ENGAEUS EXCAVATOR, A NEW SPECIES OF FRESHWATER CRAYFISH (DECAPODA: PARASTACIDAE) FROM CENTRAL NORTHERN TASMANIA, WITH NOTES ON ITS ECOLOGY, DISTRIBUTION AND CONSERVATION

by Alastair MM Richardson

(with three figures and seven plates)

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A new species of freshwater crayfish, *Engaeus excavator*, is described from locations near Latrobe in central northern Tasmania. The species is identified by the elongate fingers of the propodus and carpus of the chelae, and a fringing row of tufts of long flexible setae along the ventral margin of the propodal finger in both large and small dimorphic claws. It is currently only known from two localities, where it excavates very deep burrows (>2 m) in clay soils. The original native vegetation at both localities has been cleared to grass paddocks or rough grazing. The species' persistence in such cleared habitat suggests that it is resilient, but its conservation status is unclear.

Key Words: burrowing crayfish, Engaeus, Tasmania, Australia.

INTRODUCTION

The southeastern Australian freshwater crayfish genus *Engaeus* was last revised by Horwitz (1990), who recognised 32 species. Of these, 14 species occur in Tasmania, all but two of which are endemic to the island. Later, Horwitz (1994) added a further species, *Engaeus yabbimunna*, which is also endemic to Tasmania.

Four species of *Engaeus* are currently listed as threatened under Tasmanian and Commonwealth legislation (NRE 2024). Of these, *Engaeus granulatus*, the central north burrowing crayfish, has been an issue for several developments and land management projects in recent years because its distribution and habitat coincide with primary production, rural living and major infrastructure land uses. Until recently, *E. granulatus* was assumed to occupy a core range exclusive of other crayfish species, but an additional, undescribed species has now been found within its range. This paper describes this new species of *Engaeus* collected during environmental surveys at two localities near Latrobe in central northern Tasmania.

METHODS

Specimens were examined under a binocular dissecting microscope; measurements were made with vernier callipers. The descriptions below follow the format of Horwitz (1990) and the following abbreviations are used:

OCL: length from posterior orbit to rear of carapace
AP1–6: abdominal pleura 1 to 6
P1–5: pereopods 1 to 5
TAL: abdominal length from rear of carapace to tip of telson
CTW: cephalothoracic width
DACL: length of dactyl of chela
PROPW: width of propodus of chela
PROPD: depth of propodus of chela
PROPL: length of propodus of chela

The sternal keel includes important characters for separating *Engaeus* species. It is described below in ventral and lateral view, following the descriptions provided for other species in Horwitz (1990). The lateral view describes the keel as a mountain range, with peaks, ridges and valleys, though the peaks are in fact the most ventral points.

ENGAEUS EXCAVATOR SP. NOV. (fig. 1, pls 1–6)

Material examined

Holotype

Palmers Road, Latrobe. Deep burrows, excavated by a mechanical digger and then by hand, in silty loam over clay in grassed paddock east of road and northeast of Latrobe Creek. (41.222°S, 146.423°E). B French & A Richardson 12 February 2022. Tasmanian Museum & Art Gallery TMAG G10863 (male, OCL 24.0 mm).

Allotype

Henry Street, Latrobe. Deep burrows, excavated by a mechanical digger and then by hand, in clay in old paddock reverting to weedy scrub north of the road and Kings Creek. (41.233°S, 146.434°E). A Richardson & M Wapstra 7 July 2023. Tasmanian Museum & Art Gallery TMAG G10864 (female, OCL 29.7 mm).

