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Two new species of social crab spiders of the genus *Diaea* from eastern Australia, their natural history and distribution

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Abstract – Two new species of social, *Eucalyptus* leaf weaving thomisids are described. Social *Diaea* are large for the genus; twice the size of solitary congenerics. *D. ergandros* sp. nov. is found in sclerophyllous forests in Victoria, along the Great Dividing Range through New South Wales to Queensland. It is also found in Tasmania. *D. megagyna* sp. nov. is found along the Great Dividing Range in New England, New South Wales and southern Queensland. The group living habit of these species appears similar to that of *D. socialis* from southwestern Western Australia, and social behaviour and life history patterns of all three species are briefly compared and discussed.

INTRODUCTION

When the social thomisid *Diaea socialis* was first described by Main (1988), it was an anomaly among the social spiders; a taxonomically heterogeneous group united by all weaving a snare web (Buskirk 1981, but see also Downes this volume). In fact, the attributes of the snare web lead early workers to state that it was a necessary preadaptation for sociality to arise (Shear 1970). However, there are now two genera which do not weave a snare web; *Delena cancerides* Walckenaer (Heteropodidae) (Rowell 1985, 1987), and *Diaea socialis* Main (Main 1988; Rowell and Main 1993) and both are found only in Australia.

Main (1988) described the natural history, behaviour, population cycles and taxonomy of *Diaea socialis* from Western Australia. Subadult spiders collected from Victoria and Tasmania were included in this description, and a note about a social thomisid in southern Queensland (Brimblecombe 1962) was also mentioned. However, Main (1988) noted that "Further research may establish that there are several species involved." A long term study of the behaviour and ecology of social *Diaea* occurring on the eastern mainland and Tasmania revealed consistent differences from the Western Australian spiders. Comparison of the anatomy, life history and distribution demonstrates that there are three distinct species of *Diaea* in southern Australia. Two are new species distributed in the sclerophyllous *Eucalyptus* forests along the east of the continent and Tasmania. These two species are described here.

METHODS

Social *Diaea* from southeastern Australia are typically found in closed canopy forests of *Eucalyptus* species that have short, but slender leaves (e.g. messmate *E. obliqua*, broad-leaved peppermints *E. dives*, narrow-leaved peppermints *E. radiata*, yellow box *E. melliodora*). Locating the characteristic nests from the surrounding pendulous foliage was facilitated by their distinct ball shape. Collecting techniques varied: tall forests were surveyed by examining the canopies of felled trees immediately after falling, whereas low forests were searched by walking transects. Nests were collected either by climbing the tree, or by using secateurs on an extending pole. Collections for this study occurred in Victoria during 1991–1993, in New South Wales and the Australian Capital Territory during February 1992 and July 1993, in Queensland during August 1993, in Tasmania during September 1993, in Western Australia during October 1992 and October 1993.

A sample of adults were stored in alcohol for description. If adults were absent, the juveniles were raised to adulthood in the laboratory. Specimens examined are lodged in the following collections: the Australian Museum (AM), Australian National Insect collection (ANIC), Barbara York Main personal collection, Zoology Department, University of Western Australia (BYM), National Museum of Victoria (NMV), Queensland Museum (QM), Tasmanian Museum and Art Gallery (TMAG), Western Australian Museum (WAM). Most of the material was collected by myself, and the abbreviation TAE was used in the lists of paratypes.

Material of other social *Diaea* were also examined:

Diaea sp.: **Australia: Tasmania:** Hayle's Rd, Dial Range, 1979, J.L. Robinson (TMAG J2054); 3♀ and juveniles, Eaglehawk Neck, 11 January 1981, S.J. Smith (TMAG J2057a, b); Cynthia Bay, Lake St Clair, Tas grid ref. (4) 323, (54) 310, 20 August 1986, S.J. Smith (TMAG J2060a).

Diaea socialis Main: **Australia: Western Australia:** holotype (WAM 86/382), and paratypes (WAM 86/383, 86/384), and adults (BYM).

SYSTEMATICS

Diaea ergandros sp. nov.

Figures 1b, 1c, 2c, 2d, 3c, 3d, 4b

Material Examined

Holotype

♀, Yan Yean water catchment, 45 km N. of Melbourne, Victoria, Australia, from nest of leaves of broad leafed peppermint (*Eucalyptus dives*), 15 September 1993, T.A. Evans (NMV K3070).

