

**A MULTI-LOCUS PHYLOGENY, TAXONOMIC REVIEW AND
DESCRIPTION OF NEW SPECIES OF AUSTRALIAN *NURUS*
(SENSU STRICTO) MOTSCHULSKY, 1865 (COLEOPTERA:
CARABIDAE: PTEROSTICHINI)**

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Abstract

The genus *Nurus* Motschulsky, subgenus *Nurus* s. str., is revised, with three new species: *Nurus moorei* sp. n., from southeastern Queensland and northern New South Wales, *N. popplei* sp. n. from near Torrington, New South Wales and *N. baehri* sp. n. from the Ebor region of New South Wales. *Nurus perator* (Sloane, 1923), **comb. n.**, originally described in *Trichosternus* Chaudoir, is redescribed. Redescriptions for the remaining four species in *Nurus* s. str., distribution maps and a key to species are given. Lectotypes are designated for *N. perator*, *N. latipennis* (Sloane) and *N. imperialis* (Sloane). Cladistic analysis of a combined matrix of partial sequences from three loci: 28S, COI and CAD, found support for the inclusion of *Trichosternus perator* Sloane in *Nurus* s. str. and the reciprocal monophyly of all populations represented for recognized species with the exception of *N. moorei*, which in some resulting trees was paraphyletic. Distributions of each of the three sister pairs found in the phylogenetic analysis (*N. moorei* + *N. imperialis*; *N. perator* + *N. atlas*; *N. baehri* + *N. popplei*) are distinctly allopatric. Several distantly related species overlap in their regional distributions but are separated at the local habitat level.

Introduction

One of the most prominent groups of carabid beetles in Australia is the Pterostichini. These beetles are frequently large, conspicuous and abundant in a wide variety of habitats. Given its diversity, the group attracted the attention of early authors studying the Australian fauna. In particular, the notable taxonomists M. Chaudoir, T. Tschitschérine, T.G. Sloane and P.J. Darlington all published scattered descriptive works and semi-synthetic treatments of the taxa included in their concept of the tribe. Until Barry Moore's treatment in 1965, there had not been a complete Australian faunal treatment at the genus level for the group. Several things set Moore's work above and beyond previous studies. Foremost, Moore provided a precise set of characters and states consistently for every genus, which allowed for clear identification and comparison. These remain fundamental characters for any morphological study of pterostichines. He also established informal series, *i.e.* groups of genera, based on these characteristics and his explicit interpretation of them. These series continue to be useful and largely supported by more expansive analyses (Will 2015, KWW unpublished). Whereas Darlington (1961b) had treated *Castelnaudia* Tschitschérine as a synonym of *Trichosternus* Chaudoir, Moore recognised they had distinct male genitalia and treated them as separate genera. Moore also insightfully pointed out the problematic placement of *C. obscuripennis* (Macleay) and unresolved issues with *Nurus* s. lat. and its relationship with the broader

Trichosternus series. Moore also published a comprehensive catalogue of the Australian Pterostichini (Moore *et al.* 1987).

Based on Moore's (1965) treatment, the genera of the *Trichosternus* series can be distinguished from other Australian and New Zealand pterostichines by the following combination of characteristics: 1, mentum long and deeply emarginate; 2, ostium of the median lobe of the aedeagus deflected to the right; 3, antennae not geniculate; 4, abdominal ventrites not transversely sulcate. In addition to these character states, the included taxa have: 1, the stipes bearing two or more setae; 2, three or more umbilicate punctures basal of the relatively larger puncture at the junction of striae 8 and 9 near the elytral humeral margin; 3, female reproductive tract with spermathecal gland duct diverticulum; 4, pygidial gland reservoirs lacking dorsal lobes.

This combination of character states is found in all genera in the *Trichosternus* series except *Acanthofernia* Moore, which was shown to be a taxon derived within *Notonomus* Chaudoir (Will 2015). As noted in various contexts by Moore (1965), Darlington (1961a, 1961b), Sloane (1895) and Tschitschérine (1902), the three most species-rich genera in the series, *Trichosternus*, *Castelnaudia* and *Nurus* s. lat., are closely related and problematic. As presently constituted (Lorenz 2005, 2018), they do not have any clear characters to define them as reciprocally separate groups. Resolution of that problem is beyond the scope of this contribution but an ongoing, combined multi-gene and morphological study across the group supports clades that correspond to those genera, places problem taxa and, most significant to the present work, supports the monophyly of *Nurus* s. str. including *Trichosternus perater* Sloane.

Several subgeneric groups have been recognised within *Nurus* s. lat. and Darlington (1961a) discussed problems with the application of these. His key distinguishes subgenus *Nurus* s. str. as a southern group of species that lack setae on the mesosternum but he did not deal with this group in that paper and they are revised in the present work. *Nurus* s. str. includes eight species distributed from Mt Tamborine, Qld south to the Ebor district, NSW and from the Pacific coast west as far as Torrington, NSW.

Although large and impressive carabids, with some species having striking metallic coloration, specimens of *Nurus* s. lat. were rare in collections until the 1970s, when it was discovered (GBM pers. obs.) that all species live in deep burrows with a distinctive, specialised entrance 'stage' where they ambush prey (Charley and Andren 2018). Once this was known they could be readily searched for, dug up and many specimens accumulated for study. GBM (pers. obs.) has also noted their brood care behaviour, in which eggs are deposited in soil capsules similar to those described for the pterostichine genus *Percus* Bonelli in Europe (Kavanaugh 1998).

Some species of *Nurus* s. str. have very restricted distributions and their rarity due to habitat loss by clearing, in the Lismore district of New South Wales, led to them being used to mount a case to list rainforest remnants at Victoria Park, with *Nurus atlas* (Laporte) and, at Rotary Park, with *Nurus brevis* Motschulsky, on the Australian National Estate Register (Greenslade 1994). Both species were later listed in 2001 as 'endangered species' protected by legislation in New South Wales (NSW National Parks and Wildlife Service 2002). A detailed survey of the current status of *Nurus atlas* was carried out in 2017-18 (Charley and Andren 2018).

Materials and methods

Morphological methods. Dissection methods for male and female genitalia and defensive glands and descriptive terms follow Liebherr and Will (1998) and Will (2002). Images were taken using a Microoptics XLT digital imaging system and subsequently edited to enhance clarity using standard image editing software.

Measurements. Overall length is the length from the base of mandibles to apex of elytra. The ocular ratio is the width between the eyes at the level of the anterior supraorbital setae divided by the greatest width of the eyes as viewed from above. For new species, measurement of holotype is given first with range of paratypes in parentheses.

Taxon sampling. This includes four putative outgroup taxa: *Castelnaudia marginifera* (Chaudoir), *C. septemcostata* (Chaudoir), *Trichosternus renardi* (Chaudoir) and *T. vigorsi* (Gory). The last of each pair are the type-species of their respective genera. All species of *Nurus* s. str. are included with multiple individuals from across their ranges. A total of 47 OTUs are included in the analysis. Taxon names and authors follow Lorenz (2018).

Material examined. Specimens included in the current study include both ethanol preserved and pinned adults. A total of 789 specimens were examined from the following collections: AM – Australian Museum, Sydney; ANIC – Australian National Insect Collection, Canberra; CBM – M. Baehr collection in Zoologische Staatssammlung, München, Germany; EMEC – Essig Museum of Entomology, Berkeley, California; MCG – Museo Civico di Storia Naturale, Genoa; MV – Museum of Victoria, Melbourne; QDAF – Queensland Department of Agriculture and Fisheries Collection, Brisbane; QM – Queensland Museum, Brisbane; Additional specimens were examined by KWW in MCZ – Museum of Comparative Zoology, Harvard University, in 2017 but locality data were not recorded and specimens are not enumerated here.

All specimens are listed in abbreviated form in the material examined lists. Since most *Nurus* species cannot be sexed on external characters, sex is not recorded. Same localities are always listed in sequence with 's. l.' (same

locality) used for the name after first mention. Museum locations refer to specimens listed prior to the museum acronym. Repeated collector names are shown by initials as follows: AC, A. Calder; AM, A. Musgrave; AML, A. M. Lea; BC, B. Cantrell; BPM, B. P. Moore; CG, C. Geissman; CJW, C. J. Wild; CMD, C. M. Deuquet; CO, C. Oke; DAD, D. A. Doolan; DC, D. Charley; DKM, D.K. McAlpine; DP, D. Potter; FF, F. T. Fricke; FT, F. Turco; DJC, D. J. Cook; DKY, D. K. Yeates; ES, E. Sutton; GC, G. Czechura; GIT, G. I. Thompson; GBM, G. B. Monteith; GC, G. Cassis; HAL, H. A. Longman; HH, H. Hacker; HJ, H. Janetzki; HWB, H.W. Brown; HT, H. Tryon; IDN, I. D. Naumann; JB, J. Balderson; JD, J. Doyen; JS, J. Stanisic; KWW, K. Will; MG, M. Gray; NG, N. Gough; PB, P. Bouchard; PZ, P. Zborowski; RB, R. Blackwood; RI, R. Illidge; RIS, R. I. Storey; RJT, R. J. Tillyard; RM, R. Menendez; RO, R. Overland; RPJ, R. P. Johnson; RR, R. J. Raven; SRB, S.R. Brock; SRM, S. R. Monteith; TGS, T. G. Sloane; TW, T. A. Weir.

Other abbreviations: m, metres; ml., miles; km, kilometres; for., forest; NP, National Park; R, River; SF, State Forest; EMEC numbers are for specimens sequenced in the Will lab, vouchered in the Essig Museum, Berkeley University, California and/or data captured in the EssigDB but housed elsewhere.

DNA sequencing and analysis methods. Partial sequences for four loci were used: 1133bp aligned length of 28s rDNA (28S); 706bp + 828bp for the two primer pairs of cytochrome oxidase I (COI); and 905bp carbamoyl phosphate synthetase domain of the rudimentary gene (CAD). Primers and PCR protocols follow Will and Gill (2008), Gunter *et al.* (2013) and Will (2015), with the additional use of alternative CAD primers 5'.AACGCAAACG ACCACACAAA.3' and 5'.TGAGCTAGTGCTTGAAGAGCC.3' for some sequences. The matrix is complete for these four loci except for two *N. latipennis* (Sloane 1903) sequences: 28S is missing for the Whian Whian specimen and COI Folmer region (Folmer *et al.* 1994), *i.e.*, the 5' half of COI, is missing for the southern Tweed Range specimen. Sequences have been deposited in GenBank with the following accession numbers: 28S: MK090893–MK090938, CAD: MK090939–MK090985, COI: MK090986–MK091078.

Alignment of the protein-coding sequences was straightforward, without gaps. Multiple sequence alignment of 28S was performed by MAFFT ver. 7 (Kato and Kuma 2002) using default parameter values within Mesquite (Maddison and Maddison 2018b). The concatenated matrix of the four loci was submitted to TNT (Willi Hennig Society edition, ver 1.5 (Goloboff *et al.* 2008) using Zephyr ver. 2.11 (Maddison and Maddison 2018a) and the default search settings were used in Mesquite for both parsimony tree and jackknife resampling searches. For jackknife analysis, 5000 replications were done.

Phylogenetic analysis results

TNT returned 20 equally parsimonious trees 1075 steps long, with CI = 0.70 and RI = 0.88. The strict consensus of those 20 trees is identical to the jackknife tree (Fig. 39), with the exceptions of some additional but very poorly supported resolution seen within the *N. atlas* clade. The jackknife support values are high for all clades from the root of the ingroup to the nodes subtending all recognized species except for *N. moorei*. *Nurus moorei* specimens from the disparate samples of Numinbah Arch and Hayter's Hill form a clade that was placed sister to the remaining *N. moorei* OTUs or sister to the *N. imperialis* clade in exactly half of the trees, each. *Nurus perater* was placed unambiguously within the *Nurus* s. str. clade and showed no affinity with the two *Trichosternus* outgroup taxa.

Taxonomic treatment

Nurus (sensu stricto) Motschulsky, 1865

Characteristics, modified from Moore (1965): Mentum deeply emarginate, sides of sinus subparallel; median tooth entire, emarginate or bifid; paraglossae glabrous; antennae filiform, with three basal segments glabrous; postocular orbits inconspicuous. Pronotum cordiform or subquadrate, the margins bisetose; prosternum setose, mesosternum glabrous. Elytra fused; striae variable, intervals more or less convex or nearly flat; parascutellary striae present or absent; discal pores small, confined to the third intervals when present; marginal pores small; plica not externally visible, inner ridge present but not prominent; hind wings vestigial, strap-like. Legs relatively slender; metacoxae prominent, posterior face vertically oriented; anterior tarsi of male usually unmodified, two or three basal segments squamose beneath in *N. atlas* and *N. perater*, respectively; tarsomere 5 of all legs ventrally setose. Aedeagus (Figs 15-38) with orifice deflected to the right; parameres dissimilar, the left conchoid, the right longer, falcate.

Type species. *Nurus brevis* Motschulsky, 1865.

