdomen; tibiae not flattened.



Figs. 1–5. *Nathrius brevipennis*. **1)** Female, dorsal view. Scale bar = 2 mm; **2)** Male, dorsal view. Scale bar = 2 mm; **3)** Male, lateral view; **4)** Female, left elytron; **5)** Female, abdominal ventrites 2–5.

Abdomen with 5 ventrites, ventrites 2–5 modified in female.

Description. Length: 2.8–5.0 mm. Body elongate-oval, length 4.0–4.2 times width, bearing sparse erect setae of variable length. Sexual dimorphism: body color yellowish-brown to ferrugineus-testaceous (particularly the prothorax) in females (Fig. 1) compared to dark brown to reddish-brown in males (Fig. 2); underside of body reddish-brown, sometimes ferrugineus-testaceous, usually paler in females; eyes larger and more convex in males, smaller and less convex in females. Females with abdominal ventrites 2–5 modified and densely setose. **Head:** Transverse, not constricted behind the

eyes. Frontoclypeus inclined, transverse, finely rugose. Frontoclypeal suture weakly impressed. Gland opening at base of mandibles absent. Median frontal groove present. Longitudinal carina extending from antennal insertion usually at least partially visible anteriorly. Eyes coarsely facetted, ovoid and weakly emarginate near antennal insertion (Fig. 3), larger and more convex in male than in female. Gena in front of eye short. Labrum transverse, ligula membranous; apical labial palpomere elongate and tapered apically, longer than penultimate palpomere. Galea and lacinia normal; apical maxillary palpomere elongate, cylindrical and truncate apically, longer than penultimate palpomere. Mandible curved and pointed apically. Antennal insertions separated by 3–4 times diameter of antennal foramen. Antennal foramen in shallow depression with external articulation, widely separated from mandibular articulation; dorsal-most margin above upper margin of eye. **Antenna:** 11-segmented, filiform; in male almost reaching apex of abdomen; basal antennomeres with few erect setae, apical antennomeres with short setae only. Scape expanded towards apex, 0.3 of pronotum length, posteriorly extending to anterior margin of pronotum; pedicel longer than wide. Antennomere 3 and scape subequal; antennomere 5 in males slightly longer than 3 and 4 combined, in females antennomere 5 as long as or nearly as long as 3 and 4 combined. Antennomeres without spines. Terminal antennomere a little longer than penultimate. **Prothorax:** Wider than long; approximately as wide as head; widest at middle; not constricted at apex; constricted at base. Pronotal disc medially depressed, with sparse setae; lateral margins without tubercles or spines. Male (Fig. 3) with more and longer setae than female. Microsculpture with fine transverse striations basally and small reticulations medially in females; males with fine transverse striations basally and rugose medially and laterally. Prosternum in front of procoxae about 1.6–1.7 times mid-length of procoxal cavity. Prosternal process incomplete between procoxae. Procoxal cavity with lateral extension exposing protrochantin; open posteriorly. Procoxae conical, strongly projecting below level of prosternum. **Pterothorax:** Scutellar shield rounded apically, disc glabrous. Mesonotum without striated stridulatory area. Mesoventrite in front of coxae flat or gradually rising to mesocoxae. Mesocoxae projecting, with only partially delimited cavities, at narrowest point separated by about 0.2 of coxa diameter. Secondary mesocoxal articulation absent; mesoventral intercoxal process narrow and not notched apically. Mesocoxal cavity open to mesepimeron; mesotrochantin exposed. Metaventrite without functional scent gland openings. **Elytra:** Short, about 2.0 times mid-length of prothorax in males, about 2.4 times mid-length of prothorax in females (Fig. 4). Elytra dehiscent and rounded apically, covering at most three-quarters of abdomen. Elytral punctures shallow, sparse, confused, not arranged in rows; a seta inserted in each puncture. Setae both more numerous and longer in males; in females setae more prominent in basal quarter of each elytron. Wings extended beyond elytra, folded only towards their extremity when at rest, leaving the distal abdomen bare. **Legs:** Protrochanter strongly oblique. Protibia not curved inwards; antennal cleaner complete; protibial spurs paired. Femora without ventral setose brushes. Meso- and metafemora arched and pedunculate-clavate (abruptly thickening distally). Metafemur not exceeding apex of abdomen. Tibia narrow, covered with long setae and bristles. Metatarsomere 1 about same length as tarsomeres 2–5 together. Empodium not visible; pretarsal claws widely divergent. **Abdomen:** Ventrite 1 in female elongate, as long as ventrites 2–5 combined; in male, ventrite 1 about as long as ventrites 2–3 combined. Ventrites 2–5 in female modified (Fig. 5). **Male terminalia:** Not examined.