Paratypes

Australia: Victoria: 1♀, 2♂, same data as holotype (NMV K3054); 1♀, 1♂, same data as holotype except from leaf nest (NMV K3058); 3♀, 1♂, 3 subadult ♀, same data (NMV K3057); 4 subadult ♀, 3 subadult ♂, same data (NMV K3056); 2♀, 2♂, 2 subadult ♀, same data (NMV K3055); 1♂, 3 subadult ♀, Brisbane Ranges near Gellibrand, in leaf nest, 11 September 1993, TAE (NMV K3059); 4♀, 4 subadult ♀, 1 subadult ♂, Carlisle State Park, Otway Ranges, from leaf nest, 21 September 1993, TAE (NMV K3061); 1♀, near Kinglake National Park, from leaf nest, 20 September 1993, TAE (NMV K3062); 1♀, near Moe, from leaf nest, 26 December 1993, TAE (NMV K3063); 4♀, Holey Plains State Park, in leaf nest, 26 December 1993, TAE (NMV K3064); 3 subadult ♀, same data (NMV K3065); 2♀, 2♂, Beechworth, in leaf nest, 23 July 1993, TAE (NMV K3066); 2♀, 1 subadult ♀, same data (NMV K3067); 1♀, 1♂, 1 subadult ♀, Yackandandah, in leaf nest, 23 July 1993, TAE (NMV K3068); 1♂, 2 subadult ♀, same data (NMV K3069). **Australian Capital Territory:** 2♀, 1♂, 1 subadult ♀, Orroral River in Booth Range, TAE (ANIC). **New South Wales:** 5 subadult ♀, 6 subadult ♂, near Porters Retreat, Blue Mtns, from leaf nest, 27 July 1993, TAE (AM KS40848); 5 subadult ♀, 4 subadult ♂, near Hampten, Blue Mtns, from leaf nest, 27 July 1993, TAE (AM KS40850); 1 subadult ♀, 1 subadult ♂, same data (AM KS40849); 3♀, 2 subadult ♀, 3 subadult ♂, Nandewar Ranges near Armidale, 29 July 1993, TAE (AM KS40851); 1♀, 2♂, 2 subadult ♀, Bald Nob, 30 km E. of Glen Innes, from leaf nest, 31 July 1993, TAE (AM KS40852); 4♂, 4 subadult ♀, same data (AM KS40853). **Tasmania:** 8 subadult ♀, Saltwater, Tasman Peninsula, from leaf nest, 2 August 1993, TAE (TMAG J3147); 1 subadult ♀, 1 subadult ♂, same data (TMAG J3144); 1♀, 1♂, Tarraleah, from leaf nest, 4 August 1993, TAE, L. Robertson (TMAG J3145); 1 subadult ♂, Copping (30 km E. of Sorrell), from leaf nest, 2 August 1993, TAE (TMAG J3146).

Diagnosis

This species is distinguished by its large size, colour and by morphology of the genitalia. Epigyne mushroom shaped and simple (Fig. 2c); spermathecae ovoid and smooth; with short fertilization ducts but very long copulatory ducts, sclerotised section of which extend anteriorly for twice the length of spermathecae, turn and travel posteriorly between the spermathecae without touching each other (Fig. 2d). Palps with very large cymbium, which terminates distally in a sharp point, and is notched on inner lateral surface; embolus emerges ventrally and proximally at about 180°, and circles around cymbium two and a half times (Fig. 3c); tibial apophysis with small, off-centre ventral edge and with lateral spine that is long, laterally bifurcated and folded elaborately; this spine widens markedly distally before terminating in a sharp point (Fig. 3d).

Description

Size large, total lengths, 7 mm (♀), 5 mm (♂) (Figs 1b, c). Female with bright green prosoma, which may have brown dorso-lateral lines above the legs. Opisthosoma mottled light brown, two white dots on anterior dorsal surface, followed posteriorly by dark brown spots in two rows on either side of midline. Opisthosoma may also have dorso-lateral reddish-pink marks. Legs I and II 8 mm long, legs III and IV about 4 mm long (Table 1). All legs mostly green, except for tarsi, metatarsi, and distal half of tibiae I and II which are red-brown. Epigyne mushroom shaped, and simple in structure; spermathecae ovoid with smooth surface; fertilization ducts are twice the length of spermathecae (Figs 2c, d). Male with burgundy-brown prosoma and a mottled light and dark brown opisthosoma with dorsal markings as for female. Legs I, II mostly burgundy-brown, except for soft joints which are green; legs III and IV entirely green. Cymbium very large and complex, with long embolus that circles the cymbium two and a half times; tibial apophysis large, folded apophysis extending distally (Figs 3c, 3d).