Included species (Figs 1-8). *Nurus atlas* (Laporte), *N. perater* (Sloane), **comb. n.**, *N. brevis* Motschulsky, *N. latipennis* (Sloane), *N. popplei* **sp. n.**, *N. baehri* **sp. n.**, *N. imperialis* (Sloane) and *N. moorei* **sp. n.**

Nurus atlas (Laporte, 1867)

(Figs 1, 11, 14-17, 40)

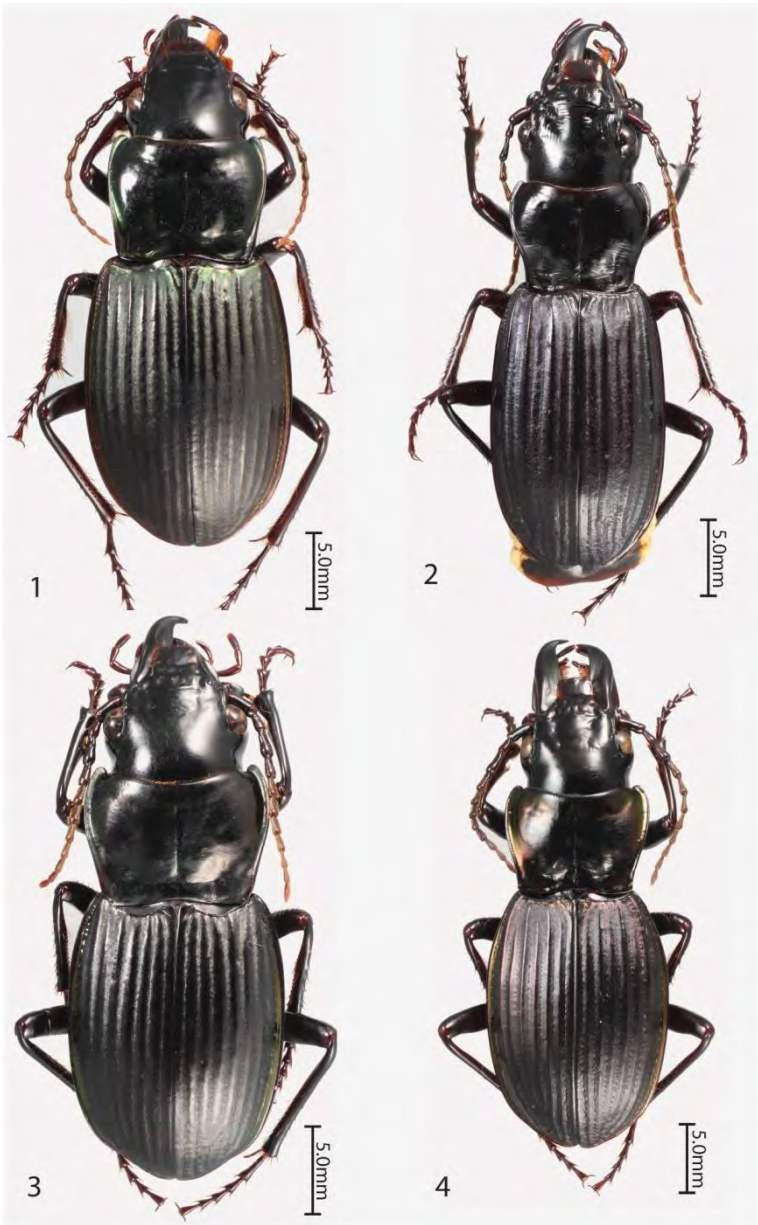
Feronia atlas Laporte, 1867.

Nurus atlas (Laporte): Tschitschérine (1902).

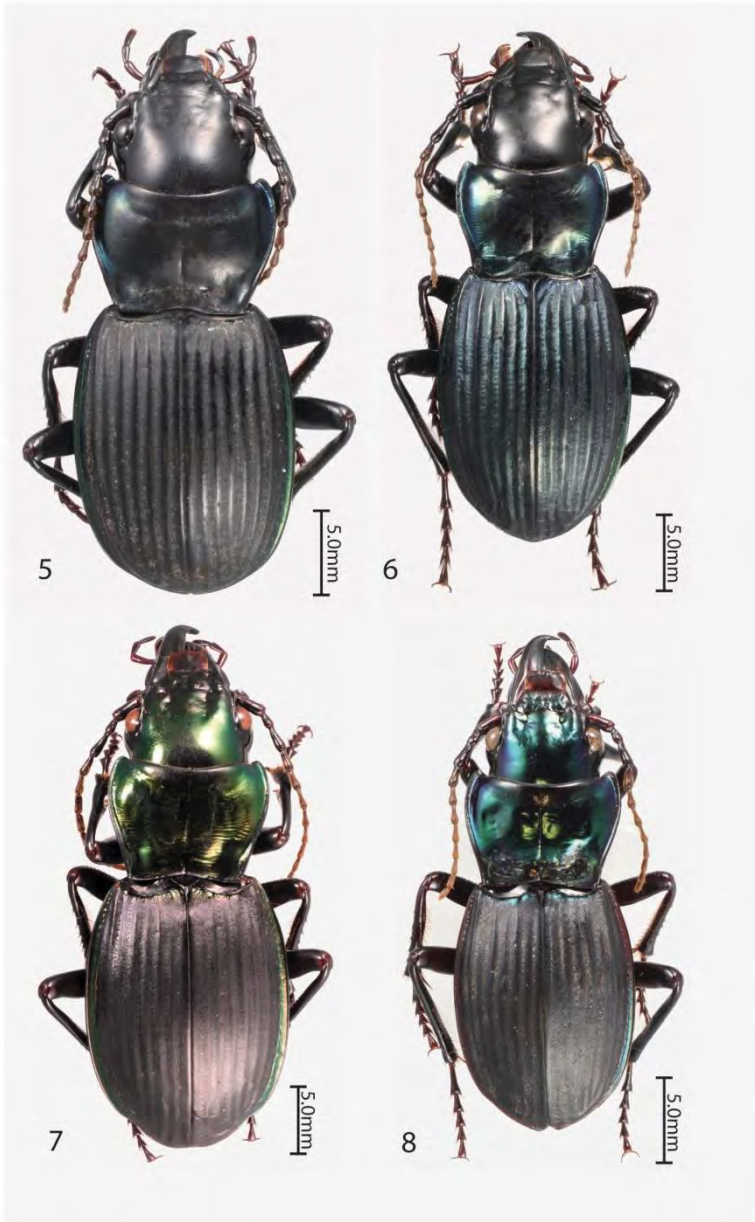
Feronia obesa Laporte, 1867.

Homalosoma crassiforme Sloane, 1900.

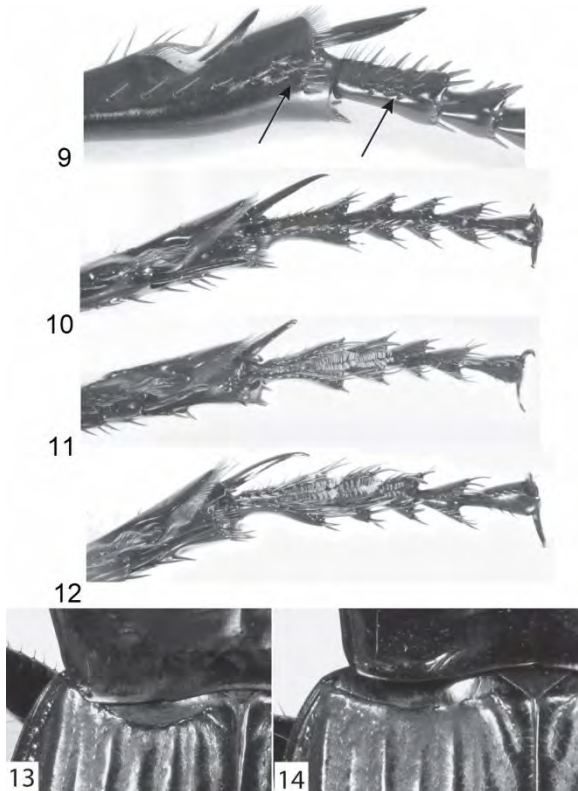
Type material. Lectotypes for *Feronia atlas* and *Feronia obesa* designated by Straneo (1936) in MCG; not examined. Syntype of *Homalosoma crassiforme* Sloane: 1, 'Cairns, Qld', in MV; examined.



Figs 1-4. Dorsal views of *Nurus* spp: (1) *N. atlas*; (2) *N. perater*; (3) *N. brevis*; (4) *N. latipennis*.



Figs 5-8. Dorsal views of *Nurus* spp: (5) *N. popplei* **sp. n.**; (6) *N. baehri* **sp. n.**; (7) *N. imperialis*; (8) *N. moorei* **sp. n.**



Figs 9-14. *Nurus* spp, characters of protibia, protarsus and elytral base: (9) ♂ *Nurus moorei* sp. n., medial view of apical portion of right protibia and protarsomeres. Arrows indicate region of setae on protibia and protarsomere 1; (10-12) ventral view of apical portion of left protibia and protarsomeres of male: (10) ♂ *N. moorei*, lacking squamous setae on all tarsomeres; (11) ♂ *N. atlas*, with squamous setae on tarsomeres 1-2; (12) ♂ *N. perater*, with squamous setae on tarsomeres 1-3; (13-14) basal margin of left elytron: (13) *N. brevis*; (14) *N. atlas*.

Other material examined. (96): NEW SOUTH WALES: 5, Victoria Park, 7.5 km SSW Alstonville, 9.xii.1973, GBM; 5, s. l., 23.iii-2.viii.1975, GBM & SRM; 1, s. l., 16.xi.1974, GBM; 1, s. l., 2.viii-15.xi.1975, GBM & SRM; 8, s. l., 26.xii.1974-23.iii.1975, GBM & SRM; 2, s. l., 29.i.2008, GBM & FT (one is EMEC346319); 1, s. l., 12.vii.2016, GBM (EMEC346320) (QM); 1, Victoria Park, 29 Jan 2008, GBM & FT (EMEC 346318) (EMEC); 2, s. l., 9.xii.1973 (ANIC); 1, s. l., 9.xii.1973 (QM); 1, s. l., 19-20.i.1974, RIS (QDAF); 6, Lumley Park, Alstonville, 23.iii.1975, GBM (QM); 1, Davis Scrub, 4.5 km SW of Alstonville, 3.ii.2009, GBM (AM); 2, s. l., 29.i.2008, GBM & FT (2 are EMEC346322 & EMEC346323) (QM); 2, same data (CBM); 1, s. l., 29 Jan 2008, GBM & FT (EMEC346321); 1, 2.6 km N of Wardell, 2013, L. Popple (EMEC346324) (EMEC); 8, Molly's Grass, nr. Tregearle, 10 km SE

of Lismore, 10.i.-21.ii.1982, DKY; 1, s. l., 4.iv.2018, DC (EMEC1411129); 1, Brockley North Scrub, 10.5 km E of Lismore, 28.iv.1018, DC, (EMEC1411127); 1, Whites Lane Scrub, 2.5 km SW of Wollongbar, 3.iv.2018, DC (EMEC1411128); 1, Willowbank Scrub, 4.9 km N of Alstonville, 27.iv.2018, GBM (EMEC1411126); 1, Wollongbar Research Stn, 27.iii.2018, GBM (EMEC1411125); 2, Lismore, CD (QM); 1, Lismore, CMD; 1, Richmond R. K14453; 1, s. l., ES; 18, s. l., 14.xii.1976, FF (AM); 1, s. l., CD (QM); 1, s. l.; 4, Tweed R. (MV); 2, s. l., HWB; 2, Alstonville, 13.xii.1976, FF (AM); 1, Alstonville, xii.1976, FF; 1 ♂, New Holland/Ehlers; 1, Wollongbar, 1897 (ANIC); 1, Wardell (MV); 1, no data (QM); 5, no data (ANIC).

Type localities. For *F. atlas* and *F. obesa*: Clarence River, NSW; for *H. crassiforme*: ‘Cairns’ (spurious). The name ‘Clarence River’ was used as a broad district name that included the Clarence River watershed and adjacent areas during the early days of settlement in the mid-1800s when the types were collected. The species has been very well surveyed (Charley and Andren 2018) and does not occur in the Clarence River watershed but in a very restricted part of the Richmond River drainage a little further north.