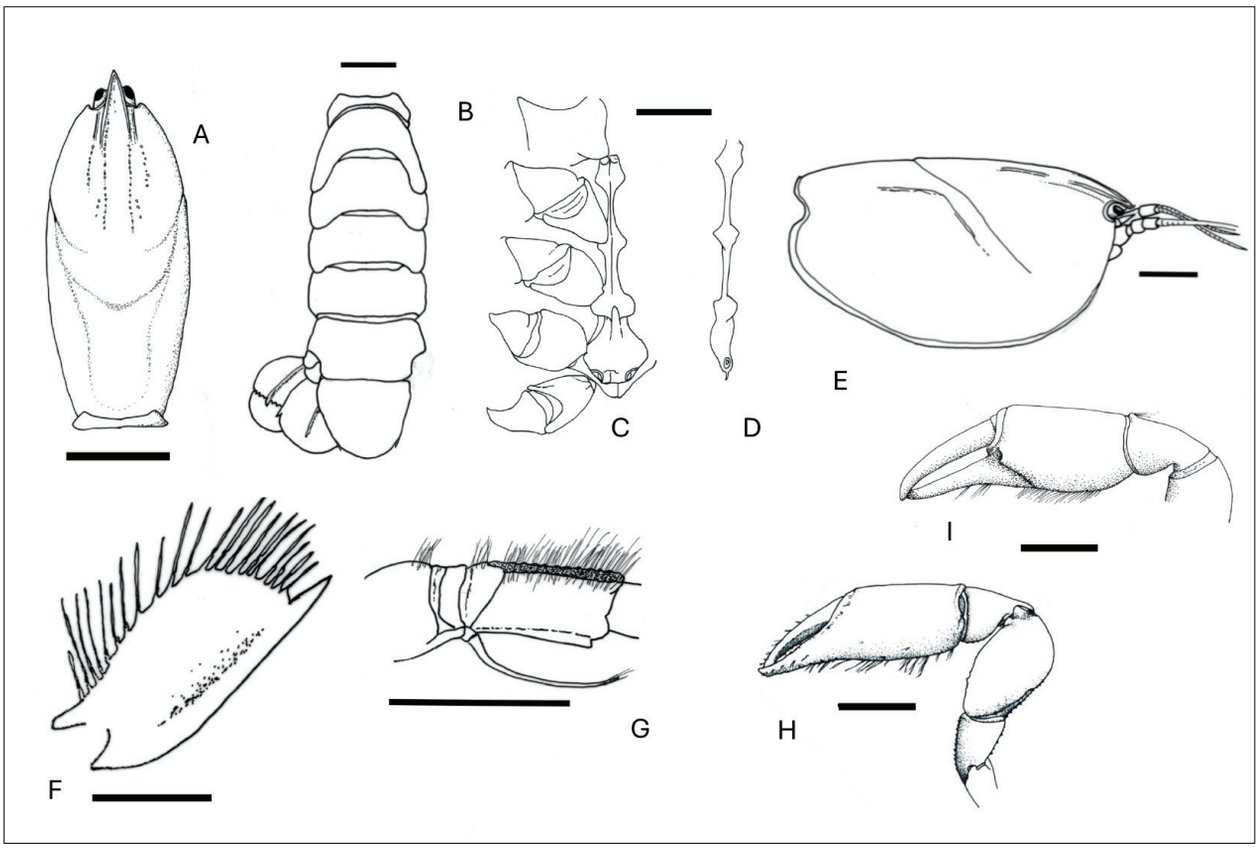

FIGURE 1 — *Engaeus excavator*. **A.** cephalothorax dorsal; **B.** abdomen dorsal; **C.** sternal keel ventral view; **D.** sternal keel lateral profile; **E.** cephalothorax lateral; **F.** antennal scale; **G.** third maxilliped, showing coxopodite, basipodite, ischium and exopodite; **H.** major chela; **I.** major chela. **A–H** from holotype, **I** from allotype. Scale bars **A–G**, **H, I**: 5 mm; **F**: 1 mm.

FIGURE 2 — Locations where *Engaeus excavator* sp. nov. has been collected. (Basemap: Google Earth).

Paratypes

Data as holotype Tasmanian Museum & Art Gallery TMAG G10865 (female OCL 25.1 mm); data as holotype Museums Victoria NMV J71458 (male OCL 21.5 mm); data as allotype Museums Victoria NMV J71459 (female, OCL 26.1 mm).