Distribution

Diaea ergandros is found in most sclerophyllous forests, with closed or partially open canopy, from Victoria to southern Queensland (Fig. 4b). The con-

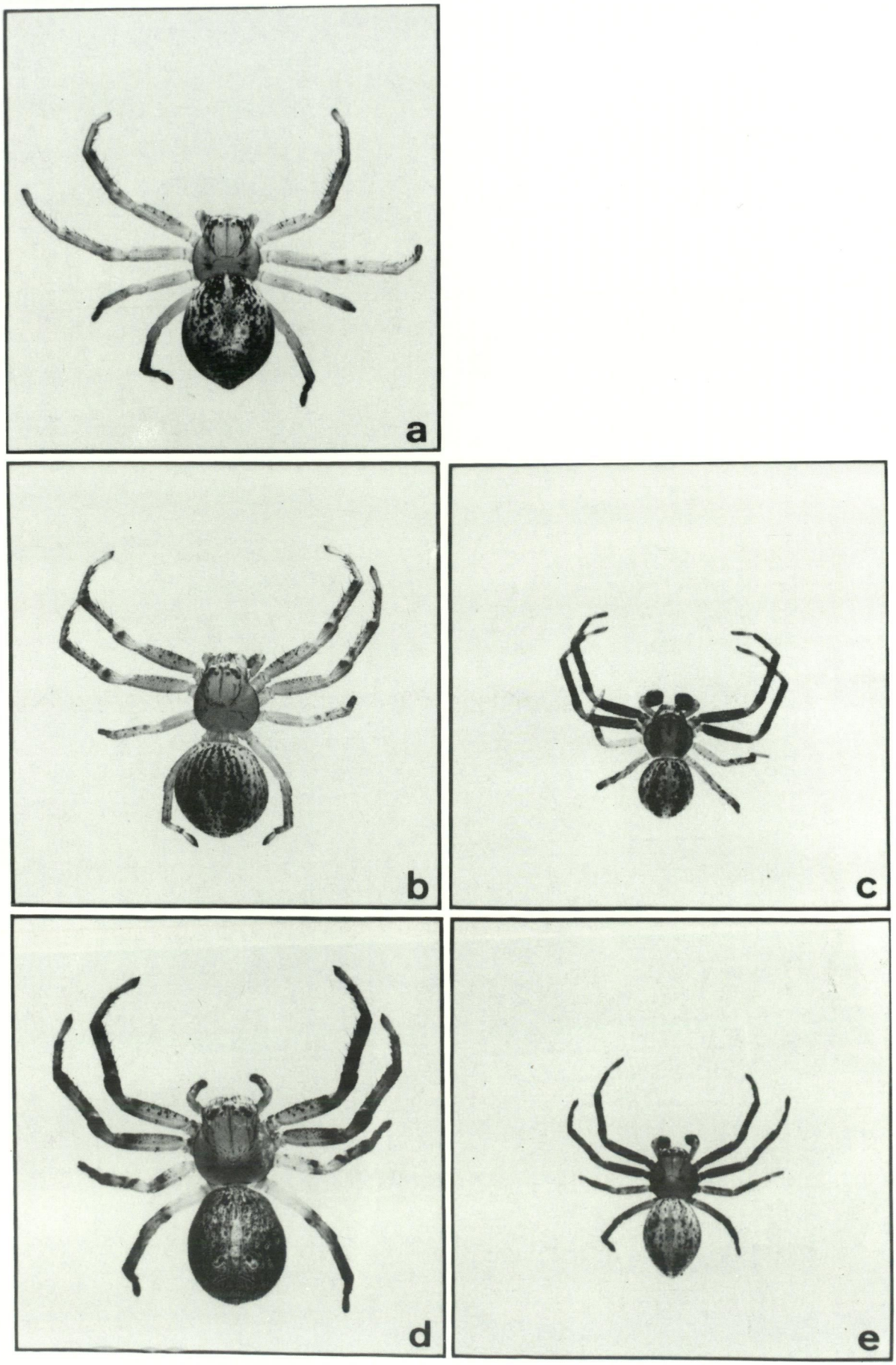

Figure 1 The social *Diaea*. *D. socialis* Main: a, female; *D. ergandros* sp. nov.: b, female; c, male; *D. megagyna* sp. nov.: d, female; e, male.