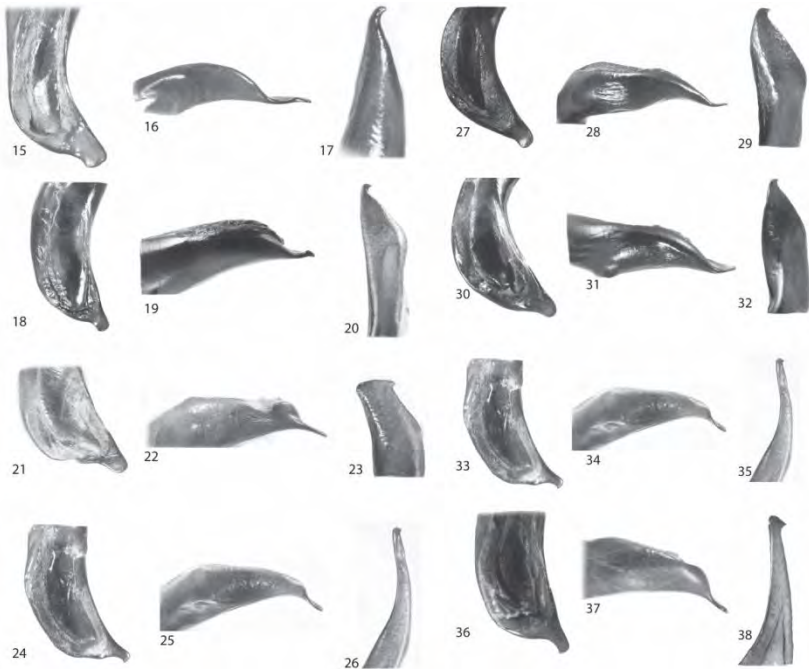
Diagnosis. Males of *N. atlas* can be distinguished from all other *Nurus* species by the presence of pads of squamose setae ventrally on protarsomeres 1 and 2 and not on 3 (Fig. 11). *Nurus atlas* is relatively robust and broad-bodied with a nearly quadrate pronotum (Fig. 1). Typically, the pronotum is metallic green or bronze, although the colour is sometimes subtle or nearly absent.

Redescription. Size. Overall length 28.5-30.5 mm; greatest width of elytra 10.8-12.9 mm. *Colour.* Dorsal and ventral surfaces with base colour black; legs, mouthparts and antennae dark piceous or black. Pronotum rarely all black, typically broadly across the base and laterally metallic green. Elytral disc black or with slight metallic green or bronze reflectance and lateral margins of elytra metallic bronze or copper, rarely metallic green. *Lustre.* Dorsally head, pronotum and elytral margins very glossy; elytral disc duller in striae and intervals dorsally contrastingly glossier; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines not visible at 50x magnification. Clypeal-ocular sulci absent. Ocular ratio 0.73-0.76; eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight or convex, medial four setae separated from each other about half to three quarters width from outermost medial seta to lateral seta. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth emarginated; constantly with one pair of setae positioned at base of median tooth and a second pair of smaller setae laterad of medial pair. Submentum with two lateral pairs of setae. Gula narrow, width at middle about as wide as width of mentum tooth. Antennae long, antennomeres 10-11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax.* Pronotum quadrate, sides subsinuate and then straight or very slightly convergent onto base. Marginal bead thick, continuous from apex to base,

slightly wider near base; basal margin not bordered, straight or slightly emarginated medially; anterior angles prominently produced; hind angles about right-angled or slightly obtuse and rounded and not denticulate; base depressed, basal impressions very broad, shallow and not clearly delimited or deeply impressed; deep to shallow, transverse linear sulci distant from basal margin. Anterior marginal seta set mesad lateral channel. Seta near hind angle set in lateral bead. Microsculpture of disc not visible at 50x magnification except near base where microlines form very irregular transverse mesh. Prosternal process medial impression present near apex deep, process apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, broadly and shallowly impressed. Parascutellar striae and angular base of stria 1 present, distinctly impressed. Elytral parascutellar setae present or absent, basal margin sharply bordered. Striae marked with dense, shallow, elongate punctulae. Elytra with nine intervals, 1-7 convex. Elytral microsculpture laterally on intervals 1-8 and in striae dense, small, granular, composed of irregular sculpticells giving a dull sheen, contrasting with convex area of intervals 1-7 that has a glossy lustre due to shallow or absent microsculpture. Interval 3 with zero to three setae. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 30-38 umbilicate setae, somewhat irregularly spaced but more closely set anteriorly and posteriorly. Stria 7 variable apically, apparent or anastomosed with stria 8. When stria 7 evident, two umbilicate setae present. Elytral humeri with distinct, low tooth oriented dorsally or posteriorly. Elytra lacking externally visible plica, apicolaterally internal ridge scarcely apparent. Vestigial flight wing present as a thin strap about 1/6 elytral length. Male protarsi slightly asymmetrically expanded and with squamose setae ventrally on 1 and 2; female protarsi symmetrical and ventrally glabrous. Protibia without anteroapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove. *Abdomen.* Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 typically with four setae in males and six setae in females but number varies, especially in females.

Male genitalia. Aedeagus (Figs 15-17) right paramere long, broad at base and tapering apically, narrowed and curved, left paramere broadly rounded at apex, conchiferous; tip of median lobe rounded. Dorsal ostium wide and rotated to right.

Distribution (Fig. 40). The entire distribution of *Nurus atlas* lies within a 10 km radius of the town of Alstonville in northern New South Wales. All occurrences are within small remnants of an extensive block of rainforest that once covered the fertile volcanic soils of this area. A detailed survey of its distribution is given by Charley and Andren (2018). Its range is separated by the deep valley of the Wilson River from that of *N. perater*, *N. latipennis* and *N. moorei* in the Nightcap Range, only 25 km north and north-west.



Figs 15-38. Aedeagus, dorsal view of apical portions of median lobe, left lateral view of apical portion of median lobe and apical portion of left paramere, respectively, for *Nurus* spp: (15-17) *N. atlas*; (18-20) *N. perater*; (21-23) *N. brevis*; (24-26) *N. latipennis*; (27-29) *N. popplei* sp. n.; (30-32) *N. baehri* sp. n.; (33-35) *N. imperialis*; (36-38) *N. moorei* sp. n.

***Nurus perater* (Sloane, 1923), comb. n.**

(Figs 2, 12, 18-20, 40)

Trichosternus perater Sloane, 1923.

Type material examined. Lectotype ♂, here designated, genitalia dissected and glued on card- // ‘Tweed R 10.04 HJC’ [H.J. Carter] // [handwritten red ink] // ‘Trichosternus perater Sl. Cotype.’ // [mixed print and type on pink paper] // ‘T. perater Sl. HOLOTYPE PJD’ // ‘ANIC Database No. 25 014984’ // Darlington placed a holotype label on the specimen but did not publish that action (ANIC). *Paralectotypes*: ♀ // ‘Tweed R 10.04;’ // [handwritten red ink] // ‘Trichosternus perater Sl. Cotype’ // [print] // ‘ANIC Database No. 25 014985’ // ♀ [handwritten red and black ink] // ‘Trichosternus perater Sl. Cotype ♀’ // [print on blue paper] // ‘PARATYPE’ // ‘ANIC Database No. 25 014986’ // (ANIC). Two specimens ‘T11905 Tweed River’ and ‘T11906 Tweed River’ (MV).

Other material examined. (148): QUEENSLAND: 3, Mt Cougal, 400 m, 18.i-27.iv.1987, GBM & DJC; 7, s. 1, 2.xi.1986-19.i.1987, GBM & DJC; 2, s. 1, 14.vi-19.xi.1987, GBM & DJC; 7, Mt Cougal, 500 m, 19.xi.1987-17.iii.1988, GBM & DJC;

3, s. l., 19.xi.1987, GBM & DJC; 1, Mt Gannon summit, 700 m, 1.vii-2.xi.1986, GBM & DJC (QM); 1, s. l., 29.xi.2010, KWW; 1, Numinbah Arch, 300 m, 2.xii.2017, GBM (EMEC); 8, s. l., 25.iv.1974, GBM; 2, s. l., 1.i-29.ii.1992, DJC, pitfall trap; 3, s. l., 14.xii.1974-22.iii.1975, GBM & SRM; 3, s. l., 22.iii-25.v.1975, GBM & SRM; 2, s. l., 25.v-13.x.1975, GBM & SRM; 8, s. l., 26.x-14.xii.1974, GBM & SRM; 1, Mt Gannon, 400 m, 2.xi.1986-18.i.1987, GBM & DJC; 7, s. l., 18.i-5.iv.1987, GBM & DJC; 1, Springbrook Repeater Stn, 1010 m, 9.i-19.ii.1995, GBM; 1, s. l., 30.viii-31.x.1997, GBM; 1, s. l., 31.x-31.xii.1997, GBM; 1, Goomalahra, Springbrook, 9-10.ii.2016, GBM; 2, Lyrebird Ridge Rd, Springbrook, 770 m, 19-29.ii.2016, GBM; 1, Lyrebird Ridge Rd, Springbrook, 805 m, 19-20.x.2016, Asquith; 1, Ankida, across creek, Springbrook, 22.x.2015, GBM; 1, Upper Tallebudgera Valley, 560 m, 6.iii-28.iv.1992, DJC; 1, s. l., 18.xi.-28.xii.1991, DJC; 1, s. l., 28.xii.1991-6.iii.1992, DJC; 1, s. l., 29.xii.1984, GBM & DJC; 1, s. l., 11.iii.1989, GBM; 1, s. l., 11.iii.1984, DJC; 1, s. l., 1.iii-31.vii.1998, DJC; 8, s. l., 8.i.-17.iii.1985, GBM, DJC & GIT; 8, Upper Tallebudgera Valley, 500 m, 8.i.-17.iii.1985, GBM, DJC & GIT; 1, Upper Tallebudgera Valley, 400 m, 15.iv.1995, GBM; 8, Upper Tallebudgera Valley, 350 m, 19.xi.2007, GBM, DJC & FT (QM); 2, same data (CBM); 3, Upper Tallebudgera Valley, 330 m, 2.i-17.ii.1995, DJC; 2, Upper Tallebudgera Valley, 300 m, 8.i.-17.iii.1985, GBM, DJC & GIT; 1, Tallebudgera Valley, falls area, 150 m, 11.xi.1997-28.i.1998, DJC; 1, Tomewin Range, 500 m, 17.x.1988, GBM; 5, s.l., 16.v.1989, GBM; 1, s. l., 19.x.1989, GBM (QM); 4, Springbrook, 1930, RB; 1, Mt Cougal NP; 1, Tomewin Range (AM). NEW SOUTH WALES: 1, Couchy Creek, 4 km S of Numinbah gate, 200 m, 25.iv.1974, GBM; 2, Mt Nardi, 760 m, 26.xii.1974-23.iii.1975, GBM & SRM; 1, S. l., 11.iii.1987, JS & DP; 1, Mt Warning, 400 m, 30.viii.1972, GBM; 3, s. l., 7.iii-13.vi.1976, GBM & SRM; 1, s. l., 13.vi.-7.xi.1976, GBM & SRM; 1, s. l., 16.xi.1975-7.iii.1976, GBM & SRM; 1, s. l., 19.xi.2007, GBM & SRM; 1, s. l., 10.vii.1961, B. Timms (QM); 1, s. l., 17.ii.1989, Hines, Pugh, Weber, Smith; 4, Billinudgel, 1930; 1, Huonbrook, 30.i.1961, DKM; 1, Nightcap Range, 17.ii.1989, Hines, Pugh, Smith, Weber; 1, NSW, F. Taylor (AM); 2, Mt Matheson, Nightcap Range, 800 m, 23.iv.2002, GBM; 1, Byrrill Ck, Mebbin NP, 19.xi.2007, GBM & RM; 1, Byron Bay, ix.1909, CD (QM); 2, Upper Wilson's Creek, 4.xii.2017, GBM (EMEC).

Type locality. The collector of the type material, H.J. Carter, used the label 'Tweed R.' for specimens collected while based at Murwillumbah, on the Tweed River, during a train and bicycle collecting trip in 1904 (Carter 1933). In a footnote, Carter (1933: 82) listed *Trichosternus renardi* (Chaudoir) as among his collections from 'Tweed R.'. That species resembles *N. perater* superficially but occurs only further north in Queensland and is what he would have assumed his specimens to be at that time. *Nurus perater* does not occur close to the lower Tweed River, which floods regularly, but Carter described riding north from Murwillumbah to the Queensland border gate for collecting. That point is the crest of the Tomewin Range (28.903°S, 153.366°E) where *N. perater* is common. It is within the Tweed River watershed and is almost certainly where he collected the type series.

Diagnosis. Male *N. perater* are distinguished from all other *Nurus* species by the presence of pads of squamose setae ventrally on protarsomeres 1 to 3 (Fig. 12). *Nurus perater* is a very large, parallel-sided, black species without

coloured reflections (Fig. 2). It is rather similar to *Trichosternus renardi* (Chaudoir) but, like all *Nurus s.str.* species, *N. perater* lacks the field of long setae on the mesosternum present in *T. renardi*. In *N. perater* elytral interval 7 and stria 7 end well before the apex, in contrast with *T. renardi*, where interval 7 is convex and continuous apicad of intervals 3-6 and stria 7 is deeply sulcate and has two setae apically.

