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Revision of the Australian endemic ant genera *Pseudonotoncus* and *Teratomyrmex* (Hymenoptera: Formicidae: Formicinae)

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Abstract

The Australian endemic formicine ant genera *Pseudonotoncus* and *Teratomyrmex* are revised and their distributions and biologies reviewed. Both genera are limited to forested areas along the east coast of Australia. *Pseudonotoncus* is known from two species, *P. eurysikos* (new species) and *P. hirsutus* (= *P. turneri*, new synonym), while *Teratomyrmex* is known from three species, *T. greavesi*, *T. substrictus* (new species) and *T. tinae* (new species). Distribution modelling was used to examine habitat preferences within the *Pseudonotoncus* species.

Key words: Formicidae, *Pseudonotoncus*, *Teratomyrmex*, Australia, new species, key, MaxEnt

Introduction

Australia has a rich and diverse ant fauna, with over 1400 native species assigned to 100 genera. Of these 100 genera, 18 are endemic to Australia. These include *Adlerzia*, *Anisopheidole*, *Austromorium*, *Doleromyrma*, *Epopostruma*, *Froggattella*, *Machomyrma*, *Mesostruma*, *Myrmecorhynchus*, *Nebothriomyrmex*, *Nothomyrmecia*, *Notostigma*, *Melophorus*, *Onychomyrma*, *Peronomyrmex*, *Pseudonotoncus*, *Stigmacros* and *Teratomyrmex*. In the present study we revise two of these endemic genera, *Pseudonotoncus* and *Teratomyrmex*.

Pseudonotoncus is found along the Australian east coast from the wet tropics in North Queensland to southern Victoria in rainforest and wet and dry sclerophyll forests. Specimens of this genus are uncommon and forage primarily on vegetation and tree trunks, both during the day and at night. The only known nest was found in soil. Nothing more is known of their biology.

Pseudonotoncus was originally established by Clarke (1934) for the single species *Pseudonotoncus hirsutus*. This species was known from only a single nest found in the Gellibrand Forest on the Otway Peninsula in Victoria. Donisthorpe (1937) described a second species, *Pseudonotoncus turneri*, from the Tambourine Mountains in Queensland, some 1,500km to the north-east of the type locality of Clark's *P. hirsutus*. Donisthorpe's description of *P. turneri* mirrors that of *P. hirsutus* in all aspects except colour. Brown (1955) noted that *P. hirsutus* had considerable variation in colour and, particularly on the propodeum and petiole, in sculpturation. He also speculated that, while *P. hirsutus* and *P. turneri* were likely the same species, additional species may emerge with more thorough collecting. Taylor (1992) also recognised that there was no convincing evidence to support *P. hirsutus* and *P. turneri* as separate species but mentioned that Clark had labelled one specimen from Woori Yallock, Victoria, with an unpublished species name ("breviceps"). This specimen is currently held in ANIC (Acc. No. 32-010753) and the name was never published.

Most records of *Pseudonotoncus* come from the area just north of the New South Wales/Queensland border south to southern Victoria with the most westerly from the Otway Peninsula. There have been occasional collections further north in Queensland, most notably specimens from the Tambourine Mountains (the type of *P. turneri* was collected here) and a single specimen from Mount Elliot, south-west of Townsville. Many specimens come from forests in and around Melbourne, Victoria, with samples from Gellibrand, the Dandenong Ranges, Kew,

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Hurstbridge and Woori Yallock. There are also several collections from south-east Queensland and single specimens from Black Mountain in the ACT and Eastwood State Forest, near Armidale in New South Wales.

Examination of materials held within ANIC suggests that *P. hirsutus* and *P. turneri* are conspecific rather than separate species. Their morphology is identical in all aspects, the only difference being slight variation in colouration. Most samples have a chocolate brown colour, with some slightly darker. Some samples collected from northern New South Wales and Queensland have lighter colouration, particularly on the gaster. We conclude that Donisthorpe was hasty in describing *P. turneri* as a separate species and would not have done so if additional material, especially from more southern localities, had been available to him.

While *P. hirsutus* and *P. turneri* are conspecific, we find that Clark's specimen bearing the unpublished name does represent a second species within the genus. This species, here described as *P. eurysikos*, differs significantly from *P. hirsutus*, especially in the structure and size of the petiolar node, and is generally found at cooler and higher-elevation sites. It occurs from near Armidale, New South Wales south through the ACT to the Dandenong Ranges, Victoria. A full description is provided below.

In contrast to *Pseudonotoncus*, *Teratomyrmex* is a rarely encountered genus that is found along coastal Queensland and extreme north-eastern New South Wales. Its main habitat is high-elevation rainforests and other suitably wet areas. Nests occur within damp rotting timber and workers forage in trees and on the ground around the nests. Very little is known of its biology.

Teratomyrmex was described by McAreavey (1957) from specimens collected in 1942 by T. Greaves from the Blackall Range in Queensland. McAreavey gave the genus the name *Teratomyrmex* after the latin '*terato*', meaning monster, wonder, or marvel. The genus has been characterised by the distinct wing-like projections on the pronotum which were described by Wheeler and Wheeler (1974) 'as if it has a huge tumor on the top of its thorax'. However, more recently found species, described here for the first time, have these pronotal projections less well developed, although still present.

Teratomyrmex is rarely encountered and fewer than 30 collections of *Teratomyrmex* are present in ANIC. The majority come from rainforests, except one which is from a dry sclerophyll forest on Mt. Coot-tha, Brisbane. While one species, *T. greavesi*, can be locally common, the other known species are rarely found and then only as stray foragers, no nests having yet been found for these species.

Methods and abbreviations

Size and shape characters were quantified and are reported as lengths or indices. Measurements were made with a stereo microscope using a dual-axis stage micrometer wired to digital readouts. The following measurements and indices are reported. For additional details on measurements see www.antwiki.org/Morphological_Measurements.

CI—Cephalic index: HW/HL x 100.

HL—Length of the head capsule excluding the mandibles, measured in full face view in a straight line from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin.

HTL—Maximum length of hind tibia, excluding the proximal part of the articulation which is received into the distal end of the femur.

HW—Maximum width of the head in full face view, excluding the eyes.

LPetI—Lateral petiolar index: PetNL/PetH x 100;

ML—Diagonal length of the mesosoma in profile from the point at which the pronotum meets the cervical shield to the posterior basal angle of the metapleuron.

MTL—Maximum length of mid-tibia, excluding the proximal part of the articulation which is received into the distal end of the femur.

PronW—Maximum width of pronotum in dorsal view.

PetH—Height of petiole in lateral view, measured vertically from the ventral margin of the posteroventral convexity/angle/projection of subpetiolar process to the level of the highest point of petiolar node.

PetNL—Maximum length of petiolar node, measured longitudinally from the level of the anterolateral angle/corner to that of the posterior-most extension of the petiolar tergum, where it surrounds the gastric articulation.

PetW—Maximum width of petiole viewed directly from above.

SI—Scape index: SL/HW x 100.

SL—Maximum straight-line length of the scape, excluding the basal constriction or neck that occurs just distal of the condylar bulb.

Collections: ANIC—Australian National Insect Collection, Canberra, ACT, Australia; BMNH—The Natural History Museum, London, UK; BPBM—B. P. Bishop Museum, Honolulu, Hawai'i, USA; MCZC—Museum of Comparative Zoology, Cambridge, Massachusetts, USA; MVMA—Museum Victoria, Melbourne, Victoria, Australia.