Remarks. In the key to Australian Cerambycinae (Ślipiński and Escalona 2016), *Nathrius* keys to couplet 24 (*Molorchoepania* Pic). These genera are very similar, sharing the following characteristics: they are small beetles (3–6 mm long) with shortened elytra, the prosternal process is reduced between the narrowly separated procoxae, and the procoxal cavity is broadly open posteriorly. However, some differences are reflected in the tribal classifications: in Psebiini (*Nathrius*) the eye is rounded (with a weak emargination near the antennal insertion), whereas in Molorchini (*Molorchoepania*) the eye is more or less emarginate (reniform). Furthermore, there is a hair brush on the abdominal ventrites of female *N. brevipennis* used during egg laying to coat eggs with frass and dust which, upon hardening, forms a protective layer. Similar hair brushes that perform a similar function have been reported from a number of other female cerambycids in the "Obriini group" (*sensu* Martins 2003) such as *Paraleptidea femorata* Gounelle in Chile (Gounelle 1913) and *Wahn zonulitis* McKeown in Australia (Ślipiński and Escalona 2016). Prior to the publication of Ślipiński and Escalona (2016), *N. brevipennis* would be misidentified as *Molorchus* sp. when using the key in Matthews (1997).

Molecular Data. The COI barcode sequence (683 bp) is available on BOLD (http://boldsystems.org): BIN BOLD:ACD4181, dataset (dx.doi.org/10.5883/DS-NATHBREV); and on GenBank (accession: OP270245). At the time of writing, there are two other sequences assigned to BIN BOLD:ACD4181 with publicly available data as follows: the first (579 bp) is a 100% match to our sequence: 12–19.vi.2013, Egypt, Alexandria, Smouha, Antoniades Gardens, leg. O. El-Ansary (BIOUG [BIOUG14838-G09]); the second (632 bp)

is a 99.2% match to our sequence: 22.vi.2011, France, Occitanie, Languedoc-Roussillon, Pyrenees orientales, Maury, reared ex *Quercus* sp., leg. G. Parmain (BOLD Sequence ID: PSFOR064-13; GenBank Accession: KM285883). Another 17 private BOLD records that have been identified as *N. brevipennis* are a >99% match to our specimen.

Distribution. Apparently native to southern Europe and western Mediterranean. Records exist for many other regions (*e.g.*, in northern Europe) due to the historic trade in basketware, etc., including Europe, Asia Minor, Middle East, Caucasus, Transcaucasia, and North Africa; introduced in China, North and South America (Di Iorio 2004; MacRae and Rice 2007; Sama 2002). The species has also been reported from New Zealand (Brockerhoff and Bain 2000; Sopow *et al.* 2015).

