

Revision of Australian *Clistoabdominalis* (Diptera: Pipunculidae)

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Abstract. The 29 Australian species of *Clistoabdominalis* Skevington are revised and a phylogenetic analysis is presented. The following 23 new species are proposed: *Clistoabdominalis ancyllus*, *C. angelikae*, *C. capillifascis*, *C. carnatistylus*, *C. collessi*, *C. colophus*, *C. condylostylus*, *C. danielsi*, *C. dasymelus*, *C. digitatus*, *C. exallus*, *C. gaban*, *C. gremialis*, *C. lambkinae*, *C. lingulatus*, *C. mathiesoni*, *C. nutatus*, *C. octiparvus*, *C. scalenus*, *C. scintillatus*, *C. tasmanicus*, *C. tharra*, and *C. yeatesi*. *Pipunculus picrodes* Perkins is proposed as a junior synonym of *C. trochanteratus* (Becker). Diagnoses and an illustrated key to species are provided. A summary of host records for all Australian species of Pipunculidae is presented to clarify confusion in the literature. Pipunculidae are documented hilltopping for the first time. This mating strategy is used by many species of *Clistoabdominalis* and patterns of hilltopping within the genus are examined.

Introduction

Pipunculidae (big-headed flies) are exclusively endoparasites of Auchenorrhyncha (particularly Cicadellidae, Delphacidae and Cercopidae). Pipunculids can be differentiated from related hover flies (Syrphidae) by the large compound eyes that occupy most of their hemispherical head, distinctive wing venation (no vena spuria, open discal cell), chitinised post-spiracular plate found in the larvae, and their unique life history. Nearly 1300 species of these flies have been described and it is likely that over 2000 species exist (De Meyer 1996; De Meyer and Skevington 2000).

Many researchers have documented the effects of parasitisation on Auchenorrhyncha (for example Whittaker 1969*b*; May 1979; Chandra 1980; Waloff 1980; Lauterer 1981; Huq 1982; Ylonen and Raatikainen 1984; Yano *et al.* 1985). Parasitised hoppers are sometimes recognisable by their swollen abdomens and sluggish movements. Jumping and walking are impaired by a reduction in femur length and damage to the thoracic muscles and nervous system (May 1979). Abdominal sclerites of adults may become poorly pigmented, body size may be reduced or increased, and wing venation is often aberrant. Ovipositor length and the length of claspers in males are reduced in parasitised individuals. In female hosts, the development of ovarioles is halted and mature eggs are rarely found. Spermathecae and accessory glands are also lost. In males, the testes, spermathecal ducts and a large part of the accessory gland are often lost. Only some males are able to copulate and fertilise females (May 1979).

Big-headed flies tend towards polyphagy. Most pipunculid species attack more than one species of host, but show a preference for a particular set of host species. Only two species have been reared from more than one subfamily of host: *Cephalops obtusinervis* Zetterstedt (A. Albrecht unpublished, in Jervis (1980)) and *Clistoabdominalis helluo* (Perkins) (Perkins 1905). Each female big-headed fly lays only one egg inside each host and appears to be able to recognise previously parasitised hosts. Superparasitism and multiple parasitism are rare and survival of more than one pipunculid in these cases is exceptional (Jervis 1980; Waloff and Jervis 1987; Morakote and Yano 1988).

Rates of parasitism vary from fractions of a per cent to 100 per cent in local populations. The importance of pipunculids as a part of the natural regulation of Auchenorrhyncha numbers is undisputedly important. However, few studies have documented the absolute importance of these flies in the control of such populations. Waloff (1975) carried out the most detailed study on host-parasitoid community assemblages involving pipunculids. Whittaker (1969*a*, 1973) performed what are probably the best such studies on the interaction of one species of pipunculid and its host. *Verrallia aucta* (Fallén) was discovered to attack *Philaenus spumarius* (L.) and *Neophilaenus lineatus* (L.) more or less in proportion to their abundance (Whittaker 1973). Each host species is suspected of acting as a reservoir for the parasitoid in years when the other host is less abundant.

Revisionary work on pipunculids is active in most biogeographical regions of the world (for example De Meyer

1989a, 1989b, 1992, 1993; Rafael 1993, 1995, 1996; Rafael and Ale-Rocha 1997; Skevington and Marshall 1998; Rafael and Menezes 1999; Földvári and De Meyer 2000). In contrast, research on the Australian Pipunculidae revolves largely around the work of Perkins (1905, 1906a, 1906b). Fortunately, Perkins's work is of high calibre and has withstood the test of time. Of 26 species discovered by Perkins in Australia, 15 were reared from leafhoppers and one from collected pupae. This degree of biological knowledge associated with a revisionary work is unprecedented and has contributed to relatively stable species concepts. Of the 26 species that Perkins described from Australia, 20 are still recognised today.

Only one new rearing record has been determined since Perkins (1905, 1906a, 1906b) carried out his research. In 1980, Cookson and New reared pipunculids from *Sextius virescens* (Fairmaire) (Auchenorrhyncha, Membracidae). This constitutes the only record of pipunculids from a treehopper host. Despite this apparent stasis with respect to new host-parasitoid relationships, the literature has become somewhat confused. Updates on the identification of Perkins's host material presented by Hardy (1964) are sometimes illogical or confusing. More seriously, rearing records from the Oriental region for widespread Australian species of Pipunculidae contain several errors and are mired in serial mis-citation. A summary of host records for Australian species of Pipunculidae is presented in Appendix 1 to clarify this situation.