Diagnosis

Engaeus excavator differs from all other Tasmanian *Engaeus* spp. except *E. mairener* by the following combination of characters: presence of a transverse suture on the outer ramus of the uropods, the absence of a terminal spine on the posterior margin of the outer uropod, the absence (or rare presence) of pores on the lateral processes of the sternal keel at pereopod 3, and the presence of pores on the lateral processes of the sternal keel at pereopod 4 (fig. 1). It can be distinguished from *E. mairener* by the elongate fingers of the propodus and carpus of the chelae, and a fringing row of tufts of long flexible setae along the ventral margin of the propodal finger in both large and small dimorphic claws.

Description

Rostrum extending almost to distal end of penultimate segment of antennal peduncle, narrow, tip variably setose, horizontal or slightly upturned. Rostral carinae conspicuous, raised, minutely tuberculate to smooth, fading out just posterior of orbit, anteriorly not fusing with rostral rim. Intercarinate region weakly u-shaped in transverse, heavily setose anteriorly, row of setae arising from weak punctuations just mesial of each rostral carina, extending posteriorly almost to cervical groove. Sub-orbital angle blunt, slightly greater than 90°. Post-orbital ridges inconspicuous, low and blunt, asetose. Eyes small. Antennal flagella long, extending to 4th abdominal segment. Antennal scale extending to base of last peduncular segment of antenna, half as wide as long at broadest point, terminating in sharp spine; lateral margin carinate, antero-mesial and mesial margins heavily setose. Antennules bi-flagellate, inner flagellum 0.7–0.9 x outer. Inter-antennal scale approximately triangular, apically pointed or blunt. Mesio-ventral corner of third maxilliped coxopodite setose with one terminal spine and two weak spines posteriorly, ventro-lateral surface of ischium narrow, setose on all but antero-lateral surface, lateral margin carinate, terminating in small spine; exopodite longer than ischium, reaching >0.5 length of merus.

Carapace vaulted, areola 0.5 x wide as long. Carapace smooth, minutely punctate and sparsely setose, becoming granulate in mandibular and antennal regions, dorsally glabrous. Cervical groove deepest at meson, broadly v-shaped.

Abdomen 1.2–1.4 x OCL. Abdominal pleura 1 reduced, weakly bilobed, overlapped by pleura of abdominal segment 2, abdominal pleura 2–6 with sparse stiff setae. Telson tapering slightly posteriorly, terminally rounded, caudo-lateral corners with weak spine. Outer ramus of uropod with weak longitudinal median carina terminating in spine on transverse suture. Transverse suture with 4–6 spines mesially and 5–7 spines laterally, caudo-lateral corner with 1–2 marginal spines. Inner ramus with weak longitudinal median carina terminating in spine before posterior margin, caudo-lateral corner with weak spine.

Chelae isomorphic or dimorphic. Large dimorphic chela with lateral surface of propodus glabrous and almost asetose, mesial and dorsal surfaces finely granulate, granulations sometimes forming short dorsal row of small tubercles posteriorly; ventral margin of propodus with staggered row of tufts of long bristle setae, extending almost to tip of finger. Propodal finger elongate, with smooth mesial and lateral longitudinal ridges separated by setose grooves or depressions, mesial margin of finger with fine plumose setae, sometimes extending onto central mesial surface of palm. Dactyl elongate, narrow, with smooth mesial and lateral longitudinal ridges separated by setose grooves or depressions, ventral margin setose, mesial margin of finger with fine plumose setae. Small dimorphic chela like large dimorph except sometimes lacking granulation on mesial surface of propodus; dactyl with dorso-mesial row of tufts of long bristle setae, propodus with dorsal row of weak tubercles on posterior half. Carpus glabrous laterally with sparse setae, granulate dorsally, ventrally and mesially, lacking centro-dorsal depression. Merus with row of tubercles on dorsal edge, ventral surface finely tuberculate.

Sternal keel commencing after lateral processes of P1, very low between P2, rising to a blunt peak at lateral processes of P2, then falling between P3 before rising to blunt keel at lateral processes of P3, continuing to broad flat plateau at lateral processes of P4, terminating posterior to articulation of P4. Lateral processes of P1 and P2 lacking pores. Lateral process of P1 raised. Lateral process of P2 weak. Lateral process of P3 raised, setose, lacking pores, or rarely with single pore. Lateral process of P4 raised, inflated, bearing large, raised ovo-elongate pore openings postero-laterally. Bullar lobes sloping antero-mesially, separated by deep groove, posteriorly blunt.