Host Plants, Biology, and Habits. *Nathrius brevipennis* is highly polyphagous, feeding on dead and dying twigs and branches of a wide variety of deciduous trees and shrubs and sometimes conifers. Host records exist across 42 genera and 22 plant families (genera are listed alphabetically within plant families). Anacardiaceae: *Pistacia* (Ambrus *et al.* 2014; La Mantia *et al*. 2010; Németh *et al.* 2019), *Pistacia lentiscus* L. (Duffy 1957; Linsley 1963; Normand 1937; Papp 1988; Sama 2002; Sama *et al.* 2010; Villiers 1946), *Pistacia terebinthus* L. (Sama *et al.* 2010); Araliaceae: *Hedera* (Özdikmen 2021), *Hedera helix* L. (Schimitschek 1944); Araucariaceae: *Araucaria angustifolia* (Bertol.) Kuntze (Barriga *et al.* 1993); Betulaceae: *Alnus* (Cherepanov 1988; Švácha and Danilevsky 1988), *Corylus* (Linsley 1963; Sturani 1981; Švácha and Danilevsky 1988), *Corylus avellana* L. (Bosq 1948); Cannabaceae: *Celtis* (Halperin and Holzschuh 1993, as cited in Sama *et al.* 2010; Sama 2002); Cornaceae: *Cornus* (Švácha and Danilevsky 1988), *Cornus sanguinea* L. (Müller 1949–1953; Sama 2002); Cupressaceae: *Cupressus* (Linsley 1963; Özdikmen 2021; Picard 1919, 1929), *Cupressus sempervirens* L. (Sama 2002); Fabaceae: *Ceratonia* (La Mantia *et al*. 2010; Linsley 1963; Özbek *et al.* 2015), *Ceratonia siliqua* L. (Ambrus *et al.* 2014; Dauber 2004; Duffy 1957; Halperin and Holzschuh 1993, as cited in Sama *et al.* 2010; La Mantia *et al.* 2010; Linsley 1963; Mifsud and Booth 1997; Özdikmen 2021; Peyerimhoff 1919; Sama 2002; Sama *et al.* 2005; Sturani 1981; Villiers 1946), *Spartium junceum* L. (Picard 1919, 1929), *Wisteria sinensis* (Sims) Sweet (Barriga *et al.* 1993; Bosq 1948; Linsley 1963); Fagaceae: *Castanea* (Duffy 1953; La Mantia *et al.* 2010; Linsley 1963; Švácha and Danilevsky 1988), *Castanea sativa* Mill. (Brasavola de Massa 1934; Di Iorio 2004; Georgiev *et al.* 2013), *Quercus* (Linsley 1963; Mayet 1903; Özdikmen 2021; Rungs 1947; Sama *et al.* 2010; Švácha and Danilevsky 1988), *Quercus agrifolia* Née (Linsley 1933, 1963), *Quercus canariensis* Willd. (Bedel 1885; Duffy 1957; Villiers 1946), *Quercus coccifera* L. (Chikatunov *et al.* 1999, as cited in Sama *et al.* 2010; Recalde Irurzun and San Martín Moreno 2015), *Quercus ilex* L. (La Mantia *et al.* 2010; Müller 1949–1953; Sama 2002; Sturani 1981), *Quercus palustris* Münchh. (Di Iorio 2004), *Quercus robur* L. (Halperin and Holzschuh 1993, as cited in Sama *et al.* 2010; Sama 2002), *Quercus wislizeni* A.DC. (MacRae and Rice 2007); Juglandaceae: *Juglans* (Linsley 1963; Mayet 1903; Németh *et al.* 2019; Švácha and Danilevsky 1988), *Juglans californica* S. Watson (Linsley 1963), *Juglans regia* L. (Ambrus *et al.* 2014; Barriga *et al*. 1993; Bosq 1948; Di Iorio 2004; Linsley 1933, 1963; Middlekauff and Underhill 1949; Özbek *et al.* 2015; Özdikmen 2021; Sama 2002; Santas 1984; Tyson 1966); Lauraceae: *Laurus nobilis* L. (Bosq 1943, 1948; Di Iorio 1996, 2004; Linsley 1963), *Persea americana* Mill. (Barriga *et al.* 1993); Moraceae: *Ficus* (Linsley 1963; Picard 1919, 1929), *Ficus carica* L. (Barriga *et al.* 1993; Di Iorio 2004; Middlekauff and Underhill 1949; Özdikmen 2021), *Maclura pomifera* (Raf. ex Sarg.) C. K. Schneid. (Bosq 1948; Linsley 1963), *Morus* (Di Iorio and Farina 2009; Linsley 1963; Novak 1940; Švácha and Danilevsky 1988), *Morus nigra* L. (Bosq 1948; Sama 2002); Oleaceae: *Fraxinus* (Cherepanov 1988; Švácha and Danilevsky 1988), *Ligustrum* (Linsley 1963), *Ligustrum japonicum* Thunb. (Bosq 1948), *Olea* (Linsley 1963), *Olea europaea* L. (Bosq 1948; Chiesa-Molinari 1948); Passifloraceae: *Passiflora caerulea* L. (Di Iorio and Farina 2009); Pinaceae: *Abies* (Özdikmen 2021), *Cedrus* (Özdikmen 2021), *Cedrus atlantica* (Endl.) Manetti ex Carriere (Bosq 1948; Halperin 1986; Sama 2002), *Cedrus libani* A. Rich. (Sama 2002), *Picea* (Sturani 1981), *Picea abies* (L.) H. Karst. (Brasavola de Massa 1934), *Pinus* (Demelt 1974; Linsley 1963; Özdikmen 2021; Vives and Trócoli 2021), *Pinus halepensis* Mill. (Duffy 1957; Linsley 1963; Peyerimhoff 1919; Sama 2002; Villiers 1946); Poaceae: *Zea mays* L. (Hoffmann 1925); Rhamnaceae: *Ziziphus lotus* (L.) Lam. (Duffy 1957; Linsley 1963; Picard 1919, 1929; Sama 2002; Villiers 1946); Rosaceae: *Cotoneaster* (Sama 2002), *Cotoneaster franchetii* Boiss. (Halperin 1986), *Crataegus* (Cherepanov 1988), *Cydonia oblonga* Mill. (Barriga *et al.* 1993), *Heteromeles arbutifolia* (Lindl.) M. Roem. (Leech 1954), *Prunus* (Linsley 1963; Novak 1940), *Prunus amygdalus* Batsch (Migliaccio *et al.* 2007; Sama 2002; Santas 1984), *Prunus domestica* L. (Barriga *et al.* 1993), *Pyrus* (Cherepanov 1988; Švácha and Danilevsky 1988), *Pyrus communis* L. (Bosq 1948), *Rhaphiolepis bibas* (Lour.) Galasso & Banfi (Mifsud and Booth 1997), *Rosa* (Duffy 1953; Linsley 1963; Švácha and Danilevsky 1988), *Rosa canina* L. (Duffy 1946), *Rosa* × *centifolia* L. (Bosq 1948); Salicaceae:

Populus (Sturani 1981), *Salix* (Barbier 1943; Duffy 1953, 1960; La Mantia *et al*. 2010; Linsley 1963; Nicolas 1891; Özdikmen 2021; Palmqvist 1945; Plavilstshikov 1940, as cited in Gressitt 1951; Reineck 1919; Sama *et al.* 2010; Schimitschek 1944; Śliwiński 1958; Švácha and Danilevsky 1988), *Salix alba* L. (Picard 1919; Sama 2002), *Salix babylonica* L. (Bosq 1948), *Salix purpurea* L. (Picard 1919), *Salix viminalis* L. (Bosq 1948; Picard 1919; Sama 2002); Sapindaceae: *Acer* (Németh *et al.* 2019); Ulmaceae: *Ulmus* (Halperin 1986; Halperin and Holzschuh 1993, as cited in Sama *et al.* 2010; Sama 2002; Sopow *et al.* 2015), *Ulmus pumila* L. (Halperin 1986); Viburnaceae: *Viburnum* (Özdikmen 2021), *Viburnum opulus* L. (Bosq 1948; Linsley 1963). Kaufmann (1946) reported that "the locust tree" is a host for *N. brevipennis*, but we suspect that this was an error and that Kaufmann may have misinterpreted the reports of Picard (1919, 1929), who referred to *Ziziphus lotus*, sometimes known commonly as "lotus tree". Duffy (1953, 1960) and Linsley (1963) appear to have perpetuated the error by interpreting "locust tree" as *Robinia* (Fabaceae). We could not find any other records of *Robinia* in the primary literature. Similarly, Duffy (1960) cited Bosq (1943) and erroneously listed *Prunus* as a host (see Di Iorio 2004). There are, however, separate reports listing *Prunus* as a host.

In Chile, large numbers of *N. brevipennis* adults have been found visiting flowers of linden trees (*Tilia cordata* Mill. and *Tilia platyphyllos* Scop.) (Malvaceae) (Bosq 1948). In the laboratory, *N. brevipennis* adults avidly sought out apple (*Malus*; Rosaceae) shoots according to Cherepanov (1988). Korczyński (1985) showed experimentally that *N. brevipennis* can develop on twigs of *Pinus sylvestris* L. (Pinaceae), but adverse climatic conditions in Poland (cold winters) is a limiting factor for the pest there.

Nathrius brevipennis, like *Gracilia minuta*, infests thin shoots used to manufacture a variety of wicker work and baskets, hampers, garden chairs, barrel hoops, packing cases, carboys, fences, etc. (Uhthoff-Kaufmann 1990). Both species have been introduced to other areas via the historical trade in these articles. In storage warehouses, larval feeding can cause extensive damage, completely reducing infested goods to fine powdery frass (Barnes 1904; Delarue 1875; Fowler 1890; Fowler and Donisthorpe 1913; Hincks 1930; Kaufmann 1946; Korczyński 1985; Manon 1911; Mulsant 1839, 1862; Nicolas 1884; Palmqvist 1945; Perris 1857; Picard 1919; Prell 1927; Reineck 1919; Scherdlin 1907a, b; Schmidt 1938; Śliwiński 1958; Trappen 1907a, b; Uhthoff-Kaufmann 1990; Zacher 1943). Possibly no other cerambycid species has been so widely dispersed by commerce (Linsley 1958).