Since Perkins completed his revisionary work, few other Australian pipunculids have been described. In 1964, Hardy redescribed Perkins' types but did not otherwise contribute to the knowledge of the fauna. De Meyer and Grootaert (1991) were the first to publish data on the pipunculid subfamily Chalarinae from Australia. In this paper, one new species and one new subspecies of *Jassidophaga* Aczél were described. Six new species of *Cephalops* were described in De Meyer and Grootaerts' (1992) treatment of the genus *Cephalops* Fallén (including *Beckerias* Aczél) in Australia. Kuznetsov (1993) described one new species of *Eudorylas* Aczél from Australia on the basis of a single specimen and Skevington (1999) revised the Australian *Cephalosphaera* Enderlein. As a result of this research, 36 species of big-headed flies are now known to occur in Australia. This may lead to the incorrect assumption that the fauna here is depauperate when it is actually diverse. Based on recent research on Australian Eudorylini, I am confident that at least 200–250 species of Pipunculidae occur in Australia.

Working on the Australian Eudorylini presented a number of problems. First, non-Australian species could not be included in species-level revisions due to the overwhelming size of such a project (516 species are described from nine genera). However, many of these species have been examined in order to avoid creating new synonyms. Second, generic concepts were not well understood within the

Eudorylini. Before any descriptive work could be attempted, the Australian fauna had to be placed into a world context and all genera had to be redefined (Skevington and Yeates 2001). As a result of this research, five genera of Eudorylini are now known from Australia. The current paper revises the most diverse among these taxa, *Clistoabdominalis* Skevington.

Clistoabdominalis is a distinctive, cosmopolitan genus. The Australian members of *Clistoabdominalis* form a monophyletic group when included with *C. macropygus* (de Meijere), *C. roralis* (Kertész), and many undescribed Australasian and Oriental species (Skevington and Yeates 2001). A diagnosis of *Clistoabdominalis* and a key to genera of pipunculids is included in Skevington and Yeates (2001). Australian *Clistoabdominalis* species can be easily recognised from all other Australian pipunculids by the following autapomorphies: membranous area absent (*cf.* Fig. 1E); syntergosternite 8 swollen (*cf.* Fig. 1E); lateral fan absent on tergite 1 (*cf.* Fig. 1E); hypandrium deflected left at nearly 90° to phallic guide (*cf.* Fig. 1F); phallus with ducts distinctly separated only in distal one third, but actually forming 3 separate tubes distal to sperm pump (*cf.* Fig. 1F); ejaculatory apodeme large, with basal rosette (*cf.* Fig. 1F).

***Clistoabdominalis* and hilltopping**

The acquisition of new material was an important part of this research, as relatively few specimens of Australian Pipunculidae existed in collections. The discovery of hilltopping in Pipunculidae was pivotal in that it supported the rapid accumulation of material for this revisionary work. Hilltopping is the behaviour in which female insects move to elevated landmarks solely for the purpose of mating with males that have aggregated there (Shields 1967; Alcock 1987; Yeates and Dodson 1990). It is a widespread mating system among insects and appears to have developed in groups that are rare, parasitic, predacious on ephemeral prey, or whose larval foodplants are scattered or rare (Shields 1967; Scott 1968; Thornhill and Alcock 1983). Under these conditions males that attempted to find females at feeding, oviposition or emergence sites might have to expend unusually large amounts of time and energy for a low return in the form of contacts with potential mates. Despite the fact that pipunculids are likely candidates for this behaviour they have not previously been reported to hilltop. The patchy and ephemeral nature of their food source (honeydew) combined with the fact that only a single adult emerges from its host suggests that there will rarely be clusters of emerging, foraging, or ovipositing female pipunculids available for males to locate easily.

Although there is no published record of hilltopping in pipunculids, this mating strategy is a prevalent behaviour in Australian big-headed flies. Hilltop collecting is an excellent way to sample much of the pipunculid diversity in an area and often provides large numbers of specimens – of great use

when examining species level variation for revisionary systematics. For example, 973 specimens of Australian Eudorylini were obtained from 37 museums around the world. In three years, I collected 3053 additional specimens, 2249 of these on hilltops (74 %). Despite considerable effort, I added only 804 specimens using traditional methods of Malaise traps and sweeping. These methods appear to be far less successful in Australia than in many Holarctic sites where I have sampled. The only drawback to hilltop collecting is that most of the specimens obtained are male. Only 29 of 2249 Eudorylini specimens collected on hilltops are female. Association of the sexes in pipunculids is often difficult and hilltop collecting does not often help to unravel this problem.

Not all species or even genera can be sampled solely by hilltop collecting (Skevington unpublished data). Based on the 2594 Australian specimens used in this revision, *Clistoabdominalis* is well represented on hilltops with over 60 % of both individual specimens and species captured at these landmarks. Patterns of hilltopping within species of *Clistoabdominalis* are discussed in the 'Remarks' sections below.

Prominent, isolated, conical hilltops with heath or dry sclerophyll vegetation were found to be the best for collecting. Mount Moffatt (Carnarvon Natl Pk, Queensland, 25°03'35"S, 148°02'38"E, 1097 m) was by far the most productive site sampled. One thousand five hundred and eighty-one individuals from at least 28 species and 12 genera were collected there during six days in 1997 and 1998. The species limits have not yet been established for five of the 12 genera, so the species diversity is doubtlessly much higher. Although other hills may not rival Mount Moffatt, many different types of prominences are often productive. Conspicuous parts of ridges to hilltops that protruded only slightly from the surrounding flat landscape often had dozens of hilltopping pipunculids on any one visit. Hilltops with scattered trees and shrubs at or near a definite summit were easiest to sample. Densely vegetated or completely unvegetated hilltops were unproductive. Pipunculids were usually found hovering around shrubs that were nearest to the summit. Most of the time they were in dappled light, rather than in direct sun.