Redescription. Size. Overall length 31.8-35.5 mm; greatest width of elytra 12.1-14.1 mm. *Colour.* Dorsal and ventral surfaces black; legs, mouthparts and antennae black or dark piceous. *Lustre.* Dorsally head, pronotum and elytral margins glossy; elytral disc duller but intervals dorsally contrastingly glossier; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines visible at 50x magnification, microlines forming irregular mesh, vertex smooth. Clypeal-ocular sulci represented by very broad, very shallow, poorly defined impressions. Ocular ratio 0.69-0.73; eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight or slightly convex and raised medially, medial four setae separated from each other about half width from outermost medial seta to lateral seta. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth entire or slightly emarginated, with one pair of setae positioned at base of median tooth. Submentum with two lateral pairs of setae. Gula narrow, width at middle about as wide as mentum tooth at base. Antennae long, antennomeres 10-11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 slightly compressed at base. *Thorax.* Pronotum transverse, sides sinuate and then straight onto base. Marginal bead thick, continuous from apex to short of base where it narrows and is not medially delimited; basal margin not bordered, nearly straight medially; anterior angles prominently produced; hind angles right-angled; base depressed, impressions well impressed, linear, broad and not clearly delimited; deep transverse linear sulci basad impressions, rather distant from basal margin. Anterior marginal seta set in edge of lateral channel. Basal seta just anterad hind angle. Microsculpture of disc hardly visible at 50x magnification, where evident microlines form irregular, transverse mesh producing a slight spectral iridescence. Prosternal process medially with deep impression present near apex, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete but shallowly impressed. Parascutellar striae and angular base of stria 1 present, distinctly impressed. Elytral parascutellar setae present or absent, basal margin sharply bordered. Striae, where marked, with dense, shallow punctulae. Elytra with nine intervals; intervals 1, 3, 5 and 7 clearly raised and carinate or subcarinate, 2, 4 and 6 flat or slightly convex. Elytral microsculpture laterally on intervals 1-8 and in striae dense, small, granular, composed of irregular sculpticells giving a dull sheen, dorsal area of interval's convexity somewhat glossy lustre due to shallow or absent microsculpture. Interval 3 with three to four setae. Interval 9 and marginal

channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 42-43 umbilicate setae, somewhat regularly spaced along length. Stria 7 not evident apically. Elytral humeri with distinct, sharp, dorsally oriented tooth. Elytra lacking externally visible plica, apicolaterally internal ridge scarcely apparent. Vestigial flight wing present as a thin strap about 1/6 elytral length. Male protarsi slightly asymmetrically expanded and with squamose setae ventrally on 1-3; female protarsi symmetrical and ventrally glabrous. Protibia without additional anterioapical field of setae between antennal cleaner and apical margin near longitudinal row of setae above antennal cleaner groove (*contra* Fig. 9). *Abdomen*. Abdominal ventrites smooth, 2-5 with a pair of paramedial setae. Apical margin of ventrite 6 with two setae in male and four in female.

Male genitalia. Aedeagus (Figs 18-20) right paramere long, broad, short narrowed section curved at apex with sharp hooked denticle, left paramere broadly rounded at apex, conchiferous; tip of median lobe rounded. Dorsal ostium wide and rotated to right.

Distribution (Fig. 40). *Nurus perater* occurs at high and low elevations in rainforests on the eastern half of the Tweed Shield Volcano straddling the border between Queensland and New South Wales. These include occurrences on Springbrook Plateau and its peripheral ranges and valleys, Mt Warning and the Nightcap Range. It occurs in Mebbin NP at the base of the Tweed Range but not elsewhere in the large Tweed-Lamington massif. An old record from Billinudgel near the coast east of the Nightcap Range has not been confirmed by recent collecting. *N. perater* co-occurs with *N. moorei* at low elevation sites east and west of Springbrook.

***Nurus brevis* Motschulsky, 1865**

(Figs 3, 13, 21-23, 42)

Nurus brevis Motschulsky, 1865.

Feronia solandersii Laporte, 1867.

Type material: Possible syntypes of *N. brevis* in Zoological Museum of Moscow University; not studied. Lectotype of *F. solandersii* in MCG designated by Straneo (1936); not studied.

Other material examined. (58): NEW SOUTH WALES: 2, Blue Gum Hut, Richmond Range, 12.x.1977, GBM; 6, s. l., 7.ii.-6.v.1978, GBM; 8, s. l., 12.x.1977-7.ii.1978, GBM; 1, s. l., 27.v-2.x.1978, GBM; 1, s. l., 12.x.1977, GBM; 1, s. l., 2.ii.2009, GBM (EMEC346336); 1, s. l., 17.i.1992, JS & J. Chaseling (QM); 1, s. l., 1977-78, GBM; 1, Cambridge Plateau, 300-600 m, 17.xii.1988, Smith, Hines, Pugh, Webber (AM); 2, s. l., 19-21.x.1990, M. DeBaar; 2, s. l., 29.xi.2016, GBM (EMEC346334, EMEC346335) (QM); 2, same data (EMEC346332 & EMEC346333) (EMEC); 3, Rotary Park, Lismore, 26.xi.1972, GBM; 1, s. l., 9.xii.1973, GBM; 1, s. l., 1974, GBM & SRM; 1, s. l., 26.xii.1974-23.iii.1975, GBM & SRM; 1, s. l., 12.vii.2016 (EMEC346341) (QM); 2, s. l., NSW, 26.xi.1972, GBM (ANIC); 1, s. l., 8.v.1973, RIS (DAF); 1, Lismore, 3.ii.2009, GBM & FT; 3, Wilson Park, Lismore, 29.i.2008, GBM

& FT (QM); 1, same data (AM); 1, same data (CBM); 1, s. 1., 12.vii.2016, GBM (EMEC346340) (QM); 2, s. 1., 28.i.2008, GBM & FT (EMEC346338 & EMEC346339) (EMEC); 2, Cherry Tree SF, via Mallangancee, 12.x.1977, GBM; 1, s. 1., 2.x.1978-22.ii.1979, GBM; 1, Bulmers Rd, Mallangancee SF, 1.xii.2016, GBM (EMEC 346337) (QM); 1, Coll. French; 6, V. de Poll / *Trichosternus brevis* Id by Sloane (ANIC).

Type localities. For *N. brevis*: 'Nouvelle Hollande'. For *F. solandersii*: 'Clarence River'. See discussion under *Nurus atlas* for comment on the interpretation of 'Clarence River' as a collection locality in the mid-1880s. The known range of *N. brevis* lies mostly within the Richmond River drainage at Lismore but its western population along the Richmond Range is on the watershed between the Richmond and Clarence Rivers.

Diagnosis. *Nurus brevis* has a relatively broad form, similar to *N. popplei*. However, *N. brevis* has the pronotal basal margin more distinctly concave and the basal margin of elytra clearly sinuate, whereas *N. popplei* has a shallowly emarginate pronotal base and nearly straight basal elytral margin (Figs 13-14).

Redescription. Size. Overall length 23.5-28.2 mm; greatest width of elytra 9.5-11.6 mm. *Colour.* Dorsal and ventral surfaces with base colour black; legs, mouthparts and antennae black or dark piceous. Pronotum all black or subtle metallic green at lateral and basal margins. Elytral disc black, lateral margins of elytra metallic green or mixed with a little copper. *Lustre.* Dorsally head, pronotum and elytral margins glossy; elytral disc slightly duller than forebody but also glossy; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines visible at 50x magnification, microlines forming irregular, slightly transverse mesh, vertex smooth. Clypeal-ocular sulci absent or represented by broad, very shallow, poorly defined impressions. Ocular ratio 0.70-0.73; eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight, medial four setae separated from each other about three-quarters width from outermost medial seta to lateral seta. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth emarginate or entire; constantly with one pair of setae positioned at base of median tooth, occasionally with two pairs of setae laterad of medial pair. Submentum with two lateral pairs of setae. Gula narrow, width at middle slightly wider than mentum tooth at base. Antennae moderately long, antennomere 11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax.* Pronotum transverse, sides subsinuate or not sinuate and convergent to base. Marginal bead thick, narrowed apically, ending at level of basal impression or scarcely marked medially and ending near hind angles; basal margin not bordered, deeply and broadly emarginated medially; anterior angles very prominently produced; hind angles obtuse or nearly right-angled, not denticulate; base broadly depressed, basal impressions not apparent or very broad and not

clearly delimited. Anterior marginal seta set mediad and touching lateral channel. Posterior seta set in hind angle. Microsculpture of disc visible at 50x magnification, microlines form very irregular, somewhat transverse mesh; often with a slight spectral iridescence. Prosternal process medial impression present near apex, varying from very shallow to shallow, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, very broadly and shallowly impressed. Parascutellar striae very short or absent and angular base of stria 1 present, distinctly impressed. Elytral parascutellar setae absent, basal margin sharply bordered and deeply concave. Striae typically smooth or occasionally marked with dense, shallow punctulae. Elytra with nine scarcely convex intervals. Elytral microsculpture on intervals 1-8 and in striae dense, small, granular, composed of irregular sculpticells giving a dull sheen, dorsal area of interval's convexity slightly glossier due to shallow microsculpture. Interval 3 with 0-2 setae. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 28-36 umbilicate setae, somewhat irregularly spaced but more closely set anteriorly. Stria 7 not evident near apex. Elytral humeri with distinct, sharp or somewhat rounded tooth. Elytra lacking externally visible plica, apicolaterally internal ridge low small but apparent. Vestigial flight wing present as a thin strap about 1/6 elytral length. Male and female protarsi symmetrical and ventrally glabrous. Protibia without anteroapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove. *Abdomen.* Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 with four setae in males, four to six setae in females. Female also with one or two pairs of subapical setae medially on ventrite 6.

Male genitalia. Aedeagus (Figs 21-23) right paramere moderately long, very broad, bluntly rounded at apex with sharp hooked denticle, left paramere broadly rounded at apex, conchiferous; tip of median lobe elongate and rounded. Dorsal ostium wide and rotated to right.

Distribution (Fig. 42). *Nurus brevis* now occurs in two disjunct areas about 50 km apart. The easternmost occurrence is in dry lowland rainforests along the Wilson River in and adjacent to the city of Lismore. The other population is in wetter rainforests of the Cambridge Plateau at the southern end of the Richmond Range as well as the dry rainforests in foothills a little further south near Mallanganee. These two populations might have been contiguous before complete clearing of vegetation along the connecting Richmond River valley took place.

***Nurus latipennis* (Sloane, 1903)**

(Figs 4, 24-26, 42)

Castelnaudia latipennis Sloane, 1903.

Nurus latipennis (Sloane): Moore *et al.* (1987).

Type material examined. Moore *et al.* (1987) listed two syntypes from ‘Dunoon’ and ‘Richmond R’ in ANIC. *Lectotype* ♀, here designated: ‘Dunoon, Richmond R’. It has an old ‘♀ Type’ label on it and Darlington has added his red label, ‘*Nurus latipennis* Sl HOLOTYPE PJD’, but did not publish that action (ANIC). *Paralectotype*, here designated: ‘Dunoon, iv.90, Helms’ (ANIC).

Other material examined. (116): QUEENSLAND: 1, Bald Mtn area, 1100 m, 38 km E of Warwick, 26.i.1973, I. Titmarsh; 1, s. l., 22-27.i.1971, GBM; 4, s. l., 26-30.i.1973, GBM; 1, s. l., 27-31.i.1972, GBM; 3, Mt Asplenium, 1240 m, 18-20.xii.1992, GBM; 2, s. l., 20.xii.1992-31.iii.1993, GBM; 1, s. l., 29-30.i.1993, GBM; 13, Mt Superbus summit, 1370 m, 8-9.ii.1990, GBM, GIT & HJ; 2, s. l., 23.x.1998, PB & DKY; 2, s. l., 9.i.2009, GBM (1 is EMEC346344) (QM); 2, s. l., 16-18.ii.2002, S.J. Hey & A. Polak (ANIC); 5, Nothofagus Mtn, 1120 m, 25.xi.1982, GBM & DKY; 6, s. l., 1000 m, 4-6.ii.1982, GBM & DKY (QM); 1, s. l., 950 m, 4-6.ii.1982, GBM & DKY (ANIC). NEW SOUTH WALES: 1, Tooloom Plateau, 720 m, via Urbenville, NSW, 16-17.xii.1972, GBM (ANIC); 1, s. l., 16-17.xii.1972, GBM; 3, s. l., 22.x.1972, GBM; 3, s. l., 29.xii.1972, GBM; 1, s. l., 30.i.1973, GBM; 2, s. l., 25.ii.1973, GBM; 2, s. l., 30.ix.1973, GBM; 2, s. l., 11.xi.1973, GBM; 3, s. l., 24.xi.1973, GBM; 1, s. l., 28.ix.1989, GBM; 2, s. l., 19.i.1974, GBM; 1, s. l., 9.ii.1974, GBM; 1, s. l., 31.xii.1973 (QM); 2, s. l., 6.xii.2017, GBM; 4, Big Scrub Loop, Nightcap NP (= Whian Whian SF), 3.i.2011, KWW (1 is EMEC1005747); 1, s. l., 29.i.2008, GBM & FT (EMEC); 1, s. l., 5.v.1973, RIS; 2, s. l., 25-26.xi.1972, GBM; 2, s. l., 29.i.2008, GBM & FT (QM); 1, same data (CBM); 3, s. l., 16.xi-26.xii.1974, GBM & SRM; 1, s. l., 17.vii.2016, GBM (EMEC346343) (QM); 2, s. l., 180 m, 4.ii-9.iv.1993, MG & GC; 3, s. l., 220 m, 4.ii-9.iv.1993, MG & GC; 2, Yabba SF, 600-900 m, 28°38’S, 152°20’E, 12.xii.1988, Smith, Hines, Pugh, Webber; 2, Beaury SF, 7 km from top end of Tucker Box Trail, 740 m, 4.ii-9.iv.1993, MG & GC; 2, Beaury Creek, 5.xii.1975, FF (AM); 1, Beaury SF, 282°9’Sx152°23’E, 700 m, 15-17.ii/1983, TW & AC (ANIC); 1, Urbenville, 5.xii.1976, FF (AM); 4, Nightcap Range, via Dunoon, 820 m, 16.xi-26.xii.1974, GBM & SRM; 1, s. l., 25.i.1972, GBM; 1, s. l., 820 m, 6.v.1973, IDN; 3, 4 km S. of Bar Mtn, Tweed Range, 29.i.2008, GBM & FT (1 is EMEC346342) (QM); 1, s. l., 28.i.2008, GBM&FT (EMEC); 1, Whian Whian SF, 700’, via Dunoon, 25-26.xi.1972, GBM; 1, Dunoon (= Whian Whian SF), xi.72, GBM; 2, Gwydir Hwy, 45 ml. E (of Glen Innes), 3.xii.1963, BPM (ANIC); 2, Acacia Plateau (QDAF).