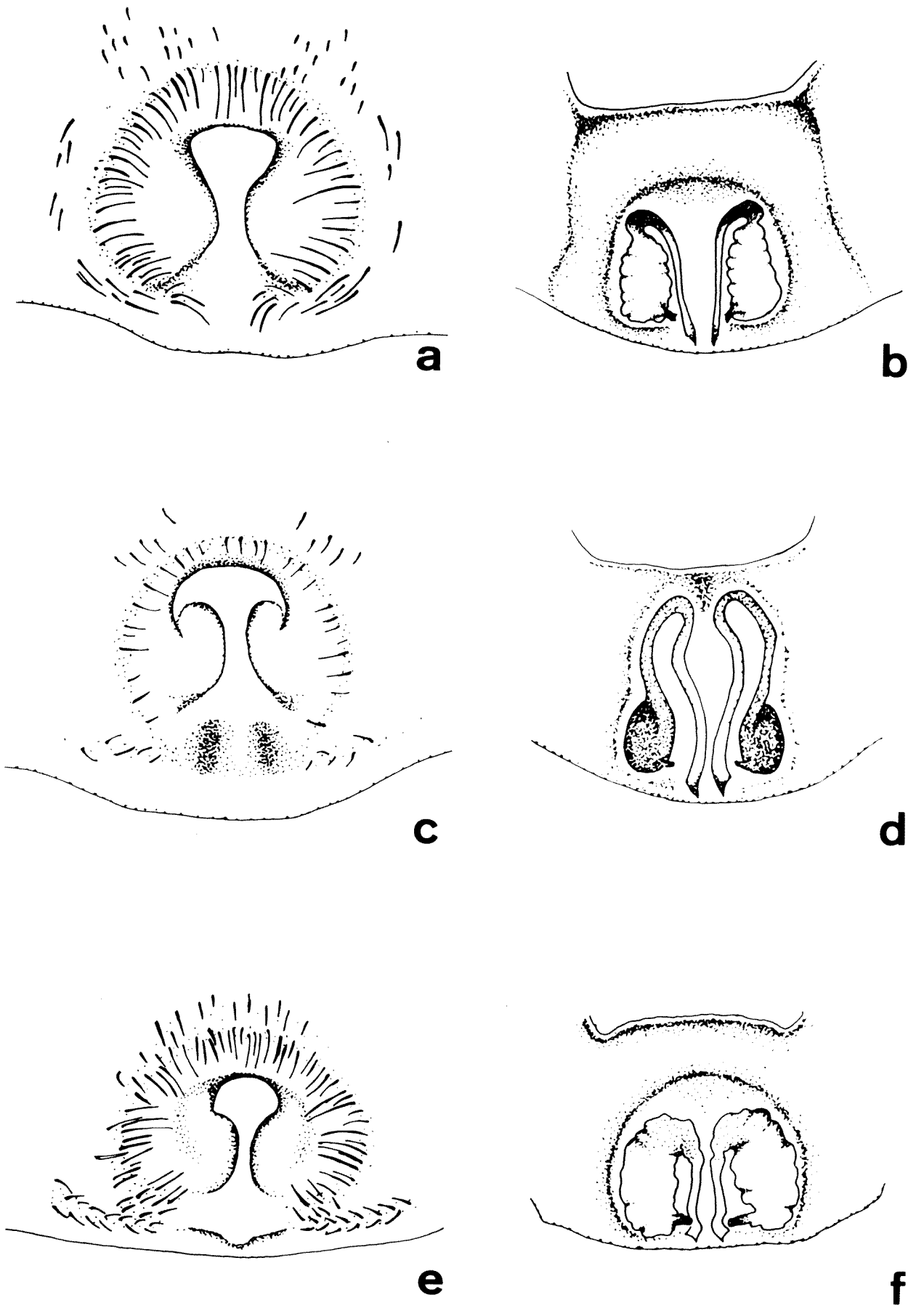

Figure 2 Female genitalia of the social *Diaea*. *D. socialis* Main: a, epigyne, ventral view; b, cleared spermathecae, dorsal view; *D. ergandros* sp. nov.: c, epigyne, ventral view; d, cleared spermathecae, dorsal view; *D. megagyna* sp. nov.: e, epigyne, ventral view; f, cleared spermathecae, dorsal view.