Materials and methods

Specimens obtained from the following collections were used either directly in this revision or indirectly for comparative purposes (abbreviations follow Evenhuis (2000)).

AMNZ	Auckland Museum Entomology Collections, Auckland, New Zealand
AMS	Australian Museum, Sydney, Australia
ANIC	Australian National Insect Collection, Canberra, Australian Capital Territory, Australia
ASCU	Orange Agricultural Unit, Orange, New South Wales, Australia
BMNH	The Natural History Museum, London, United Kingdom
BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii, USA
CAS	California Academy of Sciences, San Francisco, California, USA

CNC	Canadian National Collection of Insects, Ottawa, Canada
CMNZ	Canterbury Museum, Christchurch, New Zealand
DEBU	University of Guelph Insect Collection, Guelph, Ontario, Canada
EIHU	Hokkaido University, Sapporo, Japan
FICB	Forest Research Institute, Lae, New Guinea
GDCB	Greg Daniels Collection, Brisbane, Queensland, Australia
INHS	Illinois Natural History Survey, Champaign, Illinois, USA
INPA	Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil
ISNB	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium
KSUC	Kansas State University, Manhattan, Kansas, USA
MAGD	Northern Territory Museum of Arts and Sciences, Darwin, Northern Territory, Australia
MNRJ	Universidade Federal do Rio de Janeiro Museu Nacional, São Cristóvão, Rio de Janeiro, Brazil
MRAC	Musée Royal de L'Afrique Centrale, Tervuren, Belgium
MVMA	Museum of Victoria, Abbotsford, Victoria, Australia
MZLU	Lund University, Lund, Sweden
NZAC	New Zealand Arthropod Collection, Auckland, New Zealand
QDPC	Queensland Department of Primary Industries, Brisbane, Queensland, Australia
QM	Queensland Museum, Brisbane, Queensland, Australia
SAM	South Australian Museum, Adelaide, South Australia, Australia
SEMC	Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA
SNMC	Slovenské Národné Muzeum, Bratislava, Slovak Republic
TAMU	Texas A&M University, College Station, Texas, USA
TDAH	Tasmanian Department of Agriculture, Hobart, Tasmania, Australia
UQ	University of Queensland Insect Collection, Brisbane, Queensland, Australia
USNM	National Museum of Natural History, Washington DC, USA
WADA	Western Australian Department of Agriculture, Perth, Western Australia
WAMP	Western Australian Museum, Perth, Western Australia
WARI	Waite Agricultural Research Institute, Adelaide, South Australia
ZMAN	Instituut voor Taxonomische Zoölogie, Zoölogisch Museum, Universiteit van Amsterdam, Amsterdam, Netherlands
ZMUC	Zoological Museum, University of Copenhagen, Copenhagen, Denmark

The following abbreviations are used in the 'Material examined' sections: I – Island; Mt – Mount, Mountain; Mts – Mountains; NP – National Park; SF – State Forest; Ck – Creek; R. – River; N – north; S – south; E – east; W – west; (and combinations of N, S, E, and W). Collectors names are abbreviated in material examined sections as follows: DB – Daniel J. Bickel; PB – Pat Bouchard; CB – Chris Burwell; BC – B. K. Cantrell; JC – J. C. Cardale; DC – Don H. Colless; GD – Greg Daniels; GAD – Greg and Alice Daniels; TD – Thomas W. Davies; SE – S. Evans; EE – E. M. Exley; EF – E. A. Fonseca; JF – J. A. Forrest; HF – H. Frauca; SG – S. D. Gaimari; JLG – J. L. Gressett; LMG – L. and M. Gressett; JG – J. Grimshaw; AH – Anthony Hiller; DSH – D. S. Horning, Jr.; GH – G. A. Holloway; MI – M. E. Irwin; CL – Chris Lambkin; ZL – Z. Liepa; RL – R. Lynch; SM – S. A. Marshall;

MM – Michael Mathieson; DM – David K. McAlpine; GM – G. B. Monteith; IN – I. D. Naumann; AN – A. Neboiss; KN – K. R. Norris; SP – S. J. K. Paramonov; FP – F. A. Perkins; NP – Narelle Power; ER – E. F. Riek; ES – E. I. Schlinger; MS – Margaret A. Schneider; JS – Jeff Skevington; JAS – Jeff and Angela Skevington; JRS – Jeff and Richard Skevington; DW – Damien White; SW – Shaun Winterton; WW – W. W. Wirth; DY – David K. Yeates; AZ – A. Zwick. The following abbreviations for Eudorylini taxa are used throughout the text: *Clistoabdominalis* (C.), *Dasydorylas* (D.), and *Eudorylas* (E.).

Specimens captured in traps were collected into 80% ethanol. Specimens netted by hand were either killed with potassium cyanide or by immersion in absolute ethanol. Absolute alcohol was used so that some specimens could be used in molecular studies. Specimens killed with cyanide were pinned later the same day. A number of pinning techniques were used. The best method for obtaining views of the insect's genitalia involves double mounting. Pinning through the right mesopleuron with a minuten before pinning to pith is more expensive and time consuming than pointing, but produces excellent specimens that are less likely to require dissection than other pinning techniques. Specimens collected into alcohol were dried with a critical point drier and then pointed.

Dissection of male genitalia was necessary. The abdomen was removed and heated in lactic acid (approximately 85%) for roughly 30 minutes. Lactic acid was chosen as a clearing agent due to its many advantages over potassium hydroxide (KOH) or sodium hydroxide (NaOH) (Skevington and Marshall 1998). The macerated abdomen was then removed from the acid and placed directly into clean glycerin. The abdomen and dissected terminalia are stored in glycerin in plastic microvials on the same pin as the source specimen.