Type locality. The lectotype is labelled ‘Dunoon’, which is a small village surrounded by cleared farmland that was formerly rainforest. It is unclear if there are any extant populations of this species in or near Dunoon but it is common only 5.5 km NNE of that location at the Big Scrub Loop Walking Track (28.635°S x 153.329°E)

Diagnosis. The range of *Nurus latipennis* is adjacent to those of *N. perater*, *N. atlas*, *N. moorei* and *N. brevis*. Among these it is the only species that has copper, bronze or aeneous colours. The elytra of *N. latipennis* are rather elongate-oval in contrast with all of these species (Fig. 4).

Redescription. *Size.* Overall length 25.0-26.1 mm; greatest width of elytra 10.0-10.5 mm. *Colour.* Dorsal and ventral surfaces with base colour piceous or black; legs, mouthparts and antennae piceous. Pronotum with bronze or copper colour, occasionally mixed with aeneous reflection at lateral and basal

margins. Elytral disc black or with metallic red to copper reflectance and lateral margins of elytra metallic bronze or copper. *Lustre*. Dorsally head, pronotum and elytral margins glossy; elytral disc duller; ventrally moderately glossy. *Head*. Dorsal microsculpture with microlines visible at 50x magnification. Clypeal-ocular sulci absent. Ocular ratio 0.70-0.74; eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight or slightly convex, medial four setae separated from each other about half width from outermost medial seta to lateral seta. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth emarginated; constantly with one pair of setae positioned at base of median tooth, occasionally with a second pair of setae laterad of medial pair, rarely with a few other scattered setae. Submentum with two lateral pairs of setae. Gula narrow, width at middle about as wide as width of mentum tooth. Antennae long, antennomere 11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax*. Pronotum transverse, sides sinuate and then straight onto base. Marginal bead thick, continuous from apex to base or slightly broadened basally and ending at level of basal impressions; basal margin not bordered, very shallowly emarginated medially; anterior angles very prominently produced; hind angles right-angled or slightly acute and denticulate; base depressed, basal impressions very broad, moderately impressed and not clearly delimited or deeply impressed; transverse linear sulci basad, impressions near basal margin form a wide border or sulci absent. Anterior marginal seta set mesad lateral channel. Seta near hind angle set in lateral bead. Microsculpture of disc visible at 50x magnification, microlines form very irregular transverse mesh. Prosternal process medial impression present near apex deep, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, broadly and shallowly impressed. Parascutellar striae and angular base of stria 1 present, distinctly impressed. Elytral parascutellar setae absent, basal margin sharply bordered. Striae marked with dense, shallow punctulae. Elytra with nine intervals, 2-7 convex, 1, 8-9 scarcely raised. Elytral microsculpture on intervals 1-8 and in striae dense, small, granular, composed of irregular sculpticells giving a dull sheen, slightly glossier in narrow dorsal area of interval's convexity due to shallower microsculpture. Interval 3 with one to three setae. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 24-27 umbilicate setae, somewhat irregularly spaced but more closely set anteriorly and posteriorly. Stria 7 evident apically, with one umbilicate seta. Elytral humeri with small, sharp tooth. Elytra lacking externally visible plica, apicolaterally internal ridge scarcely apparent. Vestigial flight wing present as a thin strap about 1/6 elytral length. Male and female protarsi symmetrical and ventrally glabrous. Protibia without anterioapical field of setae between antennal cleaner and apical margin in

addition to longitudinal row of setae above antennal cleaner groove. *Abdomen.* Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 in both sexes typically with four setae, some individuals with six to nine setae.

Male genitalia. Aedeagus (Figs 24-26) right paramere long, very narrow, tapering to small, sharply hooked denticle, left paramere broadly rounded at apex, conchiferous; tip of median lobe narrow, blunt, with a small, rounded denticle. Dorsal ostium wide and rotated to right.

Distribution (Fig. 42). *Nurus latipennis* is the most widespread member of the group but occurs only in rainforest. It occurs sporadically on mountain tops (Mt Nothofagus, Mt Superbus, Mt Asplenium, Bald Mtn) along the Border Ranges west of the Tweed Shield Volcano, then further south on Tooloom and Yabbra ranges, then at both high and low elevations on the Nightcap Range, which is the southern flank of the Tweed Shield Volcano. Barry Moore collected two specimens 110 km further south on the Gibraltar Range, more than halfway to its close sister species *Nurus baehri*. This disjunction between the Queensland Border Ranges and Gibraltar Range is bridged by other flightless Coleoptera such as the dung beetle *Amphistomus trispiculatus* Matthews, 1974.

Nurus popplei sp. n.

(Figs 5, 27-29, 42)

Types. *Holotype* ♂, NEW SOUTH WALES: 'NSW:29.305°Sx151.688°E, 1.1 km N of Torrington, 20July2016, 1160 m, open for. G.B. Monteith 38649'. Deposited in QM, Reg. No. T244815. *Paratypes* (11): NEW SOUTH WALES: 1, Blatherarm Camp, Torrington, 29.252°S x 151.707°E, roving, 7.i.2016, L.W. Popple; 1, Silent Grove Rd, Torrington, 29.306°S x 151.689°E, 1130 m, 3.xii.2016, GBM, open forest, in burrows (AM); 3, same data (1 is EMEC346325) (QM); 1, 1.1 km N of Torrington, 29.305°S x 151.688°E, 1145 m, open forest, 20.vii.2016, GBM (QM); 2, same data (EMEC346326 & EMEC346327) (EMEC); 1, same data (CBM).

Type locality. 1.1 km north of Torrington, NSW (29.305°S x 151.688°E)

Diagnosis. *Nurus popplei* is similar to *N. baehri* and *N. brevis* but is only found in the area of Torrington, NSW, rather distant from populations of *N. baehri* and *N. brevis*. Additionally, the basal margin of the elytra is distinctly, deeply concave in *N. brevis* and only shallowly so in *N. popplei* and *N. baehri* (Figs 13-14). *Nurus popplei* is readily separated from *N. baehri* by its pronotal shape and its flatter and duller elytral intervals (Figs 5-6).

Description. *Size.* Overall length 32.3 (31.8-35.5) mm; greatest width of elytra 10.5 (10.4-12.3) mm. *Colour.* Dorsal and ventral surfaces with base colour black; legs, mouthparts and antennae black or dark piceous. Pronotum at lateral and basal margins and lateral margins of elytra metallic green, blue or purple. Elytral disc black or rarely striae punctures with a metallic green reflectance. *Lustre.* Dorsally head, pronotum and elytral margins slightly

glossy; elytral disc dull; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines clearly visible at 50x magnification, microlines forming irregular mesh, vertex smooth. Clypeal-ocular sulci absent or represented by very broad, shallow, poorly defined impressions. Ocular ratio 0.72 (0.69-0.73); eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight, medial four setae separated from each other about three-quarters width from outermost medial seta to lateral seta. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth emarginate or bifid; constantly with one pair of setae positioned at base of median tooth, occasionally with a second pair of setae laterad of medial pair. Submentum with two lateral pairs of setae. Gula very narrow, width at middle about as wide as mentum tooth at base. Antennae long, antennomeres 10-11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax.* Pronotum transverse, sides not or only very slightly sinuate and convergent onto base. Marginal bead thick, continuous from apex to base; basal margin not bordered, moderately emarginated medially; anterior angles very prominently produced; hind angles right-angled and denticulate or slightly obtusely angled with denticle scarcely apparent; base depressed, basal impressions not apparent or very broad, shallow and not clearly delimited. Anterior marginal seta set mediad of lateral channel. Posterior seta set in hind angle. Microsculpture of disc clearly visible at 50x magnification, microlines forming irregular mesh. Prosternal process with very shallow medial impression near apex, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, broadly and shallowly impressed. Parascutellar striae and angular base of stria 1 absent, present or very shallow or only partially marked. Elytral parascutellar setae absent, basal margin sharply bordered. Striae smooth or marked with irregular, sometimes dense, shallow punctulae. Elytra with nine slightly convex intervals. Elytral microsculpture on intervals 1-8 dense, small, granular, composed of irregular sculpticells giving a dull sheen, without a contrast with strial region or with a narrow dorsal area of interval's convexity contrasting, slightly glossy lustre due to shallow microsculpture. Interval 3 with 0-4 setae, often variable between elytra, typically one seta present in basal and apical thirds of elytron length. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 20-26 umbilicate setae, somewhat irregularly spaced but typically more closely set anteriorly and posteriorly. Stria 7 with one or two setae near apex. Elytral humeri with distinct, sharp or somewhat rounded tooth. Elytra lacking externally visible plica, apicolaterally internal ridge scarcely apparent. Vestigial flight wing present as a thin strap about 1/5 elytral length. Male and female protarsi symmetrical and ventrally glabrous. Protibia without anteroapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove.

Abdomen. Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 with four to six setae.

Male genitalia. Aedeagus (Figs 27-29) right paramere long, broad, narrowed at apex with sharp hooked denticle, left paramere broadly rounded at apex, conchiferous; tip of median lobe uniformly rounded. Dorsal ostium very wide and rotated to right.

Female genitalia and reproductive tract. Gonocoxite 2 with one short marginal ensiform and one or two apical nematiform setae. Elongate spermatheca ending in an oval expansion, with a very small spermathecal duct digital diverticulum near base, attached to base of common oviduct. Spermathecal gland connected to spermathecal duct near base by long, narrow duct about 1.5x length of spermatheca; glandular portion elongate ovoid. *Pygidial gland* with large, elongate reservoir; efferent duct very broad; collecting duct connected to dorsal face of reservoir near its base.

Etymology. The specific epithet, *popplei*, is a Latinized version (genitive case) of the surname of Dr Lindsay Popple, who first collected this species and who has made significant discovery of localities for the endangered *Nurus atlas*.

Distribution (Fig. 42). *Nurus popplei* occurs at above 1000 m on an isolated granite plateau surrounding the township of Torrington, 40 km SW of Tenterfield. It is unique in the group in living in open eucalypt woodland with grassy understorey and occurs further inland (175 km from coast) than other species.