Animals with male or female gonopores only.

Holotype male

Cephalon

Rostrum: moderately long, narrow, extending to distal end of penultimate segment of antennal peduncle, 0.11 x OCL, spineless with straight lateral margins converging to slightly upturned, bluntly-pointed tip. Whole rostrum sloping slightly downwards in lateral profile; bordered entirely by thin rim, dorso-laterally steep, weakly setose and concave between rim and rostral carinae. Rostral carinae conspicuous, straight, converging anteriorly, but fusing neither with themselves nor rostral rim, weakly tuberculate and long, 2 x long as rostral length, fading out well posterior of posterior margin of orbit. Intra-carinal region broadly u-shaped in transverse profile, becoming moderately setose anteriorly, setal row immediately mesial of rostral carinae, extending from rostral tip posteriorly almost to cervical groove. Sub-orbital angle obtuse >90°; post-orbital region slightly depressed; post-orbital ridges faint, blunt; no notch in orbital rim. Eyes small, extending halfway along rostrum.

PLATE 1 — *Engaeus excavator* sp. nov. Female. Dorsal view. Henry Street, Latrobe. (Scale bar: 30 mm) (Photo: Ryan Francis)

PLATE 2 — *Engaeus excavator* sp. nov. Female. Lateral view. Henry Street, Latrobe. (Scale bar: 30 mm) (Photo: Ryan Francis)

Antennal flagella long (tip missing), extending to 2nd abdominal segment. Antennal scale short, extending to base of distal segment of antennal peduncle 0.08 x OCL, 0.5 x wide as long, widest at distal 2/3, conical terminal spine about 0.25 x length. Ventro-lateral margin sharp, weakly setose, dorsal sub-lateral margin with rounded carina, mesial margin and antero-lateral tip with long plumose setae. Antennules bi-flagellate, flagella sub-equal 0.5 x OCL. Intra-antennal scale broad, sub-triangular, laterally rounded at base, anterior tip rounded, lateral margins slightly raised.

Ventral disto-mesial corner of third maxilliped coxa with one large and one minor tubercle, ventro-mesial margin raised, weakly tuberculate. Ventro-mesial margin of ischium with long bristle and plumose setae, plumose setae extending over posterior half of ventro-lateral face, absent on disto-lateral half. Lateral margin weakly concave, smoothly carinate, terminating in small anterior tubercle. Exopodite long, multiarticulate, shaft >0.5 x ischium, flagellum extending to 1/3 merus.

Carapace

Vaulted, 0.76 x as wide as deep, areola narrow 0.5 x as wide as long. Branchiostegites, mandibular, antennal and orbital regions of carapace minutely punctate and weakly setose, setation becoming denser ventrally. Dorsal cephalon and areola minutely punctate with sparse short setae. Cervical groove deep, broadly v-shaped at meson.

Abdomen

TAL 1.19 x OCL, AP1 reduced in width, 0.62 x CTW. AP1 with bi-lobed pleura overlapped by anterior extension of AP2 pleura. AP2–6 pleura minutely punctate with sparse setation, extending almost to dorsum on AP5–6.

PLATE 3 — *Engaeus excavator* sp. nov. Female. Anterior cephalothorax, lateral view. Henry Street, Latrobe. (Scale bar: 5 mm) (Photo: Ryan Francis)

PLATE 4 — *Engaeus excavator* sp. nov. Female. Anterior cephalothorax, dorsal view. Henry Street, Latrobe. (Scale bar: 5 mm) (Photo: Ryan Francis)

Tail fan

Telson tapering posteriorly to caudo-lateral corner bearing small spine; terminally rounded but slightly concave, dorsal surface sparsely setose, caudal margin with long plumose and bristle setae. Outer ramus of uropod with short fine bristle setae on lateral margin, low longitudinal median carina terminating in spine on transverse suture. Median suture almost straight, with 5 small spines laterally, 4 larger spines mesially. Caudo-lateral corner with two widely-separated small spines; caudal section of ramus with very faint median ridge, faint carinae radiating caudally, rear margin with plumose and bristle setae, caudal section constricted at caudo-lateral and caudo-mesial corners. Inner ramus sparsely setose dorsally, with strong median carina terminating in spine. Caudo-lateral corner with small spine, posterior margin with bristle and plumose setae. Inner and outer rami as long as telson. Uropod peduncle rounded, outer lobe setose.