Once the genitalia were cleared, dissection involved separating syntergosternite 8 from the remainder of the abdomen. Removal of syntergosternite 8 was also necessary to facilitate examination of the sperm pump, ejaculatory apodeme, and parts of the hypandrium. Genitalia thus prepared were examined in glycerine placed on depression slides.

Drawings were made using a drawing tube mounted on a Zeiss Axioskop compound microscope or a Zeiss Stemi SV 6 dissecting microscope. Measurements were made using a graticule. Scale bars on the figures are all 0.1 mm. When possible, at least six specimens from each species were used to obtain the recorded values. When fewer specimens were available, all were measured.

All specimens are labelled with a unique reference number in the format J. Skevington Specimen #n. This has been shortened to follow the format #n throughout the text. These numbers are used in a database of primarily Australian Pipunculidae specimens maintained by the author (available upon request). Material examined is listed in order of increasing latitude within states. States are organised clockwise starting from the Northern Territory. Where square brackets are used in the material examined list, they enclose inferred data or notes that are not present on specimen labels. The lists of non-type specimens examined are presented in summarised form. A fully comprehensive version of these data can be obtained from the author, or from CSIRO Publishing, either in printed form or electronic form as an Accessory Publication, at <http://www.publish.csiro.au/journals/it/>. Species are described in alphabetical order to facilitate cross-referencing from the key. RangeMapper (Philip 1994) was used to create species distribution maps.

Morphological terminology and measurements

The terminology used here follows Skevington and Yeates (2001) and is illustrated in Fig. 1. Body length was measured as a sum of the distances from the front of the head (excluding antennae) to the tip of the scutellum and from there to the tip of syntergosternite 8. Measurements made in this way minimise variability that is introduced by deflection of the abdomen.

The length of the bristles on the pedicel is of phylogenetic significance. To quantify the length of these bristles, ratios of pedicel width:bristle length were measured (Fig. 1B). Throughout the text the ratio of pedicel width:dorsal bristle length is expressed as PW:DBL and that of the pedicel width:ventral bristle length is expressed as PW:VBL. In females, the frontal eye facets are considerably enlarged in relation to other eye facets. The degree of front facet enlargement is relatively consistent within species. A ratio of the diameter of the largest eye facets to the width of the lower frons is used to quantify the degree of facet enlargement (FFE). The width of the frons in females usually varies throughout its length. Measurements are taken at the widest and narrowest points on the frons and are expressed as a ratio of widest to narrowest. In the key and in species descriptions this ratio is referred to as FR.

Some wing characters are of phylogenetic utility. The ratio of lengths of costal section 4 to costal section 3 is recorded as the costal section ratio (C₄:C₃; Fig. 1A). The position of the r-m crossvein is useful for characterising some pipunculid clades. The position of this crossvein is expressed herein through the M-sector ratio, that is the ratio of sector 3 of the M vein to sector 2 (S₃:S₂; Fig. 1A).

The degree of symmetry of tergite 5 in males is quantified by measuring the length of the right and left sides and presenting the measurements in the ratio T5R:T5L (Fig. 1E). Similarly, epandrium symmetry is represented by ER:EL (Fig. 1C). A ratio of the width of syntergosternite 8 (WS8) to the length of tergites 3–5 (LT35) is represented by WS8:LT35 (Fig. 1E), the width of tergite 5 to syntergosternite 8 is WT5:WS8 (Fig. 1E), the length of tergites 3–5 to the length of syntergosternite 8 is LT35:LS8 (Fig. 1E), and the width of the subepandrial sclerite is expressed as a ratio of the width of the subepandrial sclerite to the epandrium (WSES:WEP; Fig. 1C).

In general, there is little intraspecific variability in ovipositor shape. The functional significance of this variation is unclear; there appears to be no obvious relationship between ovipositor shape and the host(s) attacked. Viewing the ovipositor laterally will enable assessment of the degree of curvature of the piercer and the relative lengths of component parts of the piercer and base. The degree of curvature must be assessed visually by comparing specimens to the figures. Because of the importance of the ovipositor in species identification, all drawings for each genus are included together. Several measurements of the ovipositor are made to avoid purely visual comparisons and to help with the identification of species with structurally similar ovipositors. Ovipositor length (OL) is measured in a straight line from the piercer tip to the point where the ovipositor base articulates ventrally with sternite 6 (Fig. 1J). Piercer length (PL) is measured as a straight line from the proximal edge of the cerci to the tip of the piercer (Fig. 1J). This is represented as part of the ratio of ovipositor length to piercer length (OL:PL). The length of the ovipositor base (B) is measured as a straight line from the proximal end of the cerci to the point where the ovipositor base articulates ventrally with sternite 6 (Fig. 1J). This is given as part of the ratio of the length of the ovipositor base to piercer length (B:PL). A ratio of body length to ovipositor length (BL:OL) is also given in all descriptions.

Exemplar selection

There is evidence from the Eudorylini tribal phylogenetic analysis that the Australasian and Oriental species of *Clistoabdominalis* form a monophyletic group within the genus (Skevington and Yeates 2001). All of the described species from this lineage except *C. roralis* and *C. macropygus* are included in this analysis. *Clistoabdominalis roralis* and *C. macropygus* both clearly belong to the *C. helluo*-group (see below). This lineage is characterised by a remarkable degree of morphological conservatism. There are few characters that serve to delimit relationships within the *helluo*-group and the phylogeny within the group is poorly resolved as a result. Nothing can be gained by adding more species to this clade, so these two non-Australian taxa were omitted.