***Nurus baehri* sp. n.**

(Figs 6, 30-32, 42)

Types. *Holotype* ♂, NEW SOUTH WALES: 'NSW:30.532°Sx152.362°E, Cunnawara Trail 1350 m 3Jul2017 G.B. Monteith ex burrow, *Nothofagus* RF 39423'. Deposited in QM, Reg. No. T244816. *Paratypes* (135): NEW SOUTH WALES: 1, Point Lookout, 14.x.1973, L. Keogh (ANIC); 17, s. l., 11.xi.1980-16.iii.1981, GBM & SRM, pitfalls; 13, s. l., 22.iii.1980-11.xi.1980, GBM & SRM, pitfalls; 1, s. l., 17.xii.1975, BC; 3, s. l., 20-23.x.1978, GC; 1, New England NP, 25.vii.1980, RR; 2, s. l., 11.xi.1980, GBM; 1, s. l., 1-2.i.1967, GBM; 1, s. l., 8-9.iv.1966, GBM; 2, s. l., *Nothofagus*, 1450 m, 12-13.xi.2008, GBM, ex burrows (QM); 3, s. l., 10.i.1963, BPM; 2, s. l., 1.xii.1963, BPM; 4, Ebor, NSW, 1.xi.59, BPM; 1, s. l., NSW, 28-30.xii.1974 (ANIC); 4, s. l., xi.1976, FF; 1, s. l., 15.i.1912, RJT; 1, s. l. (AM); 1, s. l., 15.xi.1917; 4, s. l., 15.i.1912; 1, New England NP, Robinsons Knob Trail, 29.xii.1999, L. Toledano; 1, New England NP, Cunnawarra Trail, 3.vii.2017, GBM (1 is EMEC346331 voucher) (QM); 2, s. l., 3.vii.2017, GBM (1 is EMEC346330) (EMEC); 2, s. l., 1130 m, 4.ii-9.iv.1993, MG & GC; 1, Styx R. SF, Cliffs Trail, 3 km S of Pt Lookout, 1350 m, ii-iii, 1993, MG & GC; 2, Styx River SF, bottom end of Cliffs Trail, ca 3.8 km NE Oxley Rd, 1180 m, 4.ii-9.iv.1993, MG & GC; 1, New England NP, Cliffs Trail ca 2 km S of gate from Pt Lookout Rd, 1300 m, MG & GC; 1, New England NP, top end of Cliffs Trail, 1350 m, 4.ii-9.iv.1993, MG & GC;

3, Marengo SF, 0.5 km NE along Foamy Creek Rd from Chaelundi Rd, 1200 m, 4.ii-9.iv.1993, MG & GC; 1, 7 km N of Pt Lookout, 3.x.1977, DAD; 1, Dorrigo, xii.1953, FF; 1, s. l., i.1974, PZ (AM); 2, s. l., 5.xii.1974, R. Overland; 2, s. l., FF; 1, Majors Point, 20.xii.2002, S.J. Hey & A. Polak (ANIC); 12, s. l., 28.xi.1975, FF; 2, Banksia Point, 20.xi.1975, FF (AM); 3, s. l., 7.i.2011, KWW; 2, Mt Hyland, 3.vii.2017, GBM (EMEC346328 & EMEC346329) (EMEC); 2, s. l., 3.vii.2017, GBM (CBM); 9, Guy Fawkes, xii.1955, FF; 1, Styx River, 13.xi.1976 (AM); 1, Styx River rest area, 26.xii.2000, JB; 1, Styx River SF, Wattle Camp, 13.xi.1982, JD; 1, Blue Hole, 15.ix.1974, P.G. Wong (donated ex UNE colln) (ANIC).

Other material examined. 2, Dorrigo; 4, Ebor (MV).

Type locality. Cunnawarra Trail, NSW (30.532°S x 152.362°E)

Diagnosis. *Nurus baehri* is similar to *N. popplei* but is only found much further south of that and other *Nurus s.str.* species. *Nurus baehri* is readily separated from *N. popplei* by its pronotal shape and more convex and glossier elytral intervals (Figs 5-6).

Description. Size. Overall length 26.3 (24.0-27.5) mm; greatest width of elytra 10.8 (10.6-10.8) mm. *Colour.* Dorsal and ventral surfaces with base colour black; legs, mouthparts and antennae black or dark piceous. Pronotum rarely all black, typically metallic green or blue at lateral and basal margins. Elytral disc black or with striae and/or intervals with metallic green reflectance, lateral margins of elytra metallic green, blue or purple. *Lustre.* Dorsally head, pronotum and elytral margins glossy; elytral disc duller but intervals dorsally contrastingly glossier; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines hardly visible at 50x magnification, microlines, where evident, forming irregular mesh, vertex smooth. Clypeal-ocular sulci absent or represented by very broad, shallow, poorly defined impressions. Ocular ratio 0.67 (0.67-0.70); eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight, medial four setae separated from each other about three-quarters width from outermost medial seta to lateral seta. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth entire, emarginated or bifid; constantly with one pair of setae positioned at base of median tooth, occasionally with a second pair of setae laterad of medial pair. Submentum with two lateral pairs of setae. Gula very narrow, width at middle about as wide as mentum tooth at base. Antennae long, antennomeres 10-11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax.* Pronotum transverse, sides sinuate or subsinuate and then straight or convergent onto base. Marginal bead thick, continuous from apex to base; basal margin not bordered, moderately emarginated medially; anterior angles very prominently produced; hind angles right-angled and denticulate, some with denticle scarcely apparent; base depressed, basal impressions not apparent or very broad and not clearly delimited. Anterior marginal seta set mediad of lateral channel. Posterior seta set in hind angle. Microsculpture of

disc hardly visible at 50x magnification, where evident near base and lateral margins microlines form very irregular mesh. Prosternal process medial impression present near apex, varying from very deep to shallow, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, broadly and shallowly impressed. Parascutellar striae and angular base of stria 1 present, distinctly impressed. Elytral parascutellar setae absent, basal margin sharply bordered. Striae smooth or marked with dense, shallow punctulae. Elytra with nine intervals, 1-8 convex or subcarinate. Elytral microsculpture laterally on intervals 1-8 and in striae dense, small, granular, composed of irregular sculpticells giving a dull sheen, contrasting with broad dorsal area of interval's convexity that has a glossy lustre due to shallow or absent microsculpture. Interval 3 with zero to three setae, often variable between elytra, typically one seta present in basal and apical thirds of elytron length. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 22-28 umbilicate setae, somewhat irregularly spaced but more closely set anteriorly and posteriorly. Stria 7 with one or two setae near apex. Elytral humeri with distinct, sharp or somewhat rounded tooth. Elytra lacking externally visible plica, apicolaterally internal ridge scarcely apparent. Vestigial flight wing present as a thin strap about 1/5 elytral length. Male and female protarsi symmetrical and ventrally glabrous. Protibia without anteroapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove. *Abdomen.* Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 with four to six setae.

Male genitalia. Aedeagus (Figs 30-32) right paramere long, very broad, narrowed and curved at apex with sharp-hooked denticle, left paramere broadly rounded at apex, conchiferous; tip of median lobe rounded. Dorsal ostium wide and rotated to right.

Female genitalia and reproductive tract. Gonocoxite 2 with one short marginal ensiform and two apical nematiform setae (occasionally only one visible, likely due to damage). Elongate spermatheca ending in an oval expansion, with a very a very small spermathecal duct digital diverticulum near base, attached to base of common oviduct. Spermathecal gland connected to spermathecal duct near base by long, narrow duct, about 1.5x length of spermatheca; glandular portion elongate ovoid. *Pygidial gland* with large, elongate reservoir; efferent duct very broad; collecting duct connected to dorsal face of reservoir near its base.

Etymology. The specific epithet, *baehri*, is a Latinized version (genitive case) of the surname of Dr Martin Baehr, Munich, Germany, the foremost and most prolific authority on Australian carabid beetles, having described over 1200 species of Australian carabids to date.

Distribution (Fig. 42). *Nurus baehri* occurs in both rainforests and dense eucalypt forests on the high mountains south-west (Major's Point), south (New England NP) and north (Mt Hyland) of the town of Ebor. Most localities are above 1000 m. There are earlier records from 'Dorrigo', lower and further east, but modern collecting has not located the species near Dorrigo and earlier collectors might have used 'Dorrigo' as a district name that included Ebor.

Nurus imperialis (Sloane, 1895)

(Figs 7, 33-35, 41)

Homalosoma imperiale Sloane, 1895.

Nurus imperialis (Sloane): Tschitschérine (1902).

Type material. Lectotype, here designated: '*Homalosoma imperiale* Sl., Moreton Bay' [looks like original drawer label, now on spm] // 'HOLOTYPE' [red, printed] // 'On permanent loan from Macleay Museum, University of Sydney' [printed] // 'Brisbane' [printed], in ANIC. *Paralectotype* ♂, here designated: 'Type/*Trichosternus imperialis* Sl, probably not HOLOTYPE' [printed red label, with 'probably not' handwritten].

Other material examined. (115): QUEENSLAND: 2, Tamborine Mt, 20.ii.1911, WWF; 2, s. l., 14.ii.1903, WWF; 1, s. l., HJC, xi.24; 1, s. l., RI; 2, s. l., HJC; 1, s. l., AML; 1, s. l., Davidson; 1, s. l., 16.iv.1971, RO; 1, s. l., 6.i.1963, BPM; 4, s. l., 8.x.1910, TGS; 1, s. l., ES; 1, s. l., xii.1950, CO; 1, s. l., ix.28, SRB; 1, s. l., xii.1976, FF; 1, s. l., i.1973, GBM (ANIC); 10, s.l., 1956, FF; 2, s. l., xii.1955, FF; 11, s.l., 22-23.xii.1976, FF; 1, s. l., 3.v.1910, HT; 4, s. l., AML; 5, s. l., x.1924, AM & CG; 1, s.l. (AM); 3, s.l., 28.x.2012, HH; 2, s.l., iii.1921, HAL; 1, s. l., 16.v.1928; 1, s. l., 19.v.1928; 1, s. l., 14.v.1928; 2, s. l., 20.v.1928; 1, s. l., 26.iv.1959, RPJ; 1, s. l., 11.iv.1964, TW; 1, s. l., 11.iv.1964, BC; 1, s. l., AML; 1, s. l.; 1, s. l. (QM); 9, s. l. (MM); 2, s. l., 20.v.1973, RIS; 1, s. l., 1.iii.1979, Agard; 1, s. l., 30.i.1973, GBM; 1, s. l., CJW; 1, s. l., 3.v.1919, HT; 1, s. l., 10.i.1933; 1, s. l. (QDAF); 1, North Tamborine, 9.iii.1992-25.iv.1992, DJC; 2, Palm Grove, Tamborine, 14.xii.1974-22.iii.1975, GBM & SRM; 2, s. l., 22.iii.-25.v.1975, GBM & SRM; 2, s. l., 25.vi.1972, GBM; 1, s.l, 30.x.1972, GBM; 1, s. l., 23.viii.2007, GBM (QM); 1, s. l., 23.viii.2007, GBM & FT; 2, s. l., 2016, GBM (EMEC347347, EMEC346348) (EMEC); 1, s. l., 15.vi.1971, GBM; 1, McDonald Park, Mt Tamborine, 26.xi.1982, JD; 1, South Queensland; 1, 'Endeavour R.' [spurious]; 2, no data (ANIC); 1, Witches Falls, Mt Tamborine, 28.ii.1960, J. Bryan; 3, no data; 1, Queensland (QM); 1, no data (QDAF); 1, no data (AM).

Type locality. 'Moreton Bay' was the name used for the first Queensland settlement prior to it being named Brisbane in 1834 and was applied as a locality name for many early collections from the broader SE Queensland region that includes Tamborine Mountain, 55 km south of Brisbane. This species is well surveyed and occurs only within a 5 km radius at the northern end of Tamborine Mountain.

Diagnosis. The prominent metallic colour (Figs 7-8) and the patch of additional setae near the apex of the protibiae (Fig. 9) separate *N. imperialis* and *N. moorei* from all other *Nurus s.str.* species. In addition to the characteristics in the key, *N. imperialis* differs from *N. moorei* by having

much flatter elytral intervals, especially the basal half, and the base of interval 2 is usually not raised at all, whereas *N. moorei* has more convex intervals and interval 2 is usually similarly convex to other intervals. Distribution is also distinguishing, with *N. imperialis* found only on Mt Tamborine, 30 km north of the range of *N. moorei* (Fig. 41).

Redescription. Size. Overall length 28.5-33.5 mm; greatest width of elytra 11.7-13.4 mm. *Colour.* Dorsal and ventral surfaces with base colour black; legs, mouthparts and antennae black or piceous, usually piceous proximally. Head dorsally, pronotum and lateral margins of elytra metallic green, copper or aeneous colour. Elytral disc black. *Lustre.* Dorsally head, pronotum and elytral margins very glossy; elytral disc dull; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines not or scarcely visible at 50x magnification, vertex smooth. Clypeal-ocular sulci represented by broad, shallow, poorly defined impressions that are parallel and end at level of anterior supraorbital setae. Ocular ratio 0.73-0.76; eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight and raised medially, medial four setae separated from each other half or less width from outermost medial seta to lateral seta, slightly wider gap between medial setae. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth emarginate or bifid; constantly with one pair of setae positioned at base of median tooth, frequently with a second pair of setae laterad of medial pair. Submentum with two lateral pairs of setae. Gula very narrow, width at middle about as wide as mentum tooth at base. Antennae long, antennomeres 10-11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax.* Pronotum transverse to linear, sides sinuate or subsinuate and straight onto base. Marginal bead thick, continuous from apex to base; basal margin not bordered, moderately to deeply emarginate; anterior angles prominently produced; hind angles right-angled; basal impressions shallowly impressed, very broad, not sharply delimited. Anterior marginal seta set mediad, touching lateral channel. Seta at hind angle touching or in basal bead. Microsculpture of disc visible at 50x magnification as irregular mesh. Prosternal process with shallow or deep medial impression near apex, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, broadly and shallowly impressed. Parascutellar striae and angular base of stria 1 present. Elytral parascutellar setae absent, basal margin sharply bordered. Striae marked with dense, shallow punctulae. Elytra with nine very slightly convex intervals. Elytral microsculpture on intervals 1-8 dense, small, granular, composed of irregular sculpticells giving a dull sheen. Interval 3 with three to four setae. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 28-32 umbilicate setae, somewhat irregularly spaced but typically more closely set anteriorly and posteriorly. Elytral humeri with distinct, dorsally oriented

tooth. Elytra lacking externally visible plica, apicolaterally with a low internal ridge present. Vestigial flight wing present as a thin strap about 1/5 elytral length. Male and female protarsi symmetrical and ventrally glabrous. Protibia with anterioapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove. *Abdomen*. Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 with four to eight setae.