Chelae

Isomorphic, elongate, minutely setose, non-granulate laterally. DACL/PROPL 0.56, PROPW/PROPL 0.28, PROPD/PROPL 0.44, PROPL/OCL 0.97. Left chela: lateral propodal palm sparsely and minutely setose, becoming weakly granulate dorsally, mesial palm weakly granulate. Ventral margin of palm with weak sub-marginal row of short bristle setae tufts, ventral margin with staggered row of long tufts of strong bristle setae. Propodal finger ventrally with extension of sub-marginal row of short bristle setae tufts lying in groove extending to distal end of finger; ventral margin of finger with row of short (or worn) tufts of bristle setae extending to distal tip, ventro-mesial row of long tufts of bristle setae. Cutting edge with 4 proximal teeth plus 4 smaller distal teeth, fine plumose setae laterally, weak granulation on proximo-lateral face. Dactyl non-granulate with dorso-lateral, dorsal and dorso-mesial rows of tufts of short bristle setae. Cutting edge with two small proximal

PLATE 5 — *Engaeus excavator* sp. nov. Female. Ventral view of sternal keel, showing inflated lateral processes and large pores of 4th pereopod. Henry Street, Latrobe. (Scale bar: 10 mm) (Photo: Ryan Francis)

PLATE 6 — *Engaeus excavator* sp. nov. Female. Major chela, mesial view, showing ventral fringe of long setae. Henry Street, Latrobe. (Scale bar: 10 mm) (Photo: Ryan Francis)

teeth, fine plumose setae laterally. Carpus asetose apart from weak setation on ventro-lateral corner. Ventral projection with single tubercle, mesial triangle granulate, becoming tuberculate posteriorly. Merus mesial surface smooth and weakly setose, dorsal margin with row of tubercles fading anteriorly; ventral surface finely tuberculate with tubercular rows on lateral and mesial margins.

Right chela: as left except propodal finger cutting edge with 3 large proximal teeth, 5 smaller distal tubercles. Dactyl cutting edge with 2 proximal teeth and 3 well-spaced distal tubercles.

Sternum

1st P: keel absent between LP, commencing as low narrow ridge, LP slightly swollen at articulations, otherwise low and rounded, setose postero-laterally, lacking pores. 2nd P: keel rising to rounded peak then falling to narrow ridge. LP weak slightly ridged, falling away steeply from keel, setose postero-laterally, lacking pores. 3rd P: keel rising to small peak, then rising again to peaked summit well above level of articulations, then falling slightly and disappearing into broad plateau between P4. LP weakly ridged, setose and lacking pores. 4th P: keel absent, LP broad, laterally raised to level of keel summit, sparse postero-ventral setation, large ovoid postero-lateral pores, pores with slightly raised rim, bullar lobes 2/3 as a long as wide, bulbous, sloping posteriorly, separated by deep central groove.

Sex

Male gonopores only, penes papilla-like, slightly raised and calcified anteriorly.

Allotype female

As for Holotype male except:

Cephalon

Rostral region badly damaged, exposing eye peduncles. Inter-antennular scale elongate, lateral margin carinate, weakly concave, anterior tip rounded. 3rd maxilliped: coxa dorsal corner with 1 large, 2 minor tubercles. Ischium lateral margin: disto-lateral tubercle very weak; exopodite shaft strongly setose. Carapace 0.71 x as wide as deep, areola 0.58 as wide as long; branchiostegites, mandibular, antennal and orbital regions very weakly granulate.