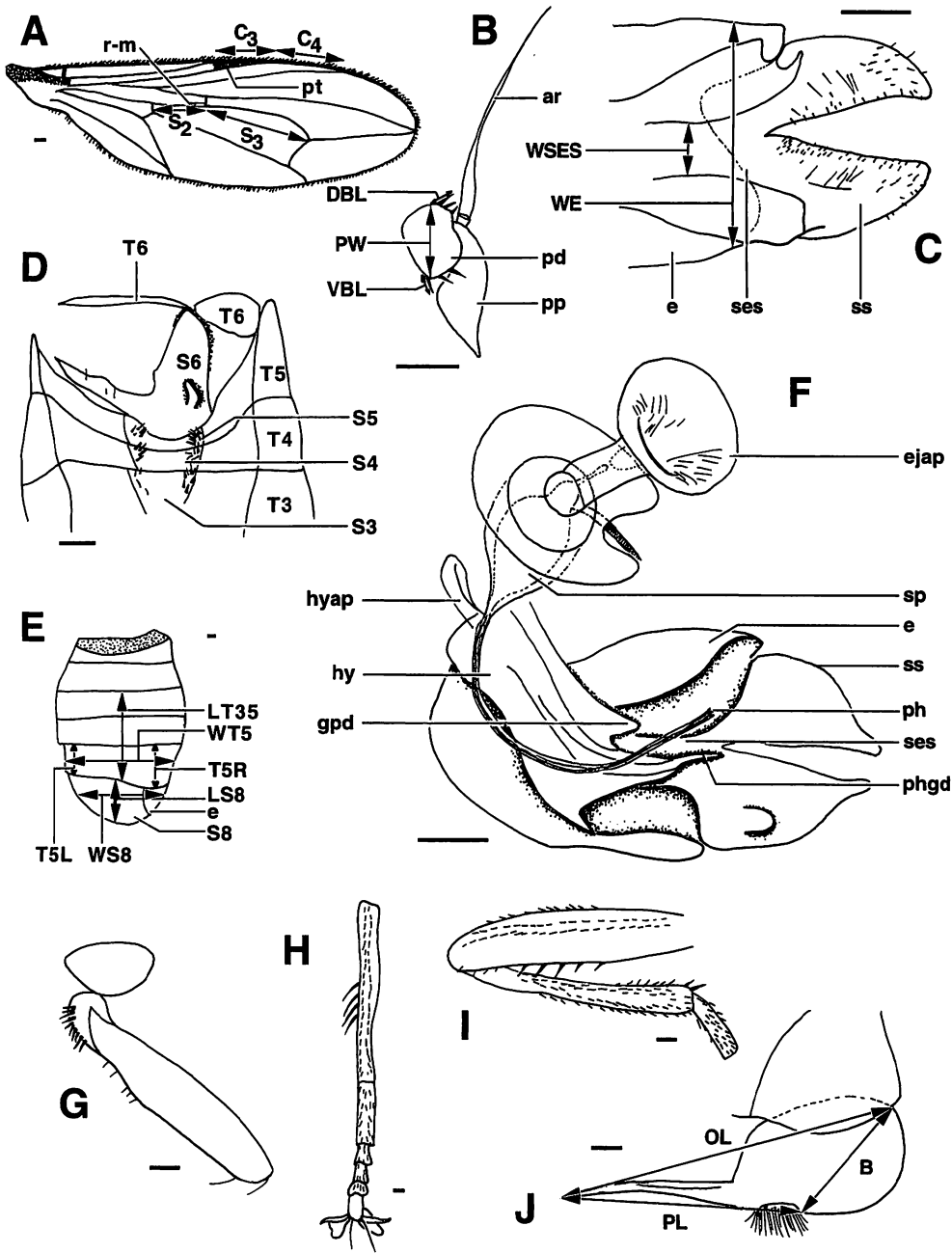


Fig. 1. Measurements and morphology. *A*, *Clistoabdominalis helluo* (#3835), right wing of male; *B*, *C. helluo* (#3835), right lateral of left antenna of male; *C*, *C. gremialis* (#7279), dorsal view of male epandrium and surstyli; *D*, *C. gremialis* (#7279), ventral view of male abdomen; *E*, *C. helluo* (#777), dorsal view of male abdomen; *F*, *C. helluo* (#386), dorsal view of male terminalia with S8 removed; *G*, *C. helluo* (#4101), anterolateral view of coxa, trochanter and femur; *H*, *Cephalops cochleatus* (#2358), dorsal view of hind tibia and tarsi; *I*, *Eudorylas mutillatus* (#4306), anterolateral view of mid femur, tibia and first tarsomere; *J*, *Clistoabdominalis capillifascis* (#800), left lateral of ovipositor. ar = arista; B = length of ovipositor base; C₃ = length of costal section 3; C₄ = length of costal section 4; DBL = dorsal bristle length; ejap = ejaculatory apodeme; e = epandrium; gpd = gonopod; hy = hypandrium; hyap = hypandrial apodeme; LS8 = length of syntergosternite 8; LT35 = length of tergites 3–5; OL = ovipositor length; pd = pedicel; ph = phallus; phgd = phallic guide; PL = piercer length; pp = post pedicel; pt = pterostigma; PW = pedicel width; r-m = radial-medial vein; S = sternite; S₃ = sector 3 of dm; S₂ = sector 2 of dm; S8 = syntergosternite 8; ses = subepandrial sclerite; sp = sperm pump; ss = surstyli; T = tergite; T5L = length of left side of T5; T5R = length of right side of T5; VBL = ventral bristle length; WE = maximum width of epandrium; WT5 = width of tergite 5; WS8 = width of S8. Scale bars = 0.1 mm.