Distribution and habitat modelling. Species habitat modelling was done using MaxEnt (version 3.3.3e, www.cs.princeton.edu/~schapire/maxent/) as implemented by The Atlas of Living Australia (spatial.ala.org.au) was undertaken for the species of *Pseudonotoncus*. Site information (latitude and longitude) for each specimen was used. Analysis was done using the 'prediction' feature of the program. Fourteen environmental condition layers were used, which provided a very high maximum training area under the curve (AUC) value of the receiver operating characteristic (ROC) for both species (0.986 for *P. eurysikos* and 0.991 for *P. hirsutus*). The layers used in the model were:

Moisture Index—highest quarter mean (Bio32) (bioclim_bio32)
Precipitation—seasonality (Bio15) (bioclim_bio15)
Erosivity (erosivity)
Growth index C4 megatherm plants—annual mean (c4gi)
Radiation—warmest quarter (Bio26) (bioclim_bio26)
Temperature—annual mean (Bio01) (bioclim_bio1)
Aridity index—month min (arid_min)
Distance—to permanent water (weighted) (substrate_distpermwat)
Clay % (substrate_clay)
Growth index C3 macrotherm plants—annual mean (megagi)
Water surplus—month min (spls_min)
Carbon—organic (soil_carbon)
Nutrient status (substrate_nutrients)
Distance—to any water (weighted) (substrate_distanywater).

Scatter plots were created with the Atlas of Living Australia (spatial.ala.org.au) using the "scatterplot" feature. The layers selected for comparison were: Temperature—annual mean (Bio01) (bioclim_bio1), Erosivity, Growth index C4 megatherm plants—annual mean (c4gi) and Precipitation—annual (Bio12).

Pseudonotoncus Clark, 1934

Key to *Pseudonotoncus* species based on workers

1. Petiole approximately square in dorsal view (Figs 1D, 3); in lateral view almost as long as high, the anterior face rounding gradually into the domed dorsal face (Fig. 1B). Dorsal surface of petiole with course longitudinal rugae (Fig. 1D) . . *eurysikos*
-. Petiole broader than long in dorsal view (Figs 2D, 3); in lateral view much higher than long, the anterior face separated from the flat dorsal face by a rounded angle (Fig. 2B). Dorsal surface of petiole smooth or with small foveate depressions (Fig. 2D) . . . . . *hirsutus*

Pseudonotoncus eurysikos sp. n.

(Fig. 1)

Types. Holotype worker from Yarra River bank, Studley Park, Kew, Victoria, 2 November 1958, B. B. Lowery, dry sclerophyll with much grass, in soil (ANIC32-066557, ANIC). Paratypes, 3 workers and 1 dealate queen, same data as holotype except ANIC32-010745 (ANIC).

Diagnosis. Petiole approximately square in dorsal view; in lateral view almost as long as high and with the

anterior face rounding gradually into the domed dorsal face. Dorsal surface of petiole with course longitudinal rugae.

Pseudonotoncus eurysikos is similar to *P. hirsutus* in all features except the size of the petiole (PetNL > 0.31 mm, PetW > 0.39 mm, LPetI > 57 vs. PetNL < 0.26 mm, PetW < 0.39 mm, LPetI < 56 in *P. hirsutus*) and the presence of course rugae on the upper petiolar surface (this surface is at most weakly sculptured in *P. hirsutus*).

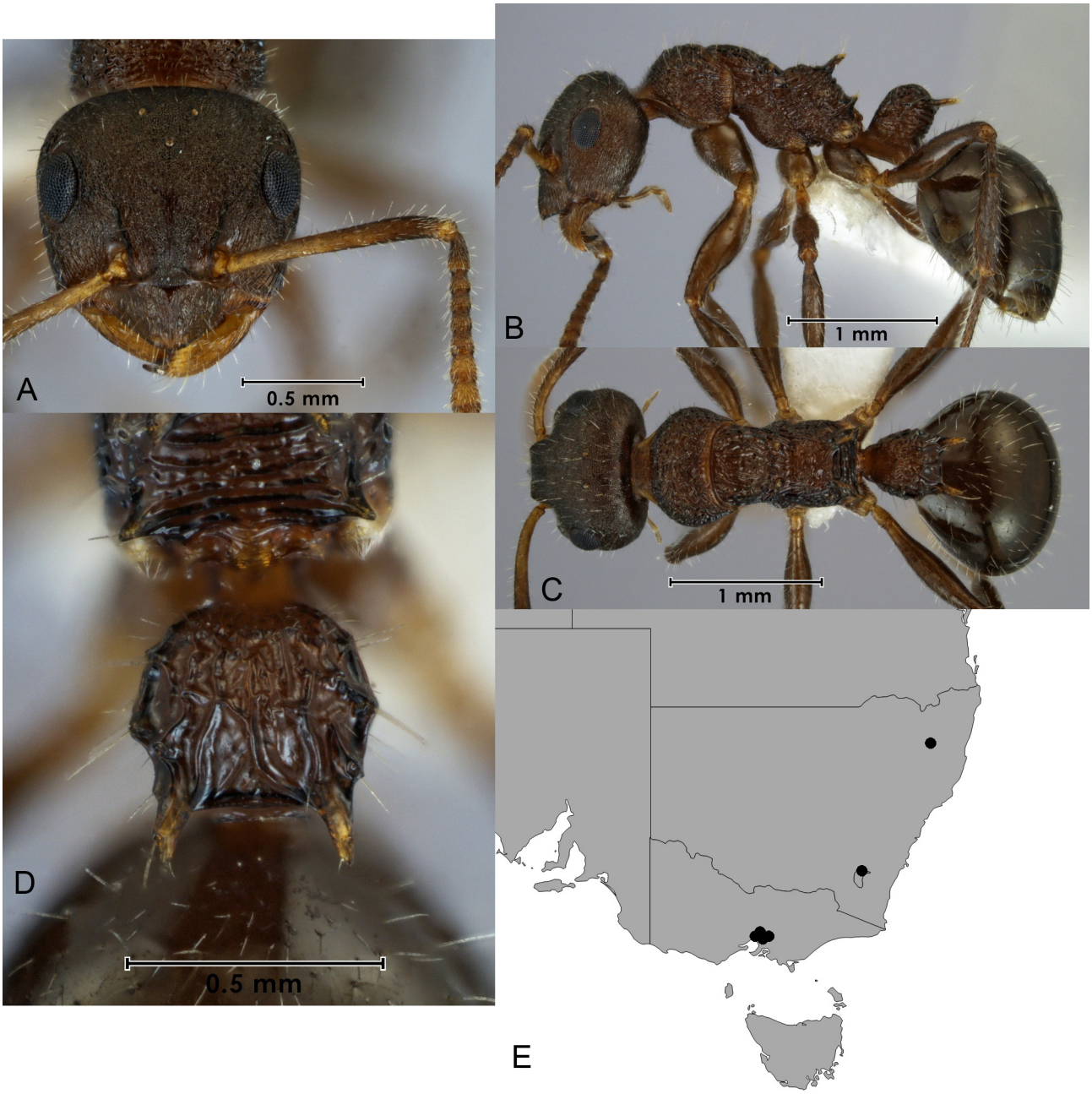

FIGURE 1. *Pseudonotoncus eurysikos* (Black Mountain, ACT, ANIC 32-029826): A. Front of head; B. Side of body; C. Top of body; D. Dorsum of petiole; E. Distribution of material examined.

Worker description. Body uniform chocolate brown. Head in frontal view with sides tapering slightly anteriorly, as wide as long. Mandibles with six teeth, the first, second and fourth larger than the remaining. Clypeus with a central carina, tapering anteriorly into a central tooth. Frontal carinae short and sharply margined. Eyes large, convex, positioned one third from posterior margin of head, one and a half times longer than wide. Ocelli small but distinct. Scapes extending one third their length beyond posterior margin of the head. Mesosoma strongly rugose-punctate, the rugae more strongly developed and longitudinal laterally and on the mesonotum, more weakly developed dorsally on the pronotum and propodeum. In dorsal view pronotum transversely convex, twice as wide

as long and wider than mesonotum and propodeum. Promesonotal suture convex and deeply impressed. Mesonotum and propodeum in dorsal view similar in width and very slightly convex. Mesonotum slightly longer than broad. Propodeum roughly square in dorsal view, with well developed, slightly curved spines at the angle and with two small spines just above the metapleural gland bulbs. Petiolar node higher than long, with a rounded dorsal surface and two posterior facing spines which are half as long as the width between their bases. In dorsal view petiolar node approximately square, with complex longitudinal rugae. Gaster simple, first segment (abdominal segment III) extending to half its length. Legs slender; tibiae and femora somewhat spindle-shaped and with numerous erect hairs.