tiguous distribution is along the Great Dividing Range, from the Hume Range near Melbourne, to the Roberts Range in Queensland. Isolated populations were found at the south western limit to their range in the Otway Range, in the Brisbane and Strzelecki Ranges, and Holey Plains National Park to the southeast, and Mt Royal Range, New South Wales, to the north. This spider is also found in the southeast and central hills of Tasmania.

Remarks

This species shares similar morphology with *D. inornata* (L. Koch) (Dondale 1966), however *D. ergandros* is larger (7 mm) and green (perhaps with brown bands), whereas *D. inornata* is smaller (5.5 mm) and yellow. Genitalia are clearly distinguishable: the epigyne of *D. ergandros* is less complex, and spermathecal morphology differs markedly, with longer, widely separated fertilization ducts, those of *D. inornata* are shorter and meet (Dondale 1966, figs 8e, 8f). These differences are mirrored in the male: *D. ergandros* is larger (5.5 mm) and red-brown, whereas *D. inornata* is smaller (3.5 mm) and orange yellow, with red bands. The male palps differ also: cymbium of *D. inornata* is not pointed sharply, is not notched, and has a shorter embolus (Dondale 1966, figs 7g, 7h). Finally, *D. inornata* was collected in apple orchards, whereas *D. ergandros* appear to be found only in sclerophyllous *Eucalyptus* forests.

Etymology

This species is named after the behaviour of the males. Unlike males of other social spiders, including *Diaea socialis*, males of *D. ergandros* contribute to the group effort, in nest construction and foraging cooperatively (Greek *ergo* = work, *andros* = male).

Diaea megagyna sp. nov.

Figures 1d, 1e, 2e, 2f, 3e, 3f, 4b

Material Examined

Holotype

♀, Bald Nob, 30 km E. of Glen Innes, New South Wales, Australia, in nest of leaves of box (*Eucalyptus*), 31 July 1993, T.A. Evans (AM KS40856).

Paratypes

Australia: New South Wales: 4♀, 3♂, same data as holotype (AM KS40856); 1♀, 1♂, same data as holotype (AM KS40855); 2♀, 2♂, 1 subadult ♂, Hanging Rock near Nundle, in leaf nest, 28 July 1993, TAE (AM KS40854). **Queensland:** 2♀, 2 subadults, near Girraween National Park, near Stanthorpe, in leaf nest, 30 July 1993, TAE (QM S19713, S19714).

Diagnosis

This species is distinguished by its very large size (especially in adult females), colouring (lacking bright colours typical of genus) and by the morphology of the genitalia. Spermathecae bean shaped and wrinkled, with short fertilization and copulatory ducts, the sclerotised section of the latter exit from spermathecae by inner lateral surfaces, subanteriorly; copulatory ducts proximally broad, and narrow as they travel posteriorly between spermathecae, and do not touch (Fig. 2f). Pedipalp small, with slightly expanded cymbium; embolus leaves cymbium at about 170°, circles around the cymbium one and a half times (Fig. 3e); tibial apophysis small, with an off-centre ventral edge, a single fold, and a simple pointed-tip spine (Fig. 3f).

Description

Size large, total length 9 mm (♀), 4.5 mm (♂) (Figs 1d, 1e). Female with pale, dull green prosoma, which may have faint brown dorso-lateral lines above legs. Opisthosoma grey-brown, with dorsal, darker grey spots in two rows on either side of midline toward posterior (occasionally faint), and

Table 1 The leg formula of *D. socialis*, *D. ergandros* and *D. megagyna*. The leg formula are the segment lengths divided by carapace length.