Character polarity was based on outgroup comparison (Nixon and Carpenter 1994). As shown by Skevington and Yeates (2001), *Eudorylas* is the putative sister-group of *Clistoabdominalis*. Two species of *Eudorylas* plus one species from the more distantly related genus *Dasydorylas* are used as outgroups for the analysis (*E. mutillatus* (Loew), *E. fuscipes* (Zetterstedt), and *D. eucalypti* (Perkins)).

Character selection

Seventy-seven characters comprising 177 states were used in this analysis (Appendices 2 and 3). Sixty-three characters are coded as binary, eleven are coded with three states, two are coded with four states, and character 23 is coded with ten states. All characters were equally weighted and all multistate characters were treated as non-additive. Eighteen autapomorphies were included in the analysis where they are of potential value for future analyses or where they may act as synapomorphies when more exemplars are included (Yeates 1992).

Phylogenetic analysis

Parsimony analysis was performed with PAUP* (Swofford 1999) and replicated with PAUP (Swofford 1993). The heuristic search procedure was used with stepwise-addition and 500 random replications, tree bisection-reconnection branch swapping, MULPARS, and random addition of taxa. Successive approximations weighting was applied according to the rescaled consistency index.

Evidential support for different clades was assessed using branch support (BrS; Bremer 1994) calculated by the program TreeRot (Sorenson 1999). Branch support indicates the number of extra steps from the most parsimonious solution at which clade(s) fail to be resolved in the consensus cladogram as successively longer cladograms are examined. A high value indicates good support for a clade. Cladogram measures such as the consistency index (*CI*), retention index (*RI*), and rescaled consistency index (*RC*) were used to evaluate the fit of the data to the cladogram. Character evolution was examined using the program MacClade (Maddison and Maddison 1992). Characters were mapped onto cladograms for output using Clados (Nixon 1992). Characters for the phylogenetic analysis are listed in Appendix 2.

Phylogenetics of *Clistoabdominalis*

Analysis of the matrix (Appendix 3) with PAUP* produced five most parsimonious cladograms (length 151 steps; *CI* = 0.66; *RI* = 0.84; *RC* = 0.56). The *CI* excluding uninformative characters was 0.62. A consensus of the most parsimonious cladograms is presented in Fig. 2 along with branch supports. Successive and implied weighting are of little help in resolving the polytomy within the *helluo*-group (implied weighting gave the same result as successive weighting with $k = 2, 6$, and 10). Both place *C. angelikae* in the position shown in Fig. 3, but provide no additional resolution within the group. As a result, I arbitrarily chose one of the three most parsimonious cladograms that places *C. angelikae* in the above position on which to illustrate character evolution (Fig. 3).

Despite low branch support (BrS 1) for the *helluo*-group, it is one of the most distinctive Eudorylini clades. All members, except for *C. eutrichodes*, have a row of spines on the hind trochanters. *Clistoabdominalis eutrichodes* is undoubtedly part of this lineage because of its remarkable similarity to *C. beneficiens*. These species are clearly sister taxa despite the perception given by low branch support

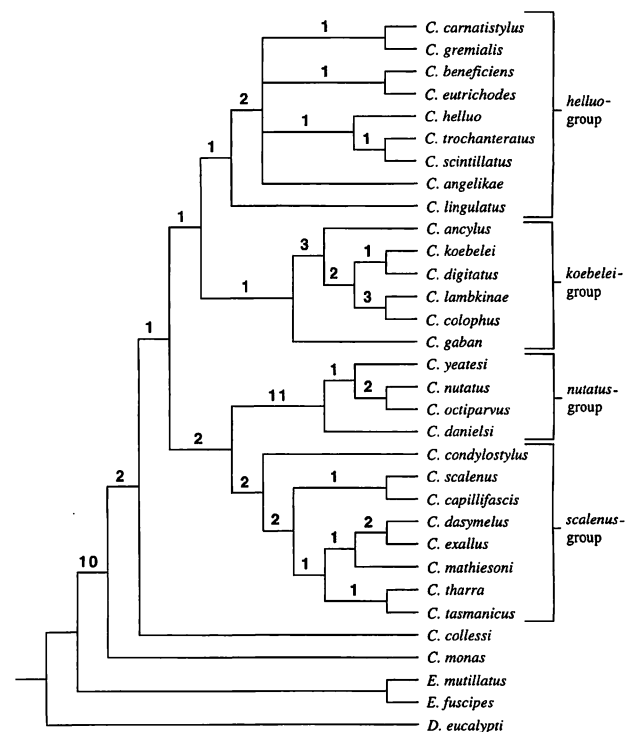


Fig. 2. Strict consensus tree of Australian *Clistoabdominalis* relationships (from five most parsimonious trees). Numbers refer to branch supports.

(BrS 1). This is a classic illustration of the degree of morphological conservatism in the *helluo*-group. Despite the degree of similarity between these two species, there is only one good synapomorphy (character 31, presence of a sharp ridge on sternite 6) linking the species. Gestalt and overall similarity clearly suggest that the two species are sister taxa, but no other synapomorphies could be discovered. A similar situation exists between *C. scintillatus* and *C. trochanteraus*. These taxa are identical except for differences in vestiture and yet have a branch support of one because only one subtle surstylus character provides synapomorphic evidence of their relationship (character 46, Fig. 3).