Measurements. Worker (n=8) - CI 97–108; PetW 0.39–0.56mm; HL 0.96–1.23mm; HTL 1.02–1.15mm; HW 1.03–1.22mm; LPetI 57–67; ML 1.37–1.85mm; PetH 0.51–0.63mm; PetNL 0.31–0.40mm; SI 82–96; SL 0.90–1.05mm.

Additional material examined (ANIC)**. Australia**: *ACT*: Black Mt. (Barnett,N.J.). *New South Wales*: nr. Armidale, Eastwood State Forest (Sakurai,Y.). *Victoria*: Ferntree Gully (Clarke,C.E.); Hurstbridge (Lowery,B.B.); The Basin (Williams,J.B.); The Basin, Dandenong Ra. (Jones,D.L.); Woori Yallock (Thorn,L.B.).

Comments. *Pseudonotoncus eurysikos* has been found primarily within dry sclerophyll forests in cool climate areas. It is likely this species is suited to cool areas with low rainfall (see below under **Discussion** for details). The majority of samples for this species are from forests near Melbourne, with single specimens from Black Mountain in the Australian Capital Territory, and Armidale in New South Wales. Very little is known of their nesting and foraging habits. Brown (1955) described this species (as *P. hirsutus*) at Arthurs Seat, Victoria as nesting in soil without covering or detectable craters and with workers and dealate females foraging on nearby shrubs for nectar and honeydew.

Pseudonotoncus hirsutus **Clark**
(Fig. 2)

Pseudonotoncus hirsutus Clark, 1934: 65.
Pseudonotoncus turneri Donisthorpe, 1937: 619. **New synonym.**

Types. *P. hirsutus*: Holotype worker and worker and queen paratypes from Gellibrand, Victoria, 19–23 January 1932, J. Clark (1 paratype worker in ANIC, ANIC32-010751, examined). *P. turneri*: Holotype worker from Tambourine Mountain, Queensland, 19–26 April 1935, R. E. Turner (BMNH, examined).

Diagnosis. Petiole broader than long in dorsal view; in lateral view much higher than long and with the anterior face separated from the flat dorsal face by a rounded angle. Dorsal surface of petiole smooth or with small foveate depressions. *Pseudonotoncus hirsutus* is similar to *P. eurysikos* in all respects except the size and structure of the petiole. See **Diagnosis** under *P. eurysikos* for further details.

Worker description. Body uniform chocolate brown. Paler specimens generally with a darker gaster. Head in frontal view with sides tapering slightly anteriorly, as wide as long. Mandibles with six teeth, the first, second and fourth larger than the remaining. Clypeus with a central carina, tapering anteriorly into a central tooth. Frontal carinae short and sharply margined. Eyes large, convex, positioned one third from the posterior margin of head, one and a half times longer than wide. Ocelli small but distinct. Scapes extending one third their length beyond the posterior margin of head. Mesosoma strongly rugose-punctate, the rugae distinctly longitudinal laterally and on the mesonotum, less distinctly on the pronotum and propodeum. In dorsal view pronotum transversely convex, twice as wide as long and wider than mesonotum and propodeum. Promesonotal suture convex and deeply impressed. Mesonotum and propodeum in dorsal view similar in width and very slightly convex. Mesonotum slightly longer than broad. Propodeum roughly square in dorsal view, with well developed, slightly curved spines at the angle and with two small spines just above the metapleural gland bulbs. Petiolar node higher than long, with anterior face separated from dorsal face by a sharply rounded angle, and two posterior facing spines which are angled slightly up and half as long as the width between their bases. In dorsal view petiolar node broader than long, its upper surface smooth or sometimes with small foveate depressions. Gaster simple, first segment (abdominal segment III) extending to half its length. Legs slender; tibiae and femora somewhat spindle shaped and with numerous erect hairs.

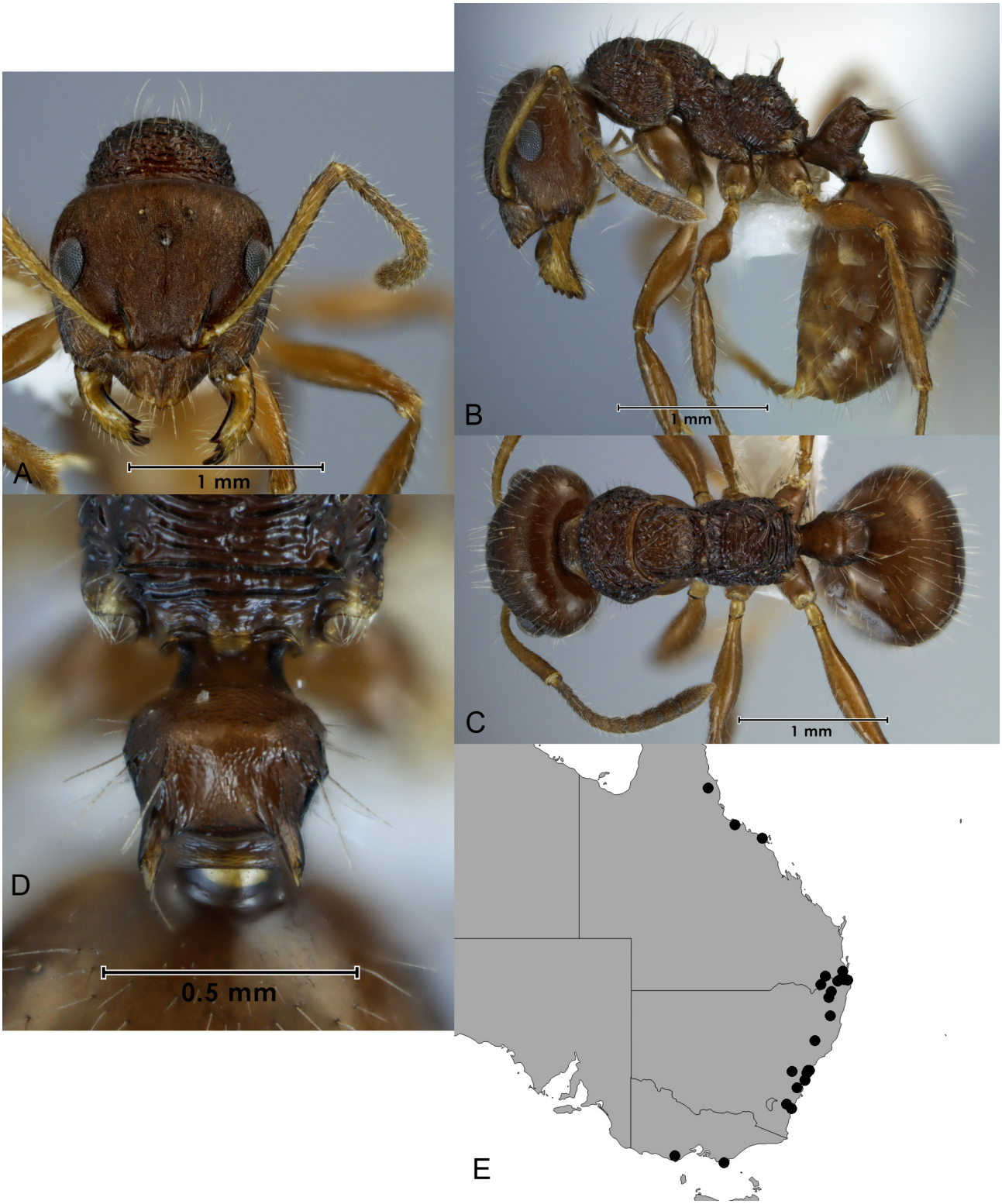

FIGURE 2. *Pseudonotoncus hirsutus* (Binna Burra, Queensland, ANIC 32-010581): A. Front of head; B. Side of body; C. Top of body; D. Dorsum of petiole; E. Distribution of material examined.