Abdomen

TAL 1.4 x OCL, AP1width 0.52 x CTW. AP2–4 with uncalcified marginal flap.

Tail fan

Telson terminally smoothly rounded. Uropod outer ramus median suture with 6 (right ramus) and 7 (left ramus) lateral and 5 mesial spines, caudo-lateral spine strong. Inner rami extending just beyond telson and outer rami.

Chelae

Dimorphic, elongate, minutely setose but non-granulate laterally. Right small dimorph DACL/PROPL 0.60, PROPW/PROPL 0.24, PROPD/PROPL 0.39, PROPL/OCL 0.93. Propodal palm smooth, minutely setose, dorsal row of 9 tubercles decreasing in size distally. Mesial palm smooth with very sparse small tubercles and setae. Ventral margin with sub-marginal row of weak setal tufts, ventral margin with staggered row of strong bristle setae tufts. Propodal finger with extension of sub-marginal row of weak setal tufts each lying in a depression, ventrally with strong tufts of bristle setae, cutting edge setose without teeth but with continuous row of scale setae. Dactyl with dorso-lateral and dorsal rows of short bristle setae, dorso-mesial row of tufts of long bristle setae, cutting edge lacking teeth but setose with continuous row of scale setae. Carpus as left dimorph but smaller and with weaker granulation. Merus as left dimorph but smaller with weaker granulation. Left large dimorph as Holotype except propodal finger cutting edge with 3 proximal teeth, 6 smaller distal tubercles. Dactyl cutting edge with proximal 3-tuberclate tooth and 9 distal tubercles reducing in size distally.

Sternum

Sternal keel: 2nd P keel rising to a higher peak; 3rd P rising to a lower, broader peak, LP more strongly ridged; 4th P keel extending as low broad ridge onto LP, LP pores strongly raised, robust rim, pores anteriorly truncate.

Sex

Female gonopores only. Right gonopore raised, left lacking raised perimeter, both with strong setation anteriorly.

Morphological variation

While there are insufficient specimens to assess morphological variation, there are some differences in the shape of the major chelae between specimens, particularly in the length and shape of the dactyl and propodal finger, which are longer and narrower in larger specimens. One specimen from Palmers Road showed a single, lateral slit-like pore on one of the lateral processes of pereopod 3.

Etymology

The specific epithet refers to the exceptionally deep burrows constructed by this species, and the machines that were required to collect specimens. It is derived from Latin *ex-* 'out' and *cavare* 'to hollow', thus *excavator*, 'one who hollows out'.

Relationship to other species

Following the identification key of Horwitz (1990) *E. excavator* would terminate with *E. mairener* at couplet 11, or in the case of the single specimen that showed a pore on one of the lateral processes of pereopod 3, with *E. mairener* at couplet 30, since sternal pores on the lateral processes of pereopod 3 are seen occasionally in *E. mairener* (Horwitz 1990). It can be distinguished from *E. mairener* by the elongate fingers of the propodus and carpus of the chelae, and the presence of a fringing row of tufts of long flexible setae on the ventral margin of the propodal finger of major

and minor chelae. Otherwise, *E. excavator* is morphologically like *E. mairener, E. granulatus* and *E. nulloporius*, which Horwitz *et al.* (1990) suggest form a clade.

Life history notes

None of the females examined were carrying eggs or young. The female specimens showed the uncalcified flap on abdominal pleuron 2 (also weakly on pleura 3 and 4) that Horwitz (1988) identified as a secondary sexual characteristic of mature female *Engaeus* species. Since this feature was present on the smallest female (OCL 25.1 mm) sexual maturity in this species must be attained below that size.

DISCUSSION

Ecology

The only other species of crayfish found sympatrically with *E. excavator* was *E. mairener.* Multiple burrows of *E. mairener* were found along a channelised section of Kings Creek bordering the Henry Street site, all of which were type 1b burrows (Horwitz & Richardson 1986), i.e., with some entrances under water at the edge of the creek. In contrast, *E. excavator* burrows were type 2, which derive their water supply from groundwater. At the Palmers Road site in January 2022 the water table was around 2 m below the surface, whereas at the Henry Street site in July 2023 some surface water was present. Soils at both sites were heavy clay.