leg	femur	patella	tibia	metatarsus	tarsus	total
Diaea ergandros						
female, carapace = 2.7 mm						
P	0.28	0.07	0.28	–	0.25	0.95
I	0.88	0.28	0.82	0.63	0.46	3.46
II	0.93	0.29	0.82	0.66	0.46	3.57
III	0.64	0.16	0.49	0.28	0.28	2.22
IV	0.64	0.16	0.49	0.28	0.28	2.22
male, carapace = 1.85 mm						
P	0.24	0.08	0.14	–	0.55	1.07
I	1.00	0.41	0.94	0.71	0.51	2.97
II	0.98	0.41	0.86	0.69	0.49	3.82
II	0.65	0.18	0.41	0.31	0.31	2.14
IV	0.65	0.18	0.41	0.31	0.31	2.14
Diaea megagyna						
female, carapace = 3.1 mm						
P	0.28	0.16	0.18	–	0.32	1.03
I	0.95	0.38	0.78	0.56	0.40	3.50
II	0.89	0.38	0.76	0.53	0.38	3.37
II	0.63	0.23	0.40	0.25	0.25	2.09
IV	0.63	0.23	0.40	0.25	0.25	2.09
male, carapace = 1.7 mm						
P	0.31	0.20	0.35	–	0.42	1.28
I	1.02	0.33	0.84	0.62	0.53	3.70
II	1.02	0.33	0.84	0.62	0.53	3.70
II	0.71	0.27	0.49	0.38	0.36	2.50
IV	0.71	0.27	0.49	0.38	0.36	2.50