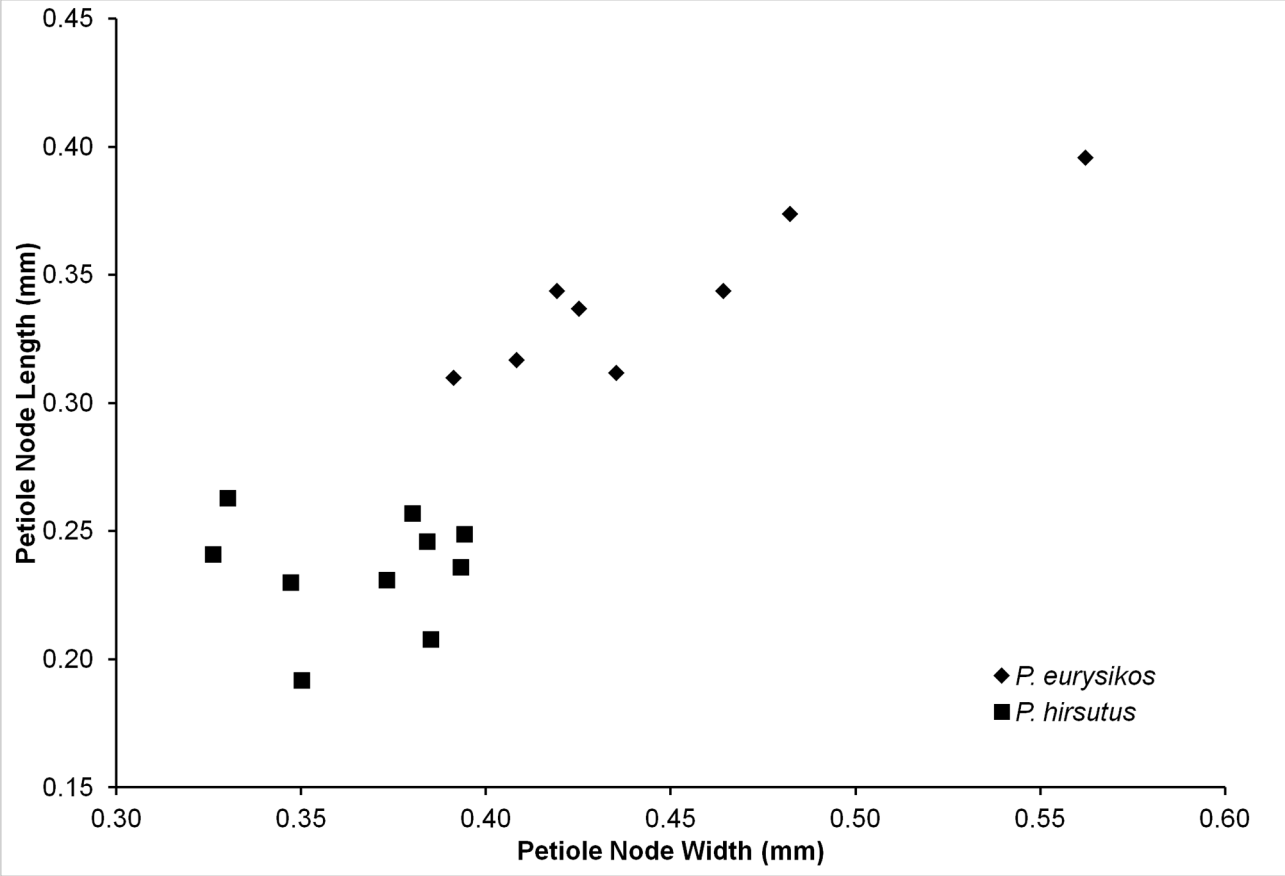

FIGURE 3. Petiolar node length versus width (mm) when viewed dorsally.

Measurements. Worker (n=10)—CI 91–103; PetW 0.33–0.39mm; HL 0.88–1.21mm; HTL 0.83–1.18mm; HW 0.88–1.22mm; LPetI 39–56; ML 1.20–1.58mm; PetH 0.47–0.55mm; PetNL 0.19–0.26mm; SI 90–100; SL 0.88–1.16mm.

Additional material examined (ANIC)**. Australia**: *New South Wales*: Benmore Falls (top) (Liepa,Z.); Brindle Creek, Border Ranges Natl. Pk (Naumann,I.D.); Burringbar Range (Lowery,B.B.); Coachwood Nature Trail, 3km SSW Blackheath (Shattuck,S.O.); Cobark For. Pk. Barrington Tops (Naumann,I.D.); Cobark Forest Pk., Barrington Tops State Forest (Weir,T.A.); Dalrymple Forest, Pymble (Lowery,B.B.); Dalrymple Forest, St. Ives, Sydney (Lowery,B.B.); Eastern fall, Clyde Mt. (Riek,E.F.); Ewingar (Kearney,E.); Lovett Bay, West Pittwater (Fletcher,M.J. & Macdonald,J.A.); Pymble, Sydney (Lowery,B.B.); Rosedale Beach (Lowery,B.B.); Rosedale, SE of Batemans Bay (Lowery,B.B.); Royal Nat. Park (Ward,P.S.); Sydney, Upper Cowan Crk. (Lowery,B.B.); Wallumbin SF, W of Mt. Warning (Lowery,B.B.). *Queensland*: 4km NE Herberton (Hourse,A.P.N.); 7km NNW North Tamborine (Ward,P.S.); Binna Burra (Ward,P.S.); Mt. Dryander summit (Monteith,G.); Mt. Elliot (Taylor,R.W.); Stanthorpe (Sutton,E.; Lowery,B.B.). *Victoria*: Gellibrand (Clark,J.).

Comments. *Pseudonotoncus hirsutus* appears to be a more generalist species than *P. eurysikos*. *Pseudonotoncus hirsutus* can be found along most of the east coast of Australia, with most samples coming from rainforest and wet sclerophyll forests, generally close to the coast. It is likely that this species prefers higher rainfall and more stable temperatures than *P. eurysikos*. It has been found primarily within dense forests.