The *koebelei*-group, excluding *C. gaban*, is a well-resolved lineage that is clearly the sister of the *helluo*-group (again, despite low branch support I have considerable faith in this grouping; Fig. 2). *Clistoabdominalis gaban* is a typical basal taxon that could logically fit into either the *helluo* or *koebelei*-group. Its position creates much of the homoplasy that weakens the support for both of these lineages. There are no convincing synapomorphies that place *C. gaban* in the *koebelei*-group. The weight of evidence simply leans more heavily in that direction. Without *C. gaban*, the *koebelei*-group is supported by three excellent synapomorphies (a distinctive fin on sternite 6, bulbous cerci, and a prominent hook at the base of the right surstylus).

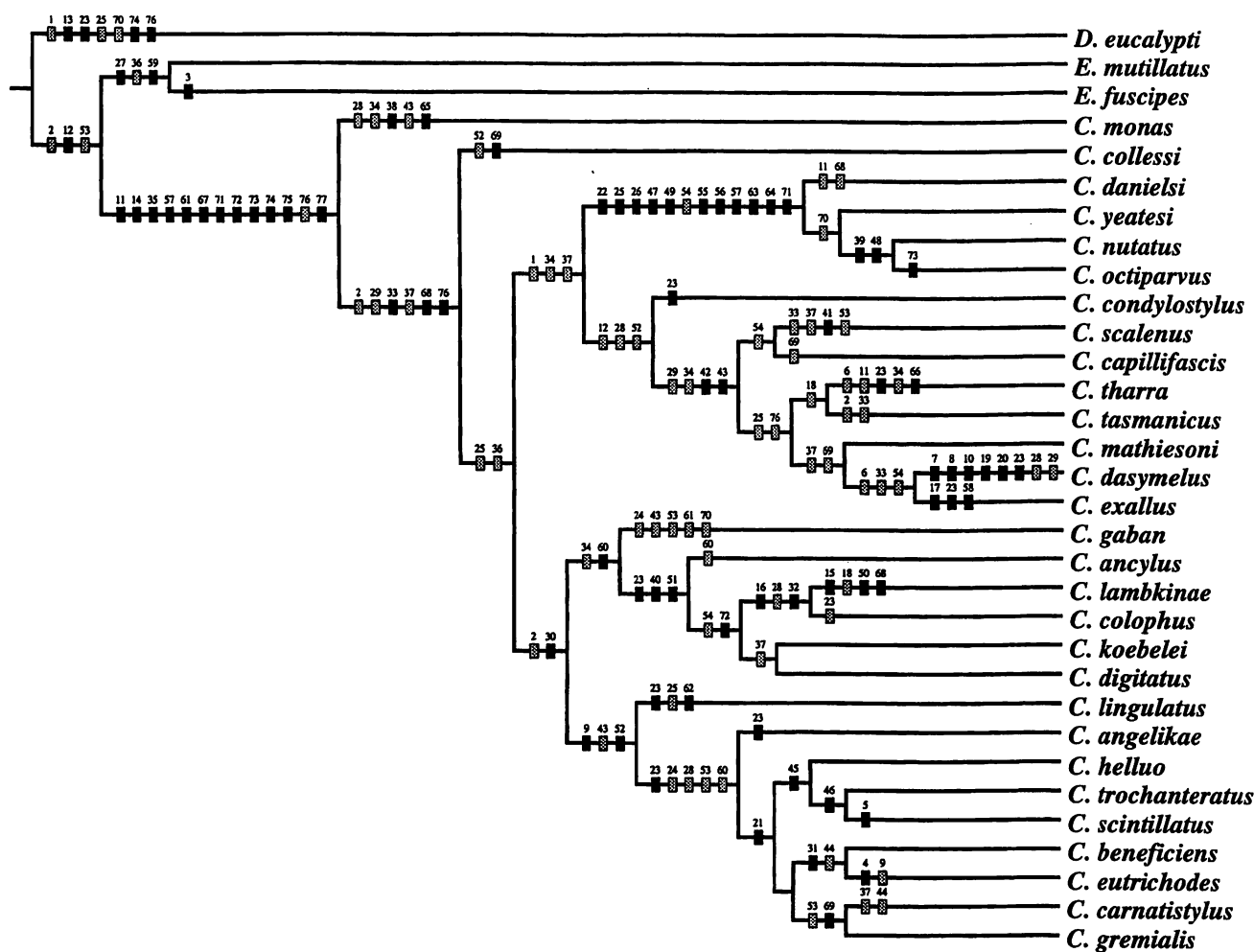


Fig. 3. One of five most parsimonious cladograms of Australian *Clistoabdominalis* relationships showing character distributions. Black hashes – forward changes; grey hashes – homoplasious changes, including reversals.

The *koebelei* + *helluo*-groups together are the sister of the *nutatus* + *scalenus*-groups (Fig. 2). Of the latter two clades, the *nutatus*-group has unequivocal support (BrS 11). Twelve synapomorphies support the lineage, most of them unique to this group. Of the four taxa within the *nutatus*-group, *C. danielsi* is the most divergent and is the sister to the remaining taxa. *Clistoabdominalis yeatesi*, *C. nutatus*, and *C. octiparvus* are quite similar but their relationship is supported by only one synapomorphy, the presence of a very narrow phallus (character 70; Fig. 3).

The *scalenus*-group excluding *C. condylostylus* is supported by four synapomorphies (characters 29, 34, 42, and 43; Fig. 3). Relationships among members of this group are poorly resolved.

The phylogenetic position of *C. collessi* is also poorly supported and strongly influenced by differential taxon sampling. It is probably either a basal relative of the lineage that includes the *helluo* and *koebelei*-groups or is correctly placed in Fig. 2.