The following biological information is largely derived from Korczyński (1985) and Cherepanov (1988). Copulation can take place immediately after emergence, and the species can reproduce parthenogenetically (Korczyński 1985). Females lay 19.2 single eggs on average. They avoid laying on twigs less than 3 mm in diameter. The abdominal ventrites (particularly ventrite 2) of the female are beset with long hairs: these brushes pick up frass, dust and dirt particles prior to oviposition (Nicolas 1884, 1891). The female then oviposits, usually in slight depressions in bark such as where a leaf is attached to a stem. Each egg measures 0.8 mm × 0.4 mm and is tapered at both ends. When freshly laid, the gelatinous egg is moist and orangish-red in color. Rapid movements of her abdomen back and forth and from side-to-side coat the egg with collected particles. The complete process (including coating) takes 20–40 s for each egg. When dried and hardened, the coated egg appears light gray in color and is almost imperceptible to the naked eye. Korczyński (1985) showed experimentally that eggs laid on cleaned willow twigs could not be coated, and the eggs dried out within 2–3 days, suggesting that the coating not only camouflages the eggs but also protects against desiccation. Sometimes the eggs are not coated and appear on the bark surface as orange dots. At 20–23 °C in the laboratory, larvae hatched after 14 days on average. The larvae are white, lack thoracic legs, and measure 5.5–7.0 mm in length and 0.6–0.8 mm wide when fully developed. Larvae mine in very small branches, less than 2.5 cm in diameter (Tyson 1966), making longitudinal galleries under the bark that are tightly packed with fine frass. When ready to pupate, the larva bores deep into the wood and makes a pupal cell at the end of a longitudinal gallery. The pupal stage lasts 2–3 weeks.

Males emerge before females from oval-shaped holes, measuring 1.48 × 0.85 mm on average. In the Northern Hemisphere, adults appear between May and July (Sama 2002). In Australia, *N. brevipennis* has been collected between December and February, which is consistent with records from other countries in the Southern Hemisphere (*e.g.*, see Brèthes 1916). The adult beetles are crepuscular or nocturnal and rest motionless on bark during the day (Sama 2002). Mifsud (1993) and La Mantia *et al*. (2010) reported an attraction to light.

In temperature-controlled laboratory conditions (20–23 °C), males lived 2–4 days and females 2–3 days (Korczyński 1985). The complete life cycle typically takes 1–2 years.

Discussion

The detection of *N. brevipennis* adults in three panel traps baited with pheromone lures during successive summers (2019–2022) near the port of

Melbourne suggests that a localized population is established there. *Nathrius brevipennis* ranks among the smallest known longhorn beetle species, is largely inactive during the daytime, and the adult lifespan is relatively short, so there is a low likelihood of detection without the aid of traps. The species is highly polyphagous in dead and dying twigs of a wide range of hosts—we found records from 42 genera across 22 plant families during our review of the literature—so finding an infested host plant would be difficult if the population is localized and persisting at a low level. In the late 19th and early 20th centuries, *N. brevipennis* was regarded as a significant pest of manufactured wicker work, etc., and was introduced into new areas via trade. There are isolated reports of *N. brevipennis* causing damage to economically important hosts, *e.g.*, almond trees in Corfu, Greece between 1975–1976, but damage was reduced by changing cultural practices such as keeping trees as vigorous as possible and pruning out dead and dying twigs (Santas 1984). Nowadays the species, although widespread, does not appear to be a significant pest.

The first detection in a panel trap in Melbourne was made in December 2019; however, it is possible that prior to September 2019 trapped specimens (if present) may have gone undetected because the contents of the collection containers were sieved in the field and not examined in detail under a microscope. Regardless, there are a few old records of *N. brevipennis* in Australia dating to the 1920s in Melbourne and Adelaide. It is not clear if these records relate to detections from imported articles such as wicker baskets, or if they were collected from local host plants. The specimens were misidentified as *Molorchus* sp. We hope that this short paper will assist others to correctly identify *N. brevipennis* in the future and highlights the role of active surveillance in biosecurity programs. The genus *Nathrius* will be incorporated into the key in the next edition of *Australian Longhorn Beetles (Coleoptera: Cerambycidae), Volume 2, Subfamily Cerambycinae* by Ślipiński and Escalona.

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