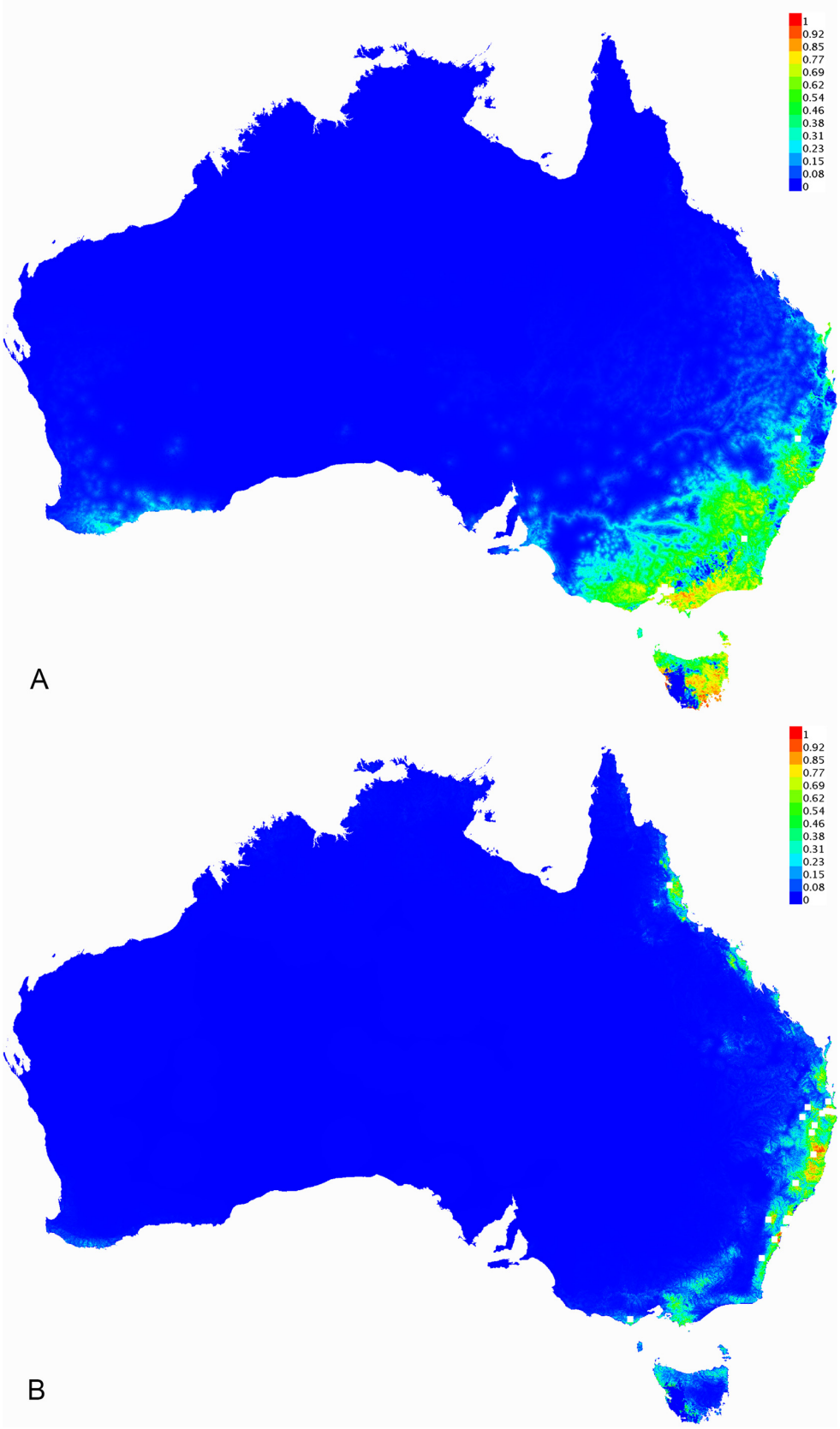

FIGURE 4. Predicted habitat area suitability based on MaxEnt analysis (as implemented at www.ala.org.au) using 14 environmental layers (bioclim_bio32, bioclim_bio15, erosivity, c4gi, bioclim_bio26, bioclim_bio1, arid_min, substrate_distpermwat, substrate_clay, megagi, spls_min, soil_carbon, substrate_nutrients, substrate_distanywater) and the default settings: A. *P. eurysikos*; B. *P. hirsutus*.

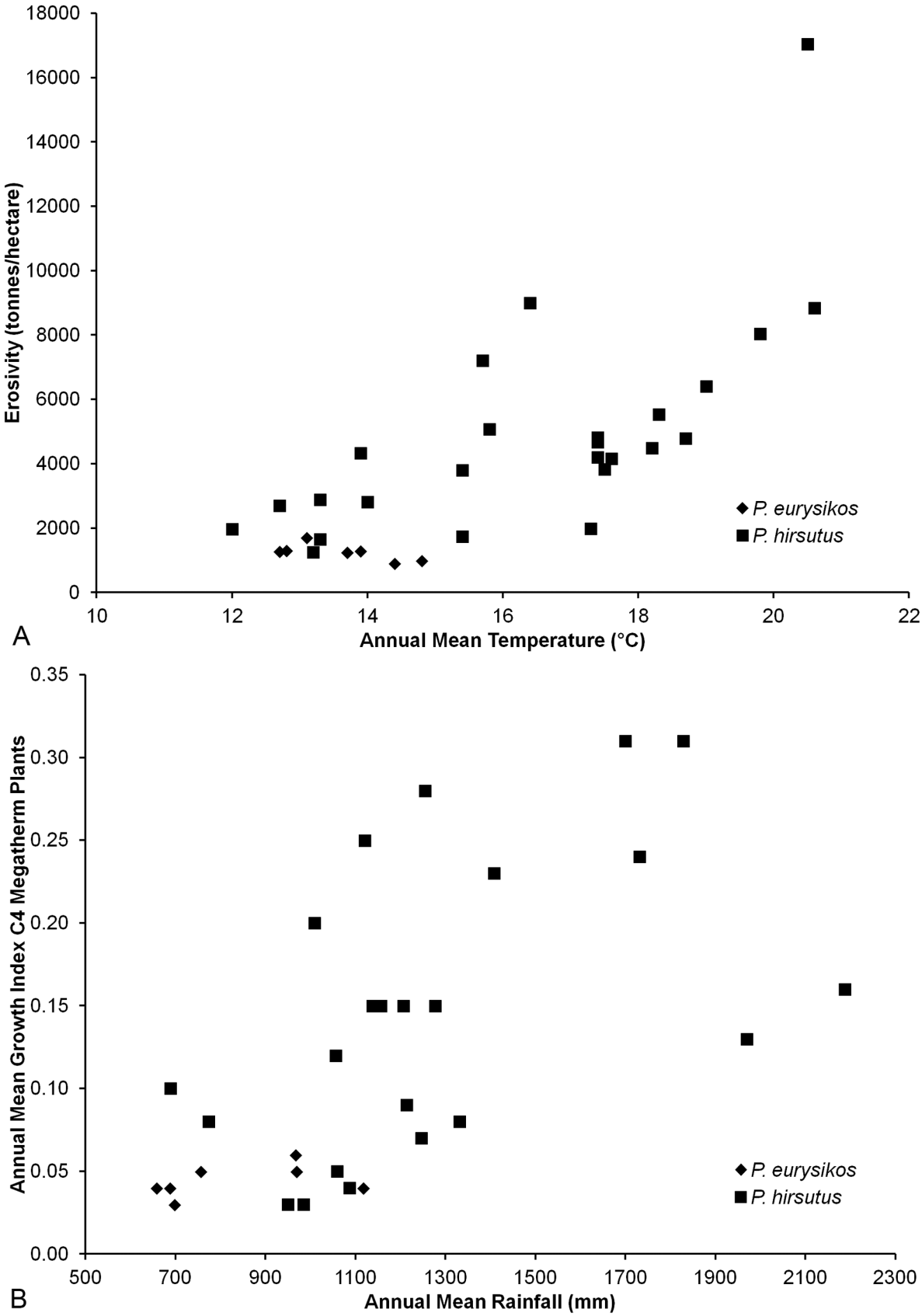

FIGURE 5. Scatter plots of MaxEnt data for *P. eurysikos* and *P. hirsutus*: A. Erosivity (tonnes/hectare) and annual mean temperature (ºC); B. Growth index C4 megatherm plants and annual mean precipitation (mm).

Teratomyrmex McAreavey, 1957

Key to *Teratomyrmex* species based on workers

1. Colour uniform through entire body (Fig. 6B); pronotum with large, wing-like structures on dorsal surface (Fig. 6C); dorsal surface of petiole concave with a pair of small spines dorsolaterally . . . . . *greavesi*
-. Body darker on head and mesosoma with coxae, trochanters and basal one third of femora white (remainder of femora brown) (Fig. 7B); pronotum lacking large wing-like structures, instead with angular pronotal humeri (Fig. 7C); dorsal surface of petiole flat, with very small projections dorsolaterally 2
2. Body with long, erect hairs only, shorter hairs and pubescence absent; dorsum of head, pronotum and mesonotum essentially smooth, sculpturing at most only weakly developed; petiole uniform brown, apex similar in colour to remainder (Fig. 7) . . . . . *substrictus*
-. Body with both long, erect hairs and short, flat-lying hairs (short hairs absent from first segment of gaster); dorsum of head, pronotum and mesonotum with abundant shallow foveae; apex of petiolar node pale yellowish-white, distinctly paler than remainder of petiole (Fig. 8) . . . . . *tinae*

Teratomyrmex greavesi McAreavey
(Fig. 6)

Teratomyrmex greavesi McAreavey, 1957: 55.

Types. Holotype worker and 6 worker paratypes from Blackall Range, Queensland (holotype in MVMA, 5 paratypes in ANIC, 1 paratype in MCZC, all examined).

Diagnosis. Pronotum very broad and high with large, wing-like projections laterally. Colour uniform throughout body; head narrower (CI < 97 vs. CI > 99 in *T. tinae*) and scape relatively longer (SI > 106 vs. SI < 98 in *T. tinae*). These characters easily separate *T. greavesi* from *T. substrictus* and *T. tinae* and this species is unlikely to be confused with them.