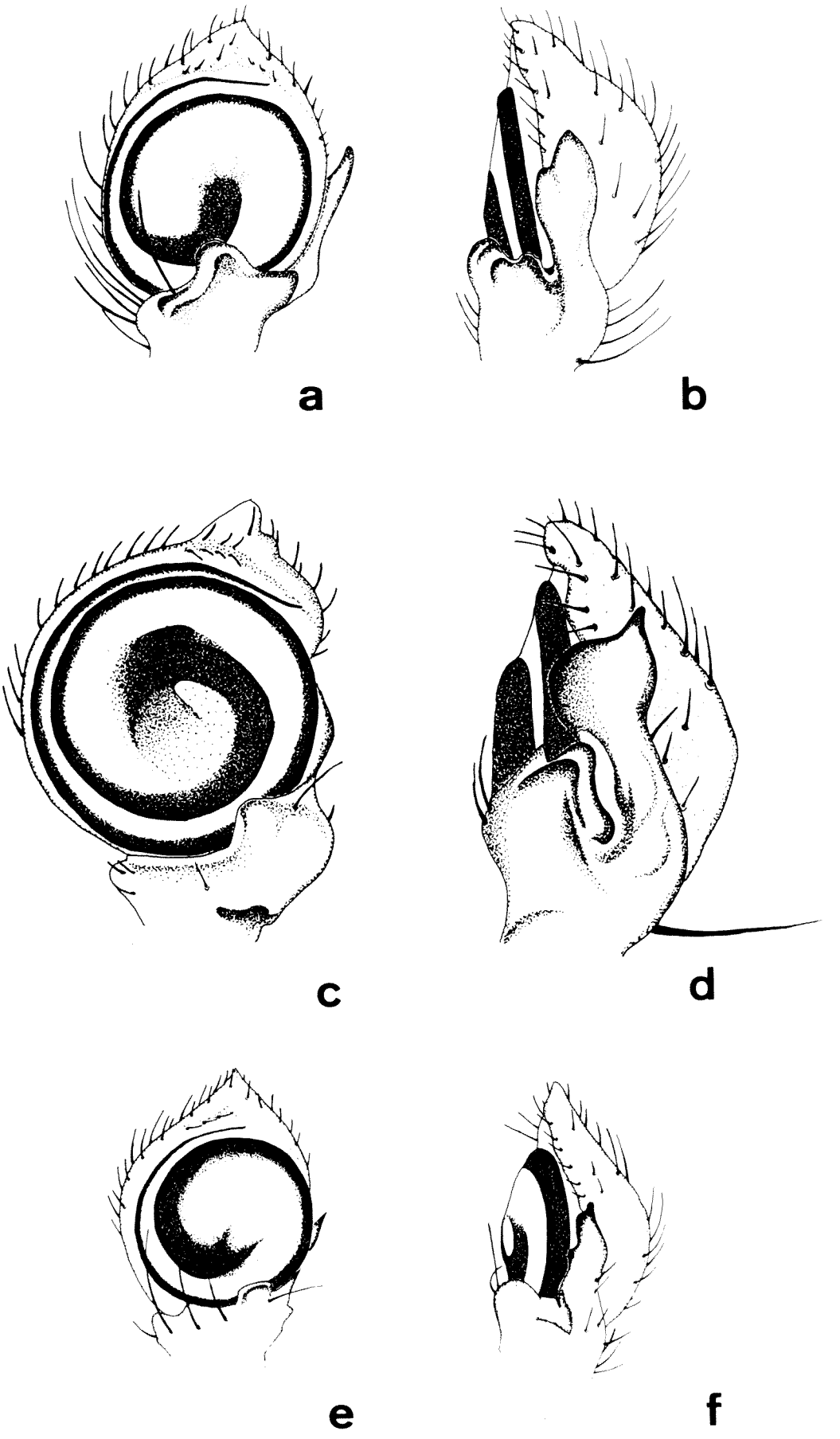

Figure 3 Left cymbium of male social *Diaea*. *D. socialis* Main: a, ventral view; b, lateral view; *D. ergandros* sp. nov.: c, ventral view; d, lateral view; *D. megagyna* sp. nov.: e, ventral view; f, lateral view.