Male genitalia. Aedeagus (Figs 33-35) right paramere long, very narrow, tapering to small, sharply hooked denticle, left paramere broadly rounded at apex, conchiferous; tip of median lobe narrow, blunt, with a small, rounded denticle. Dorsal ostium wide and rotated to right.

Distribution (Fig. 41). *Nurus imperialis* is restricted to the small (10 km long) Tamborine Mountain, a northern outlier plateau of the Tweed Shield Volcano, isolated by resistant basalt cliffs and the convergence of the valleys of the Coomera and Albert Rivers between it and the rest of the volcano (Willmott 2004). Most specimens are simply labelled 'Mt Tamborine' but Fricke (1965) noted that the species occurs only at the northern end of the plateau. The top of the plateau is cleared now and rainforests persist only in reserves below the rim. Modern surveys by GBM show the species still survives in Palm Grove, McDonald Park, Curtis Falls and Witches Falls National Parks, all of them in the northern half of the plateau.

***Nurus moorei* sp. n.**

(Figs 8-10, 36-38, 41)

Types. *Holotype* ♂, QUEENSLAND: 'Mt Gannon via West Burleigh, 700 m, SE Qld 1July-2 Nov 1986 D. Cook & G. Monteith Rainforest Pitfalls' // 'QM Reg. No. T89256'. Deposited in QM. *Paratypes* (108): QUEENSLAND: 4, Albert River, right branch, 340 m, 1.xi.1975-30.x.1976, GBM & SRM; 4, s.l., 4.iv.-8.x.1976, GBM & SRM; 2, Albert River, right branch, 420 m, 1.ii.1975, NG; 2, Albert River, s. l., 1.xi.1975, GBM & SRM (QM); 1, s. l., 1.xi.1975, GBM & SRM (ANIC); 1, Albert River, Lamington, 2 km E of YHA hostel, 1.ii.1975 (QDAF); 1, Bithongabel, Lamington NP, 1160 m, 27.ix.1975, GBM; 1, Mt Cougal, 500 m, 17.i.1989, GBM; 1, s. l., 19.xi.1986, GBM, DJC & GIT; 2, Mt Gannon summit, 700 m, 2.xi.1986-18.i.1987, GBM & DJC; 3, Mt Gannon summit, 700 m, 1.vii-2.xi.1986, GBM & DJC; 3, Mt Gannon 400 m, 1.ix.1985, GBM & DJC; 1, s. l., 2.xi.1986-18.i.1987, GBM & DJC; 12, s. l., 18.i.-5.iv.1987, GBM & DJC; 2, Mt Gannon, 500 m, 28.198°S x 153.317°E, 29.xi.2010, KWW, GBM & DJC (QM); 5, Mt Gannon, 29.xi.2010, KWW (1 is EMEC10003800); 2, Christmas Creek, 360 m, 28.298°S, 153.096°E, 1.i.2018, GBM; 2, Numinbah Arch, 2.xii.2017, GBM (EMEC); 3, Tomewin Range, 500 m, 17.x.1988, GBM; 4, s. l., 16.v.1989, GBM, pitfall traps; 1, s. l., 19.x.1989, GBM; 1, Upper Tallebudgera Creek, 560 m, 9.xii.1984, GBM & DJC; 5, s. l., 9.xii.1985, GBM & DJC; 1, s. l., 1.iii-3.vii.1985, DJC; 18, s. l., 8.i-17.iii.1985, GBM, DJC & GIT (QM); 3, Upper Tallebudgera Creek, 500 m, 8.i.1985, GBM; 7, s. l. 19.xi.2007, GBM & FT (2 are EMEC346345 & EMEC346346) (QM); 2, same data (CBM); 2, same data (AM); 3, Rat-a-Tat Hut, Lamington NP, 28°18'S, 153°08'E, 920 m, 6.vii.1998, GBM (QM); 2, s. l., 20.viii.1952, JB; 1, National Park, Q., A.H. Chisholm (ANIC);

1, Macpherson Range, 22.x-5.xi.1926 (QM). NEW SOUTH WALES: 1, Tweed R., HJC (ANIC); 1, Tweed R, NSW; 1, no data, Reg. No. K259480 (AM); 2, Hayters Hill, 115 m, 28.673°S, 153.587°E, 28.iii.2018, GBM; 1, Lower Minyon Valley, 125 m, 28.627°S, 153.393°E, 22.viii.2018, DC (QM).

Type locality. Mt Gannon via West Burleigh, 700 m, SE Qld (28.202°S x 153.314°E).

Diagnosis. The prominent metallic colour and additional setae near the apex of the protibiae (Fig. 9) separate *N. moorei* and *N. imperialis* from all other *Nurus s.str.* species. In addition to the characteristics in the key, *N. imperialis* differs from *N. moorei* by having much flatter elytral intervals, especially the basal half, and the base of interval 2 is usually not raised at all, whereas *N. moorei* has more convex intervals and interval 2 is usually similarly convex to other intervals. Distribution is also distinguishing, with *N. imperialis* only found on Mt Tamborine, 35 km north of the range of *N. moorei* (Fig. 41).

Description. Size. Overall length 25.8 (24.5-29.5) mm; greatest width of elytra 11.9 (10.1-12.5) mm. *Colour.* Dorsal and ventral surfaces with base colour black; legs, mouthparts and antennae black or piceous, usually piceous proximally. Head dorsally, pronotum and lateral margins of elytra deep metallic green or slightly bluish green colour. Elytral disc black or with intervals with a slight green reflectance and striae with a slight coppery reflectance. *Lustre.* Dorsally head, pronotum and elytral margins very glossy; elytral disc dull; ventrally moderately glossy. *Head.* Dorsal microsculpture with microlines not or scarcely visible as irregular mesh at 50x magnification, vertex smooth or with very shallow wrinkles near eyes and base. Clypeal-ocular sulci represented by broad, shallow, poorly defined impressions that are parallel and end at level of anterior supraorbital setae. Ocular ratio 0.74 (0.70-0.74); eyes large, rounded. Mandibles long, abruptly hooked apically, scrobe glabrous. Labrum anterior margin straight or very slightly convex and raised medially, medial four setae separated from each other about three-quarters width from outermost medial seta to lateral seta, slightly wider gap between medial setae. Mentum long, deeply emarginate with parallel, prominent lateral lobes; median tooth prominent, tooth entire, emarginate or bifid; constantly with one pair of setae positioned at base of median tooth, frequently with a second pair of setae laterad medial pair, often only unilaterally. Submentum with two lateral pairs of setae. Gula very narrow, width at middle about as wide as mentum tooth at base. Antennae long, antennomeres 10-11 extended beyond pronotal base, antennomeres 5-11 elongate, apices of 4-11 densely pubescent, 2-4 compressed at base. *Thorax.* Pronotum transverse to linear, sides sinuate or straight onto base. Marginal bead thick, continuous from apex to base; basal margin not bordered, moderately to deeply emarginate; anterior angles prominently produced; hind angles right-angled; basal impression deeply impressed, very broad, not sharply delimited. Anterior marginal seta set mediad of lateral

channel. Seta at hind angle touching or in basal bead. Microsculpture of disc not or scarcely visible as irregular mesh at 50x magnification. Prosternal process with deep medial impression near apex, prosternum apically plurisetose. Metepisternum and metepimeron very short. Elytral striae complete, broadly and shallowly impressed. Parascutellar striae and angular base of stria 1 present but frequently very shallow or only partially marked. Elytral parascutellar setae absent, basal margin sharply bordered. Striae marked with dense, shallow punctulae or nearly smooth. Elytra with nine intervals. Elytral microsculpture on intervals 1-8 dense, small, granular, composed of irregular sculpticells giving a dull sheen. Interval 3 with four [rarely three or five] setae. Interval 9 and marginal channel microsculpture composed of flat, very reflectant sculpticells contrasting with dull discal microsculpture. Interval 9 with 28-32 umbilicate setae, somewhat irregularly spaced but typically more closely set anteriorly and posteriorly. Elytral humeri with distinct, dorsally oriented tooth. Elytra lacking externally visible plica, apicolaterally with a low internal ridge present. Vestigial flight wing present as a thin strap about 1/5 elytral length. Male and female protarsi symmetrical and ventrally glabrous. Protibia with anteroapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove. *Abdomen*. Abdominal ventrites smooth, 2-5 with a row of paramedial setae. Apical margin of ventrite 6 with four to six setae.

Male genitalia. Aedeagus (Figs 36-38) right paramere long, thin, sharply hooked at apex, left paramere broadly rounded at apex, conchiferous; tip of median lobe rounded, with small blunt denticle. Dorsal ostium very wide and rotated to right.

Female genitalia and reproductive tract. Gonocoxite 2 with three marginal ensiform and one or two apical nematiform setae. Elongate spermatheca ending in an oval expansion, with a prominent spermathecal duct digital diverticulum near base, attached to base of common oviduct. Spermathecal gland connected to spermathecal duct near base by long, narrow duct, nearly 2x length of spermatheca; glandular portion very elongate. *Pygidial gland* with large, elongate reservoir; efferent duct very broad; collecting duct connected to dorsal face of reservoir near its base.

Etymology. The specific epithet, *moorei*, is a Latinized version (genitive case) of the surname of the late Dr Barry P. Moore. This species is so named to honour his contributions to Australian carabid beetle taxonomy and chemical ecology.

Distribution (Fig. 41). *Nurus moorei* occurs in rainforests of valleys and low outlier ridges peripheral to the Lamington and Springbrook plateaux in the northern half of the Tweed Shield Volcano, as well as in two newly discovered sites 50 km further south (Hayters Hill and Lower Minyon Valley) on the extreme southern margin of the Volcano remnants. Curiously,

it is absent from the well collected northern part of the Lamington massif, but repeated collections have been made at two remote southern localities above 900 m altitude on the same plateau (Bithongabel and Rat-a-Tat).

Key to adults of *Nurus* s. str. species

- 1 Protarsomeres 1 and 2 or 1 to 3 with pads of squamose setae ventrally (some males) (Figs 11-12) 2
- 1' Protarsomeres without pads of squamose setae ventrally (males or females) (Fig. 10) 3
- 2(1) Protarsomeres 1-2 with pads of squamose setae ventrally (males) (Fig. 11); elytral intervals more or less equally developed *Nurus atlas*
- 2' Protarsomeres 1-3 with pads of squamose setae ventrally (males) (Fig. 12); odd elytral intervals much more prominently convex than even intervals *Nurus perater*
- 3(1') Protibia with anteroapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove (Fig. 9); head with metallic reflection 4
- 3' Protibia without anteroapical field of setae, longitudinal row of two to five setae above antennal cleaner groove; head without or rarely with metallic reflection 5
- 4(3) Head, pronotum and elytral margins pure metallic green; usually smaller, length 24.5-29.5 mm *Nurus moorei*
- 4' Head, pronotum, and elytral margins bronze, aeneous or variably red to green metallic; usually larger, length 28.5-33.5 mm; restricted to Mt. Tamborine, Qld *Nurus imperialis*
- 5(3') Protarsomeres 1-2 with a field of medial setae, protarsomere 1 typically with eight or more setae, 2 with three to four, rarely one side with only one; Lismore-Casino region of NSW (Figs 40, 42) 6
- 5' Protarsomere 1 with a field of four or more medial setae, protarsomere 2 with none or rarely with only one on one side; not found in the Lismore-Casino region of NSW 7
- 6(5) Elytral basal margin deeply curved (Fig. 13); size smaller, 23.5-28.2 mm; black or with metallic reflection laterally on the pronotum and elytral margins that is blue, violet or rarely green; pronotum cordate, lateral margins sinuate, width across anterior angles wider than distance across basal angles; pronotal basal margin distinctly concave; basal margin of elytra clearly sinuate; occurs from Lismore west to Mallanganee (Fig. 42) *Nurus brevis*
- 6' Elytral basal margin shallowly curved (Fig. 14); size larger, length 28.5-30.5 mm; typically with a green metallic reflection laterally on the