Worker description. Body uniform dark brown to almost black. Entire body covered in scattered long setae. Dense, adpressed pubescence on head, mesosoma, gaster and coxae. Head roughly square with convex sides, widest at eyes and tapering slightly inwards posteriorly and more sharply anteriorly. Mandibles small, with six teeth (not five, as reported in the original description), the first, second and fourth the longest. Clypeus triangular with slight central carina, the anterior margin straight laterally with a weak central angle. Frontal area smooth. Frontal carinae short, without ridges. Eyes large, convex, positioned one-third from posterior margin of head, one and a half times longer than wide. Ocelli very small but distinct. Scapes extending one third their length past posterior margin of the head. Mesosoma smooth. Pronotum wider than the rest of the mesosoma, with large wing-like projections projecting laterally, the upper surface of these projections with small foveate depressions. Sides of pronotum convex, widest one third posteriorly from pronotal humeri. Promesonotal suture distinct, concave and roughly square. Mesonotum much narrower than the rest of the mesosoma, tapering inwards anteriorly to a narrow constriction. Propodeum narrow, twice as long as wide, but wider than maximum width of mesonotum, expanded dorsally with two small, almost vertical spines. Rear face of propodeum concave and smooth. Petiole narrow and tall, narrowed to a sharp angle dorsally which is concave with two very small spines at each tip. Gaster simple. Legs slender and straight.

Measurements. Worker (n=10)—CI 91–94; HL 0.71–0.90 mm; HW 0.66–0.85 mm; ML 0.95–1.31 mm; MTL 0.57–0.80 mm; PronW 0.61–0.80; SI 109–118; SL 0.72–0.96 mm

Additional material examined. Australia: *New South Wales*: Mt. Warning (Lowery,B.B.) (ANIC). *Queensland*: Binna Burra, Lamington Nat. Pk. (Lawrence,J.F. & Lawrence,N.) (ANIC); Blackall Range (Greaves,T.) (ANIC); Brisbane, Mount Coot-tha Park (Kohout,R.J.) (ANIC); c. Binna Burra (Taylor,R.W.) (ANIC, MCZC); Cedar Creek, Tamborine (Ross, E.S. & Cavagnaro, D.Q.) (MCZC); Joalah Nat. Park, Tamborine Mt. (Taylor,R.W.) (ANIC); Maleny (Darlingtons) (MCZC); Mt. Glorious (Gressitt,J.L. & Gressitt,M.; Major, J.D.) (ANIC, BPBM); Mt. Tenison Woods (Monteith,G.B. & Sarnes, G.) (ANIC); Numinbah Arch (Lowery,B.B.) (ANIC); Palm Grove N.P., 8km ESE North Tamborine (Shattuck,S.O.) (ANIC).

Comments. *Teratomyrmex greavesi* is found in a restricted area of extreme south-east Queensland with a single record just across the border in New South Wales. The majority of collections are from rainforest with a single reported as being from dry sclerophyll. Foraging seems to be largely on low vegetation while nests occur in rotten wood on the ground.

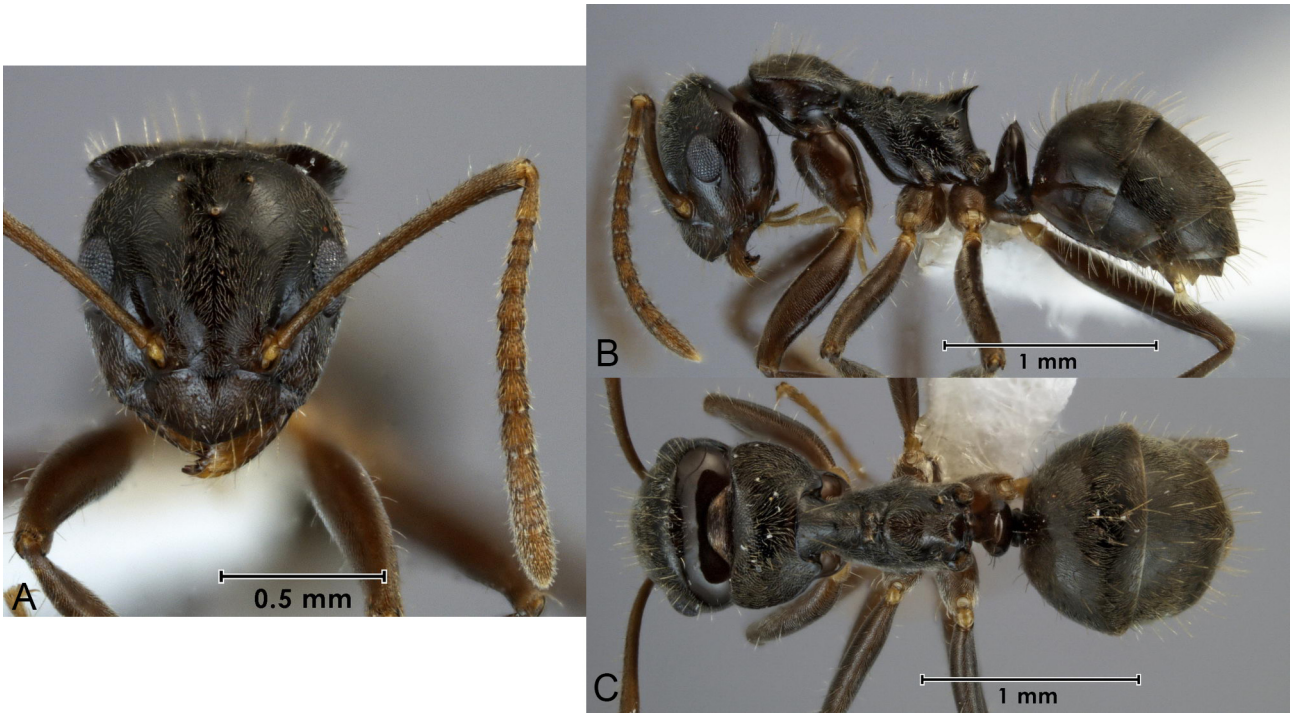

FIGURE 6. *Teratomyrmex greavesi* (Palm Grove N.P., 8km ESE North Tamborine, Queensland, ANIC32-043662): A. Front of head; B. Side of body; C. Top of body.

***Teratomyrmex substrictus* sp.n.**
(Fig. 7)

Types. Holotype worker from Cableway Base Station, Bellenden Ker Range, Queensland (approx. 17°16'S, 145°55'E), 100m, 17–24 October 1981, Earthwatch, Qld Museum (ANIC, ANIC32-066622). One paratype worker, same data as holotype except ANIC32-066620 (ANIC).

Diagnosis. Head and mesosoma dark brown, gaster slightly paler; coxae, trochanters and basal first third of femora white, remainder of femora brown; petiole uniform brown, apex similar in colour to remainder. Pronotum with small and angular humeral angles, lacking large wing-like structures. Body with long, erect hairs only, shorter hairs and pubescence absent. Dorsum of head, pronotum and mesonotum essentially smooth, sculpturing at most only weakly developed. This species is similar to *T. tinae* but differs in pilosity, sculpturing and colour as outlined above.

Worker description. Head and mesosoma dark brown, gaster slightly paler. Coxae, trochanters white. Tibiae basally white, changing to light brown at one third length. Petiole light brown. Scattered long setae on head, antennae, gaster, tibiae, tarsi and dorsal side of mesosoma. Pubescence reduced to a few scattered hairs. Head roughly square, concave on the sides and widest at eyes. Mandibles triangular, paler in colour than the head but with dark teeth. Mandibles with six teeth, the first, second and fourth the largest. Clypeus semicircular, with rounded posterior margin, straight anterior margin. Frontal area smooth. Frontal carinae very small, only slightly extending past antennal socket. Eyes large, convex, positioned one third from posterior margin of head, one and a half times longer than wide. Ocelli very small but distinct. Scapes extending one third their length beyond posterior margin of head, paler in colour than head. Mesosoma mostly smooth, with broad longitudinal striations on the side of the mesonotum and propodeum. Dorsal surface of pronotum and mesonotum essentially smooth. In dorsal view pronotum roughly hexagonal, wider than propodeum, with sides tapering slightly laterally with points at the pronotal humeri. Promesonotal suture weakly differentiated from surrounding surfaces. In dorsal view mesonotum roughly oval, the anterior margin weakly convex and the posterior margin strongly convex. Propodeum roughly square in dorsal view, with small spines on upper margin. Petiole much taller than long, weakly convex on dorsal surface. Gaster rectangular, first two segments (abdominal segments III & IV) the largest. Legs slender, tibiae and femora somewhat spindle shaped.