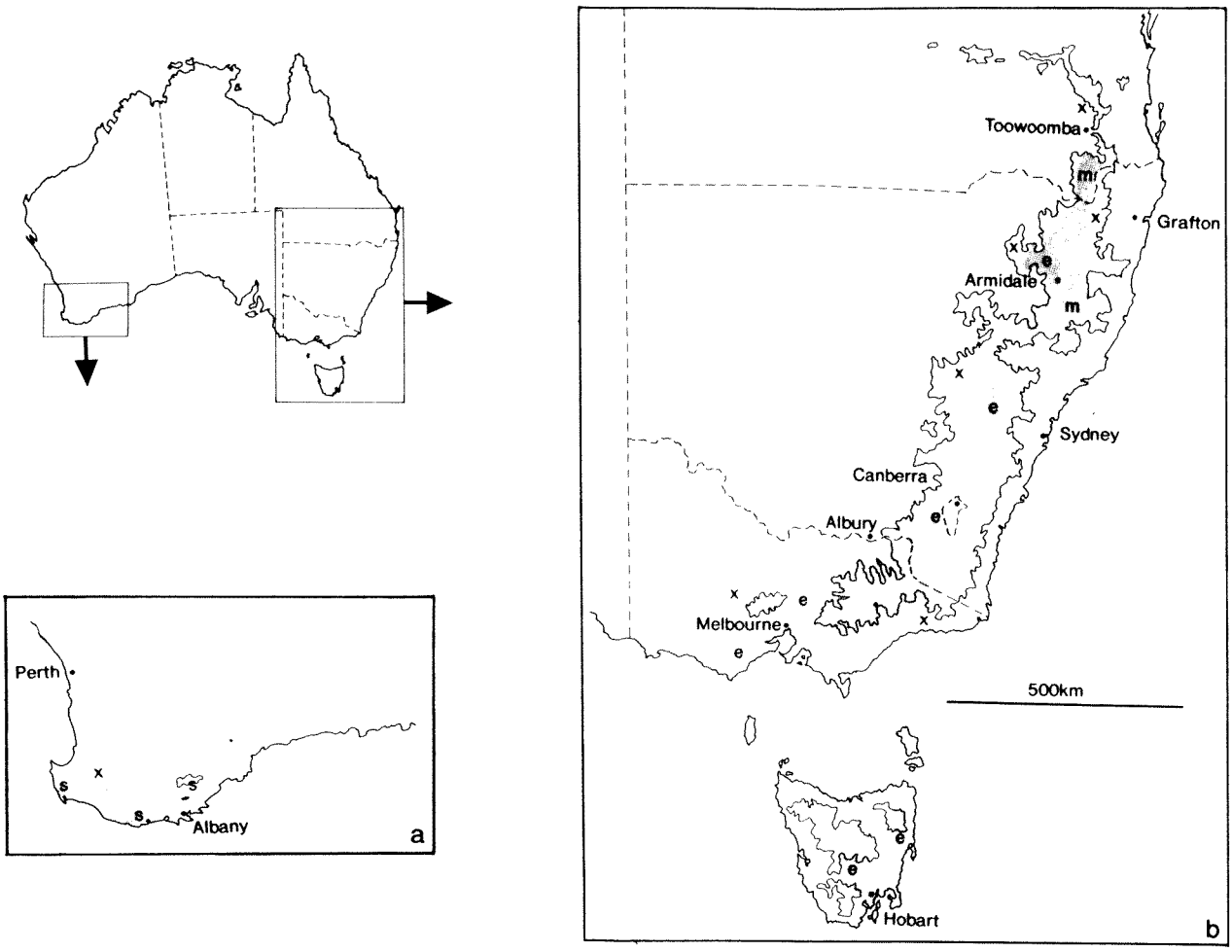

Figure 4 The range of the social *Diaea*. a, *D. socialis* Main (scale as for Fig. 4b); b, *D. ergandros* sp. nov. and *D. megagyna* sp. nov. Symbols: solid line = 500 m elevation (Stirling Ranges, W.A., Great Dividing Ranges, central Tasmanian Plateau), dashed lines = state borders, grey shaded ares = potential forest habitat, s = *D. socialis* type locality, e = *D. ergandros* type locality, m = *D. megagyna* type locality, x = no social *Diaea* found in closed eucalypt forest.

a conspicuous dark grey ventral marking between lungbooks and spinnerets. All legs I and II 9 mm long, III and IV 4.5 mm long (Table 1). Legs mostly green, except for red bands located at proximal and distal ends of tarsi, metatarsi, tibiae, patellae and distal end of femora (these may be very dark). Epigyne simple, arch-shaped, with fertilization ducts just shorter than spermathecae (Figs 2e, 2f). Male with burgundy-brown prosoma and grey-brown opisthosoma. All legs burgundy-brown. Pedipalp: cymbium small; short embolus that circles cymbium one and a half times; tibial apophysis simple and pointed, extending distally (Figs 2e, 2f).

Distribution

D. megagyna was found from Mt Royal Range, near Tamworth, New South Wales, into southern Queensland (Fig. 4b). This area may underestimate the complete range of this species as the collection terminated just north of Tamworth.

Remarks

This species is clearly distinguishable from congenerics, but is superficially similar to *D. socialis* (Fig. 1, see also Main 1988). However, *D. megagyna* is larger, and the colours are duller, with fewer markings on the dorsal surfaces. The spermathecae are somewhat different: the copulatory ducts of *D. socialis* exit from the anterior outer side of the spermathecae, are narrow, and curl so as to resemble a shepherd's crook, before travelling posteriorly (Fig. 2). Finally, the two species inhabit widely disparate ranges (see Fig. 4).

Etymology

D. megagyna is so named as the female of this species is much larger than the male, relative to the other species of social *Diaea* (Greek *mega* = big and *gyna* = female). However, an alternate meaning exists, *mega* = great, *gyna* = woman, in honour of Barbara York Main, and her role in establishing arachnology in Australia.

BEHAVIOUR AND LIFE HISTORY

In addition to the morphological differences cited above, there are also differences in the behaviour and life history strategies of the three species. *Diaea socialis* (Rowell and Main 1993) and *D. megagyna* have a sex ratio bias (Evans, unpublished data), and the males in these species contribute little to the nest, whereas *D. ergandros* has an even sex ratio, and males and females contribute equally to nest maintenance.

The seasonal patterns in the life cycles of the three species are similar, except that *D. socialis* is biennial, whereas *D. ergandros* and *D. megagyna* are annual. The life cycle for *D. socialis* was recorded by Main (1988). That of *D. ergandros* is as follows:

Summer: Adult females migrate from their parent colonies after mating. Nest construction begins with a single curled leaf, similar to that of other thomisids (e.g. solitary *Diaea* and *Cymbacha*); other leaves are then added. After four or five leaves are added, a single egg-sac containing 15–80 eggs (mean 45) is laid. The mother continues to build the nest, and catches large prey (wasps and beetles) to feed her young.

Autumn: Juveniles begin nest construction with their mother. Gerontophagy occurs when food becomes scare. The juveniles remain in the nest and use it as a retreat and foraging area.

Winter: Nest building activity is low. The occupants may abandon this nest if it is small, built badly or poorly located, to find another occupied nest that is larger, or better situated.

Spring. Growth spurt to maturation. Males mature first, then migrate to find other nests. Females mate with brothers and/or immigrating males, and then emigrate.

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