Burrows of *E. excavator* were very deep compared to those of other Tasmanian burrowing crayfish: four of the five specimens were obtained with the use of an excavator, and the basal chambers of the burrow systems had not been reached at depths of over 2 m (pl. 7). The only hand-excavated specimen was found at about 1 m depth, well above the bottom of the burrow. Given the heavy nature of the substrate and the necessary use of a mechanical excavator, it is difficult to give any detailed description of the burrows. They seemed to have 2–4 entrances, often marked with a chimney of pellets, and tunnels that descended more-or-less vertically, with few branches.

Both *E. excavator* sites have been previously cleared of native vegetation. At Palmers Road the vegetation is exotic pasture grasses and sedges, while at Henry Street the vegetation is dominated by gorse *Ulex europaeus*, and ubiquitous pasture grasses and herbs, with native plant species restricted to scattered herbs and sedges. This raises the question of what native vegetation community the species might occur in now or occurred in before European settlement.

The original native vegetation at both sites was most likely black gum *Eucalyptus ovata* forest and woodland (TASVEG code: DOV, Kitchener & Harris 2013). Less disturbed vegetation adjacent to the Palmers Road and Henry Street sites gives an indication of how this vegetation type might have been expressed. *E. ovata* would have been the dominant canopy species, with occasional *Eucalyptus amygdalina* black peppermint and *Eucalyptus viminalis* white gum. Since European settlement, this vegetation type has been heavily modified by grazing, burning and other activities so that many occurrences, including those within the potential range of this new species, are little more than remnant canopy trees over pasture grass and weeds (M Wapstra, pers. comm.).

Distribution and conservation

Engaeus excavator is known only from the Palmers Road and Henry Street sites, near Latrobe in north-central Tasmania, which are less than 2 km apart (fig. 2). Both sites are flat or gently sloping paddocks on heavy clay soils. Similar topography exists along the Bass Highway between Dooleys Hill and Staggs Hills, and to the west on the flats surrounding Latrobe and the Mersey River, within an area bounded by the 40 m contour (fig. 3). *E. excavator* may occur in heavy clay soils in this area, but much of this area is made up of paddocks and grazing land. The earliest available historical aerial imagery shows that the Palmers Road site was a cleared paddock in 1953; the Henry Street site was at least partly cleared at that time and was fully cleared by 1977. This suggests that paddocks in the area should be checked for the presence of burrows. However, because of the very deep burrows created by *E. excavator*, and the likely reluctance of landowners to allow major excavations in their paddocks, establishing its actual range will be very difficult. However, recent studies (Dawkins *et al.* 2024) suggest that eDNA can be recovered from the chimneys of crayfish burrows, which offers significant potential for establishing the ranges of burrowing crayfish without destructive sampling.

A rough estimate of colony size can be made at each known site. Over 180 burrow entrances were recorded at Palmers Road and 150 at the Henry Street site (author's unpublished data); assuming all burrows are occupied by a single adult, and that each burrow system has at least two entrances, it is likely that each site supports fewer than 100 mature crayfish. However, without any data on the extent and area of occupancy of this new species, any assessment of its conservation status, beyond an informal assessment as data deficient, is difficult. It is worth noting that the new species persists in (and to date has only been found in) highly modified habitats (i.e. paddocks) suggesting that vegetation clearance *per se* is not a threatening process. Identifying threatening processes would need to form part of any formal assessment of its conservation status. Such threats might include large-scale habitat modification, such as extensive and deep excavation to improve pasture drainage, or for roads, dams and buildings. Without data about its current extent of occurrence, area of occupancy and abundance, it is impractical to estimate changes to such threats since European settlement or in more recent decades (i.e., the 20- and 50-year periods used under IUCN criteria).