Measurements. Worker (n=6)—CI 100–106; HL 0.85–1.06 mm; HW 0.85–1.12 mm; ML 1.14–1.44 mm; MTL 0.83–0.97 mm; PronW 0.55–0.73; SI 110–124; SL 1.04–1.24 mm.

Additional material examined (ANIC)**. Australia**: *Queensland*: 5–8m. Mt. Lewis Rd. off Mossman - Mt. Molloy Rd. (Colless,D.H.); Mossman Bluff Track, 9km W Mossman (Monteith & Thompson); Mossman Gorge (Colless,D.H.); The Boulders, Babinda (Colless,D.H.).

Comments. This species is known from a limited number of locations in Far North Queensland just north and south of Cairns. All collections are from rainforest and workers were encountered while collecting from low vegetation either by using pyrethrum knockdown or by sweeping vegetation.

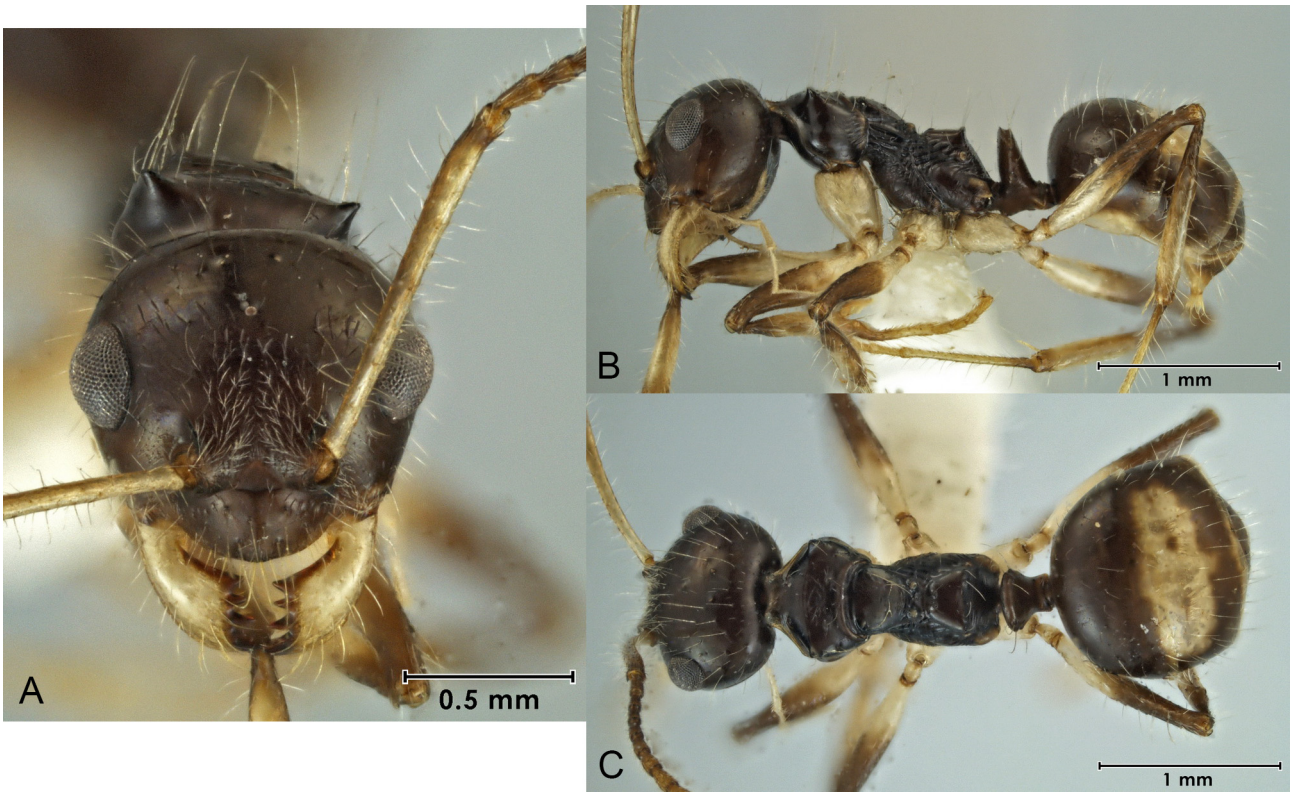

FIGURE 7. *Teratomyrmex substrictus* (ANIC32-066655): A. Front of head; B. Side of body; C. Top of body.

***Teratomyrmex tinae* sp.n.**
(Fig. 8)

Types. Holotype worker from Summit TV Station, Bellenden Ker Range, Queensland, Australia (approx. 17°16'S, 145°51'E), 1–7 November 1981, Earthwatch, Qld Museum; pyrethrum knockdown on logs, stones and tree trunks (ANIC, ANIC32-066526). Eight worker and five male paratypes, same data as holotype except ANIC32-066493, ANIC32-065986, ANIC32-066940 (6 workers, 4 males, ANIC) and 32-065985 (2 workers, 1 male, MCZC).

Diagnosis. Head and mesosoma dark brown, gaster slightly paler; coxae, trochanters and basal first third of femora white, remainder of femora brown; apex of petiolar node pale yellowish-white, distinctly paler than remainder of petiole. Pronotum with small and angular humeral angles, lacking large wing-like structures. Body with both long, erect hairs and short, flat-lying hairs (short hairs absent from first segment of gaster). Dorsum of head, pronotum and mesonotum with abundant shallow foveae. This species is similar to *T. substrictus* but differs in pilosity, sculpturing and colour as outlined above.

Worker description. Head and mesosoma dark brown, gaster slightly paler. Coxae, trochanters white. Tibiae basally white, changing to light brown at one third length. Petiole light brown ventrally and graduating to white dorsally. Scattered long setae on head, antennae, gaster, tibiae, tarsi and dorsal side of mesosoma. Pubescence on antennae and dorsal side of head, mesosoma and gaster. Head roughly square, concave on the sides and widest at eyes. Mandibles triangular, paler in colour than the head but with dark teeth. Mandibles with six teeth, the first,

second and fourth the largest. Clypeus semicircular, with rounded posterior margin, straight anterior margin. Frontal area with small foveate depressions associated with pubescence. Frontal carinae very small, only slightly extending past antennal socket. Eyes large, convex, positioned one third from posterior margin of head, one and a half times longer than wide. Ocelli very small but distinct. Scapes extending one third their length beyond posterior margin of head, paler in colour than head. Mesosoma mostly smooth, with broad longitudinal striations on the side of the mesonotum and propodeum. Small foveate depressions on the dorsal surface of pronotum and mesonotum, associated with pubescence. In dorsal view pronotum roughly hexagonal, wider than propodeum, with sides tapering into small wing-like projections with points at the pronotal humeri. Promesonotal suture convex and sharply impressed. In dorsal view mesonotum roughly oval, the anterior margin straight and the posterior margin tapering sharply. Propodeum roughly square in dorsal view, with small spines on upper margin. Petiole much taller than long, flat on dorsal surface, with two very small points on the outer margins. Gaster rectangular, first two segments (abdominal segments III & IV) the largest. Legs slender, tibiae and femora somewhat spindle shaped.

Measurements. Worker (n=13)—CI 99–113; HL 0.81–1.09 mm; HW 0.80–1.17 mm; ML 0.98–1.35 mm; MTL 0.67–0.92 mm; PronW 0.56–0.80; SI 99–106; SL 0.85–1.17 mm.