- pronotum and elytral margins; pronotum subquadrate, width across anterior angles only slightly wider than distance across basal angles; pronotal basal margin very slightly concave; basal margin of elytra almost straight; distribution restricted to near Alstonville, east of Lismore (Fig. 40) *Nurus atlas*
- 7(5') Larger, length 31.8-35.5 mm; black; elytra parallel-sided; head relatively very large; abdominal ventrites 3-5 with one pair of paramedial setae only; odd elytral intervals much more prominently convex than even intervals *Nurus perater*
- 7' Smaller, length 24.0-29.5 mm; colour black but frequently with metallic reflection on pronotum and elytral margins; elytra elongate-ovoid; head of average size for genus; abdominal ventrites 3-5 with numerous setae in a row in addition to paramedial setae on at least one ventrite, usually on all ventrites; elytral intervals more or less equally developed 8
- 8(7') Anterior and posterior supraorbital setae separated from supraocular sulcus by the width of the setal fovea or more distant; metallic colour aeneous or bronze *Nurus latipennis*
- 8' Anterior supraorbital setae less than the width of the setal fovea from or touching the supraocular sulcus; the posterior supraorbital seta position variable, but usually also one fovea width or less from the sulcus; metallic colour, when present, green, blue or rarely purple 9
- 9(8') Pronotal lateral margins sinuate; elytral disc with intervals clearly convex or subcarinate with a wide dorsal area of the interval's convexity with a contrasting glossy lustre due to the lack of or very shallow microsculpture; male genitalia Figs 30-32 *Nurus baehri*
- 9' Pronotal lateral margins subsinuate or nearly straight on the base; elytral disc with intervals low convex without a contrast with the stria region or with a narrow dorsal area of the interval's convexity scarcely contrasting, slightly glossy lustre due to shallow microsculpture; male genitalia Figs 27-29 *Nurus popplei*

Discussion

The resulting phylogenetic trees for *Nurus* s. str. species have three well-supported clades, viz. (*N. moorei* + *N. imperialis*), (*N. perater* + *N. atlas*) and (*N. latipennis* + *N. brevis* + *N. popplei* + *N. baehri*). The presumed morphological apomorphies of the *N. moorei* + *N. imperialis* clade include the anterioapical field of setae between antennal cleaner and apical margin in addition to longitudinal row of setae above antennal cleaner groove on the protibia (Fig. 9). This state is not found in any other *Nurus* s. str. species. Their clear metallic colour, especially on the head, similar form of the body (Figs 7-8) and similar male genitalia (Figs 33-38) are all consistent with this sister-group relationship and distinctiveness of the pair relative to other

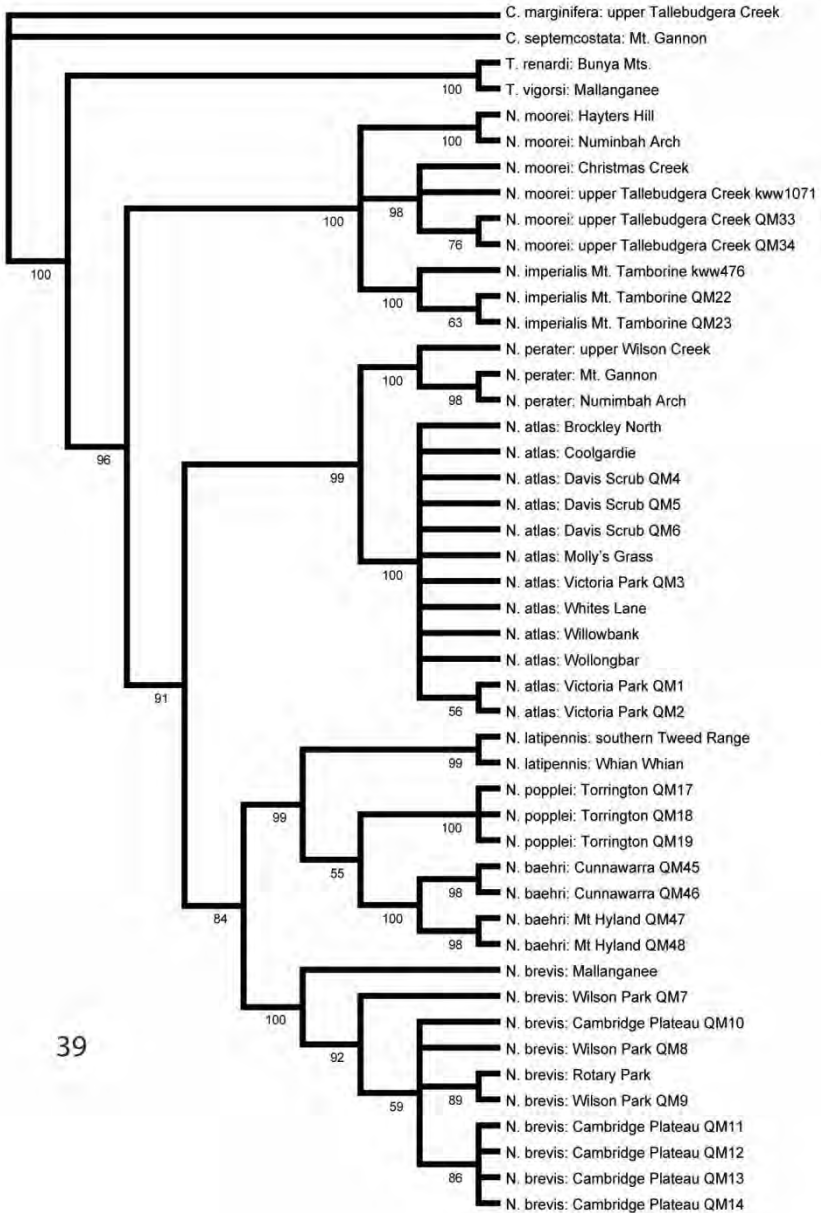
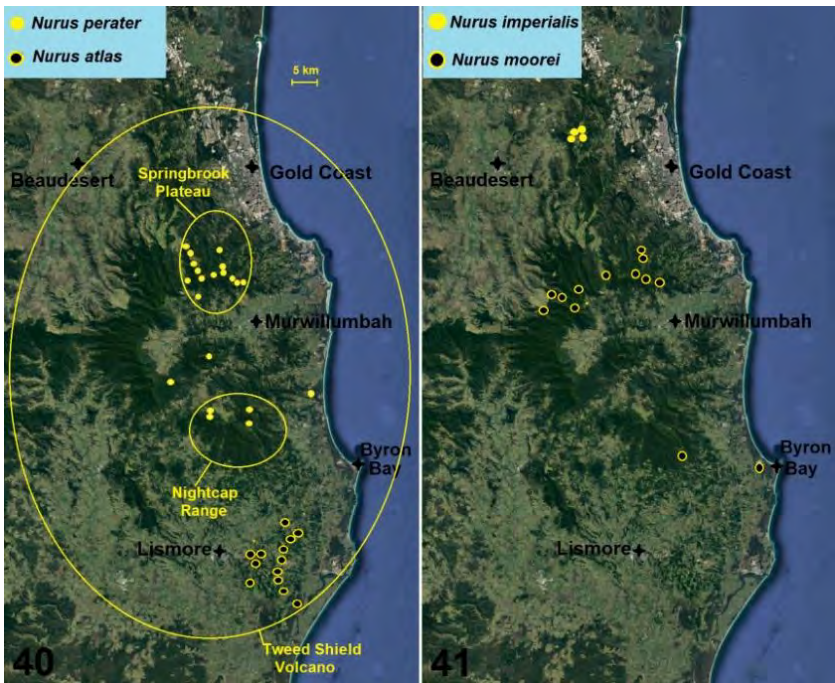


Fig. 39. Strict consensus of 20 trees for *Nurus* s. str. species. Numbers below branches are jackknife scores for clades scoring >50.

species. While recognisably different, their close similarity suggests a very recent split between the two species. In fact, samples of *Nurus moorei* do not form a monophyletic group in the strict consensus or jackknife tree (Fig. 39). Among the 20 parsimony trees, 10 place *N. moorei* from Hayters Hill and Numinbah Arch as a sister group to the remaining *N. moorei* OTUs and 10 place them sister to the *N. imperialis* clade, the latter arrangement making *N. moorei* paraphyletic. Neither placement is well supported. The paraphyletic arrangement finds support from only a few characters at the third positions of COI and this situation contrasts with the small number of synapomorphies in CAD that support *N. moorei* monophyly. Paraphyly within species for mtDNA sequences is common (Funk and Omland 2003) and monophyly is neither a necessary nor sufficient condition for species recognition (Knowles and Carsten 2007). Additionally, consistent differences between *N. moorei* and *N. imperialis*, including the form of the male genitalia (Figs 33, 36), colour of the dorsum, form and relative size of the elytra (Figs 7-8) and distinctly separated distributions (Fig. 41), all support separation and recognition of the two species.



Figs 40-41. Distribution maps for *Nurus* spp: (40) *Nurus perater* and *N. atlas*; (41) *N. imperialis* and *N. moorei*. On Fig. 40 the approximate boundaries of the Tweed Shield Volcano, the Springbrook Plateau and the Nightcap Range are shown.

A clade of *N. perator* + *N. atlas* is also well supported and, while in general body form they are very divergent, they share the condition of having the squamous vestiture on the ventral surface of the male tarsomeres, which is consistent with their placement. *Nurus perater* exhibits remarkable convergence with the general form of some species of *Trichosterus*, particularly, as noted by Sloane (1923), *T. renardi*. However, *N. perater* has a glabrous mesosternum and an arrangement of elytral striae near the apex unlike *Trichosternus* species, both states shared with other *Nurus* s. str. species. Both the DNA sequence data and details of the morphology support this result.

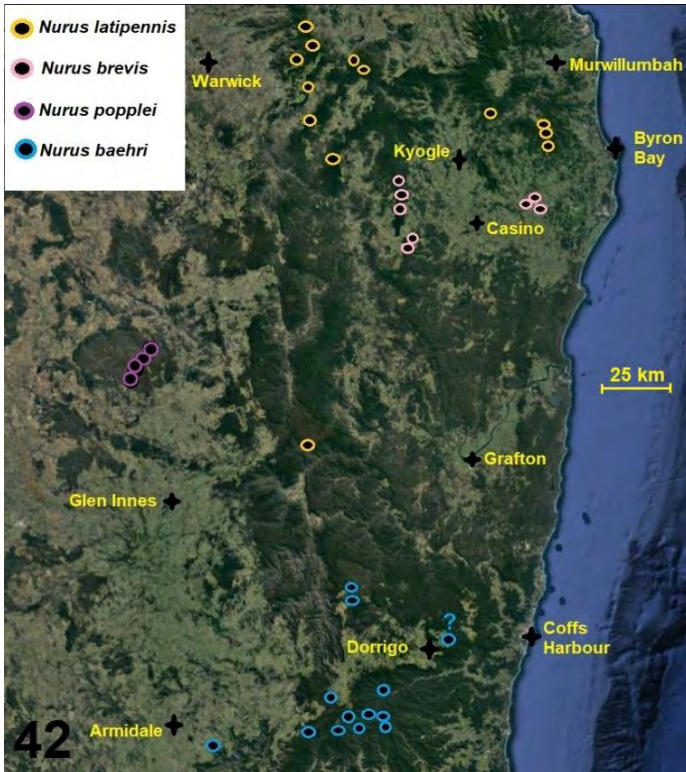


Fig. 42. Distribution map for *Nurus brevis*, *N. latipennis*, *N. popplei* and *N. baehri*.

The remaining four species form a clade that includes the most southerly and the most inland distributions. *Nurus popplei* and *N. baehri* are at these distributional extremes and are widely separated, the most widely separated of any species pair. While the support for this relationship is modest (jackknife of 55, Fig. 39), the form of the parameres (Figs 29, 32) is very similar and distinct from all other *Nurus* s. str. species.

The greatest diversity of *Nurus* s. str. occurs across the complex mountain systems that have resulted from the erosion and dissection of the 100 km diameter Tweed Shield Volcano (Wilmott 2004; Fig 40). Six of the eight species occur there and four are restricted to this region. With rare exception, the distributions of *Nurus* s.str. species are mutually exclusive, with usually only one species occurring at a single locality. The exception is the case of *Nurus perater* and *N. moorei*, which co-occur at low elevations to both the east (Tallebudgera Valley) and west (Numinbah Valley) of the Springbrook Plateau (Figs 40-41). However, at fine scale, their ranges are found to be contiguous, rather than overlapped, at those localities. At Numinbah, *N. perater* is found on the eastern side of Cave Creek while *N. moorei* is on the western side. In the Upper Tallebudgera Valley, sampling along a walking track reveals that a continuous occurrence of *N. perater* burrows changes abruptly to continuous occurrence of *N. moorei* and then back again to *N. perater* on a scale of several hundred meters, with no mixing. In the Nightcap Range (Fig. 40), which is the southernmost remnant block of the Tweed Shield Volcano, three species, representing all three clades, occur, but they are segregated into four discrete drainage systems. *Nurus perater* occurs at both the western (Mts Nardi and Matheson at the head of the Turntable Creek valley) and the eastern (head of Wilsons Creek valley) ends of the Nightcap Range. *Nurus latipennis* occurs at high and low elevations in the Rocky Creek valley and *N. moorei* occurs in the lower Minyon Creek valley, both being between the occurrences of *N. perater*. These four drainages are separated by about only 5 km between each.

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