If this species is associated with *E. ovata* forest and woodland (TASVEG code: DOV), this, in theory, affords it some protection through the forest practices system or local government planning, since this native vegetation community is listed as threatened on Schedule 3A of the Tasmanian *Nature Conservation Act 2002*. This community

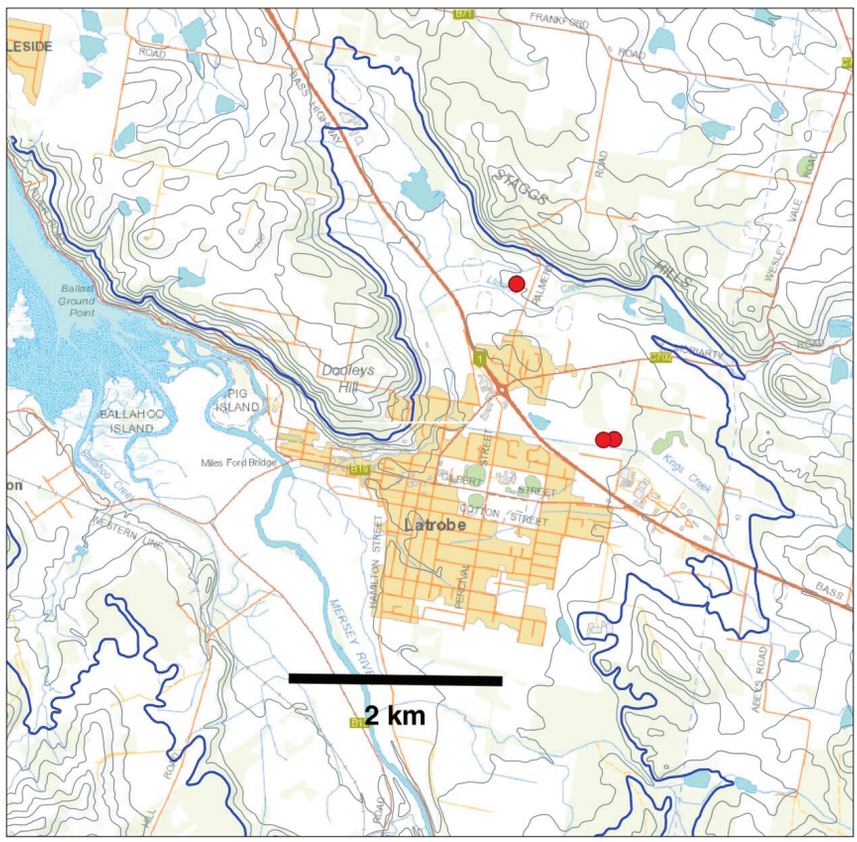

FIGURE 3 — The landscape around Latrobe, Tasmania, with similar characteristics (low, fairly flat topography, largely cleared for grazing) to the two sites (red dots) where *Engaeus excavator* n. sp. has been found. The blue line represents the 40 m contour. (Basemap: Land Information System Tasmania. https://data.thelist.tas.gov.au/).

PLATE 7 — Investigating a burrow of *Engaeus excavator* sp. nov. at the Palmers Road site, 12 January 2022. The burrow extended below the excavated depth of about 2 m. (Photo Brian French)

also equates to a threatened ecological community (Tasmanian Forests and Woodlands dominated by Black Gum or Brookers Gum) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Again, this may afford the species some protection, although only if certain threshold criteria are met in terms of extent, condition, structure and composition.

An associated conservation matter concerns the identification of burrows of *Engaeus granulatus*, the central north burrowing crayfish. This species is listed as Endangered under both the Tasmanian *Threatened Species Protection Act 1995* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*, and its presence has triggered land management issues in several areas, e.g., along the rail corridor through Spreyton, flood mitigation measures on Kings Creek in Latrobe, etc. Distribution records to date (through the Tasmanian Government's *Natural Values Atlas https://www.naturalvaluesatlas.tas.gov.au/*) have led to the assumption that *E. granulatus* occupies an exclusive range, so crayfish burrows (at least away from the edges of its range) have been assumed to be *E. granulatus* without confirmation through excavation to positively identify the occupant. If *E. excavator* proves to be more widespread it will no longer be possible to make this assumption. The development of eDNA tools to indirectly identify the occupants of crayfish burrows is therefore urgently needed.

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