Additional material examined (ANIC)**. Australia**: *Queensland*: Baldy Mtn Rd, 7km SW Atherton (Monteith & Thompson); Mt. Edith, 4–7mi. off Danbulla Rd. (Colless,D.H.); Upper Boulder Creek via Tully (Monteith, Yeates & Thompson); Windsor Tableland, Site 4 (Schmidt,E. & ANZSES); Windsor Tbld., 35km NNW Mt. Carbine (Monteith, Yeates & Cook).

Comments. This species is known from a handful of locations in Far North Queensland, stretching from Mount Windsor Tableland in the north to Tully in the south. All collections were made in rainforest and most specimens were associated with vegetation (having been collected using pyrethrum knockdown or by sweeping vegetation). The limited available information suggests that these are arboreal foraging ants which are limited to rainforest habitats.

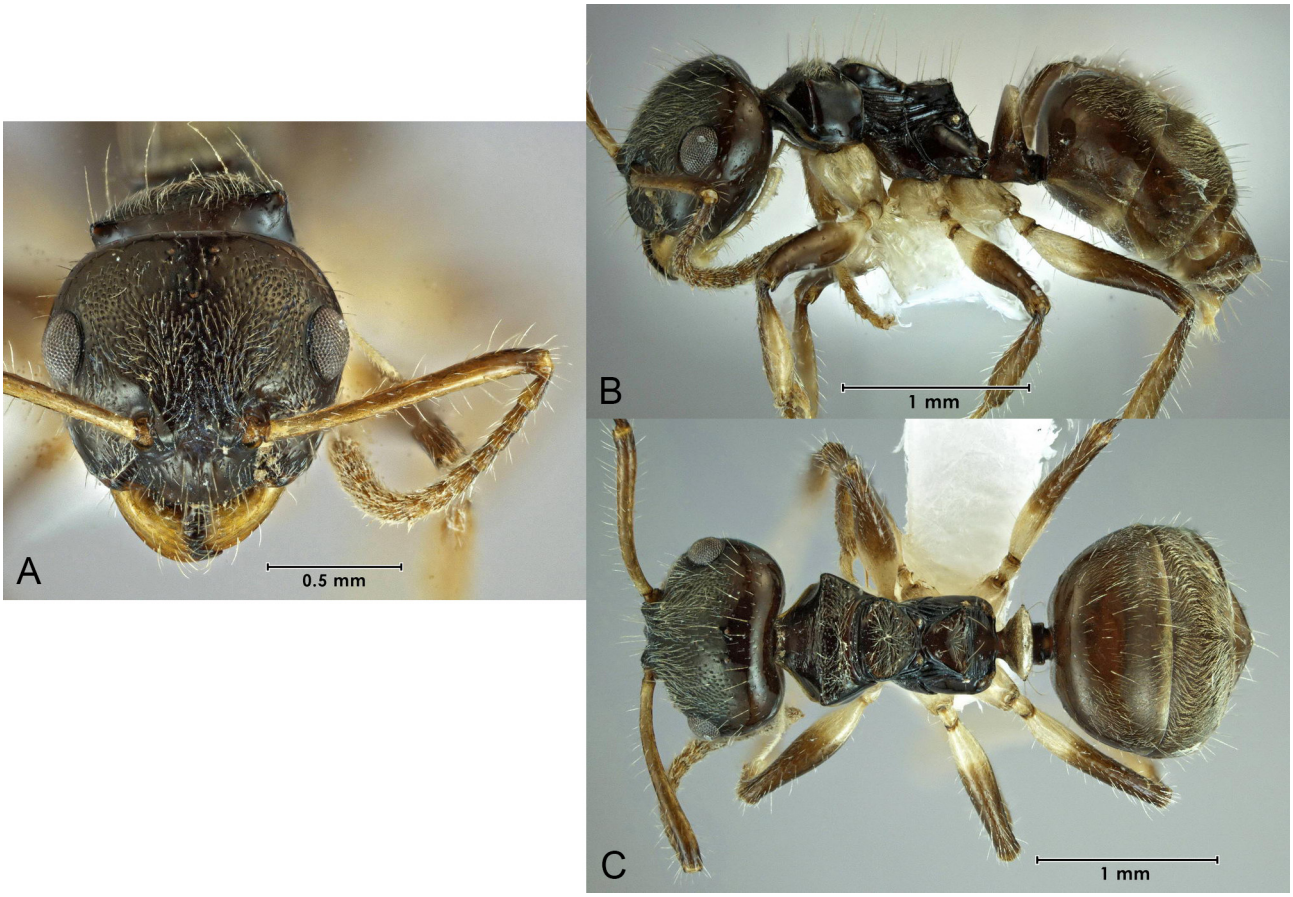

FIGURE 8. *Teratomyrmex tinae* (holotype, ANIC32-066526): A. Front of head; B. Side of body; C. Top of body.

Discussion

Distribution data (Figs 1E, 2E) were used to model the primary fundamental niche for each *Pseudonotoncus* species using the MaxEnt software package. Results show that *P. eurysikos* has its primary fundamental niche within southern areas of Victoria and New South Wales, with a small pocket of suitable habitat in northern New South Wales (Fig. 4A). In contrast, *P. hirsutus* has much of its fundamental niche along coastal areas of northern New South Wales and southern Queensland, with small pockets in northern Queensland and southern Victoria (Fig. 4B). Many areas show little or no overlap in habitats for these two species, in particular the Blue Mountains west of Sydney and much of south-east Queensland. There is some overlap of fundamental niche for the two species in the area surrounding Melbourne, Victoria, from Cape Otway in the west to Wilsons Promontory in the east. *Pseudonotoncus hirsutus* has been found at both edges of this area (at Gellibrand near Cape Otway and at Wilsons Promontory) but not between, particularly in the Dandenong ranges, where *P. eurysikos* is known to occur. The cause of the absence of *P. hirsutus* from this area is not known. If interspecific competition were involved we would expect that the dominant species would exclude the subordinate from the area. However, it is not clear whether either species is competitively dominant over the other. Additionally, because of the low population density seen in these species it is unlikely that competition plays a role in the observed distribution patterns. The distinct separation between much of the two species ranges may suggest a past history of competition resulting in niche partitioning. However, this conclusion is speculative and further research is required. There may be other factors involved which may not be related to competition between the two species, such as predator avoidance or habitat specialisation.

Scatterplot analysis shows that *P. eurysikos* is found in areas with relatively low mean temperature, low rainfall, less erosivity and lower plant growth when compared with *P. hirsutus* (Fig. 5). Erosivity was found to show the highest clustering of *P. eurysikos* specimens (Fig. 5A). Erosivity is determined by length and intensity of rainfall events (Brown and Foster, 1987). This indicates that the total amount and intensity of rainfall is a determining factor of their distribution. Annual mean temperature also strongly clusters *P. eurysikos* specimens (Fig. 5A), which tends towards cooler temperatures. Thus it would appear that *P. eurysikos* is a niche specialist found in cool areas with low rainfall.

While MaxEnt has been proven to be effective at modelling species distributions with few data (Bean *et al.*, 2012, Elith *et al.*, 2011, Pearson *et al.*, 2007), the small number of records available for each species in this study (*P. eurysikos* n=9, *P. hirsutus* n=32) limits the power of these predictions.

The results obtained here should be treated with caution and used as a guide only. The areas that appear as suitable habitat represent the species fundamental niche. Whether or not the species is present at a specific location depends on several factors including the species' ability to reach the location (that is, the lack of environmental barriers, e.g. much of Tasmania appears suitable for *P. eurysikos* but the ocean barrier has apparently prevented its colonisation) and interspecific competition (Phillips *et al*., 2006, Ward, 2007). Unfortunately little information is available on the ecology of *P. eurysikos* and *P. hirsutus* and parameters that affect their ecology may have been overlooked. Because the number of records available for each species is low (*P. eurysikos* n=9, *P. hirsutus* n=32) the power of these predictions is limited. Further collecting and incorporation of specimens from other collections would increase the power of these predictions. Future research should focus on identifying whether the species are present at (or outside of) predicted locations. This would allow greater resolution for future mapping studies, and identify the accuracy of the process. Information on the ecology of *P. eurysikos* and *P. hirsutus* would also be of benefit, particularly further details on nesting habits and diet.

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