Clistoabdominalis monas appears to be the basal member of the Australian *Clistoabdominalis* group of species. Future work exploring the phylogeny of this lineage should aim to include specimens of this putative basal taxon in the analysis. Given the apparent scarcity (six specimens) and lack of biological data for this species, this could be a challenge.

Key to Australian *Clistoabdominalis* species

As with most pipunculids, males can be identified with absolute confidence only after dissection and examination of the genitalia. Despite this, *Clistoabdominalis* has more useful external characters than many genera of pipunculids and most species can be identified with reasonable confidence without dissection.

Only 10 of the 29 species of Australian *Clistoabdominalis* have known females. The key to females provided here is therefore extremely tentative. Association of females with

males is necessary for confident identification of most species.

1. Males 2
 – Females 30
- 2(1). Front and mid tibiae with apical spines (*cf.* Fig. 1*I*) 3
 – No apical spines on tibiae 24
- 3(2). Pedicel with long bristles, PW:BL, <3:1; sytergosternite 8 small, LT3–5:LS8, >3.5:1 4
 – Pedicel with short bristles, PW:BL, >3:1; sytergosternite 8 swollen, LT3–5:LS8, <3.5:1 8
- 4(3). Fore and hind femora with rows of ventral spines present . . . 5
 – Ventral spines on fore and hind femora absent 6
- 5(4). Scutum brown pollinose dorsally; scutellum brown pollinose on posterior one half, densely silver pollinose along anterior edge; wing with r-m crossvein located basally in discal cell; S₃:S₂, 1.8:1; body length 4.4 mm; tergite 6 widest dorsally, with wide tongue projecting ventrally, forking ventrally and expanded into wider plate laterally (Fig. 15*A*); sternite 6 narrow, with no modifications (Fig. 15*A*); right surstylus greatly enlarged, with wide lateral arm projecting dorsally and long, sharp, medial finger pointed dorsomedially, left surstylus very small, simple, essentially rectangular, but tapering considerably distally (Fig. 15*B–E*); phallic guide long and narrow, deflected ventrally at nearly 90° so that tip extends through base of surstyli and emerges ventrally (Fig. 15*B–C*); phallus darkly pigmented; ducts clearly separated well back from tips (Fig. 15*B–C*) *C. danielsi*, sp. nov.
 – Scutum with two silver dorsocentral stripes; scutellum brown pollinose medially, silver-grey pollinose around edges; wing with r-m crossvein located medially in discal cell; S₃:S₂, 1.0–1.2:1; body length 5.7–6.4 mm; tergite 6 with ventral half of tergite swollen into thin, darkly sclerotised structure with wide protuberance projecting anteriorly, easily visible in ventral view without dissection (Fig. 35*B*); sternite 6 with right side developed into long, anteriorly projecting, finger-like protuberance, easily visible in ventral view without dissection (Fig. 35*B*); right surstylus larger than left, with small medial swelling along inner edge, left surstylus with triangular swelling along inner edge near apice, densely covered with short hairs over entire medial surface (Fig. 35*E*); phallic guide in same plane as surstyli (Fig. 35*E*); phallus lightly pigmented, ducts closely associated almost to tips (Fig. 35*E–G*) *C. tharra*, sp. nov.
- 6(4). Right surstylus greatly enlarged, with distal lateral upturned projection and long medial finger; left surstylus small, simple, rectangular (Fig. 31*A,D–E*); hypandrial apodeme positioned dorsal to hypandrium, with narrow dorsal extension projecting laterally (Fig. 31*C–D*); phallus supported medially by darkly pigmented membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 31*D*) *C. octiparvus*, sp. nov.
 – Surstyli not as above; hypandrial apodeme positioned ventral to hypandrium, with narrow dorsal extension projecting posteriorly (*cf.* Fig. 38*F–G*); phallus not supported by hypandrial curtain 7
- 7(6). Right surstylus greatly enlarged, upturned on right distal edge, tip twisted medially (Fig. 38*A,D–E*) *C. yeatesi*, sp. nov.
 – Right surstylus greatly enlarged, with distal medial and lateral upturned projections (Fig. 30*A,C–D*) *C. nutatus*, sp. nov.
- 8(3). Thorax and abdomen densely silver pruinescent *C. scintillatus*, sp. nov.
 – Thorax and abdomen with mixed brown and silver vestiture and many glabrous areas, never entirely shining silver as above 9
- 9(8). Entire dorsum of thorax and abdomen covered with long hairs (Fig. 19*E*) *C. eutrichodes* (Perkins)
 – Thorax mostly bare, with two dorsocentral rows of hairs and a patch of anterolateral hairs; abdomen with short hairs 10
- 10(9). First segment of hind trochanter with row of small spines (*cf.* Fig. 1*G*) 11
 – Hind trochanter with no such spines 17
- 11(10). Epandrium pruinescent; tergite 6 with three ventral protuberances (Fig. 11*B*); left surstylus expanded laterally into distinctive flap (Fig. 11*C*); sperm pump cylindrical, very elongate (Fig. 11*F*) *C. carnatiastylus*, sp. nov.
 – Epandrium glabrous, shining; tergite 6 with two or fewer protuberances; left surstylus and sperm pump not as above 12
- 12(11). Sternites 2–5 with bristles forming clusters in posterolateral corners (Fig. 22*B*); tergite 6 with a single ventral protuberance (Fig. 22*B*); surstyli symmetrical, short, simple (Fig. 22*C*) *C. gremialis*, sp. nov.
 – Sternites 2–5 with scattered peg-like bristles or longer hairs; tergite 6 and surstyli not exactly as above 13
- 13(12). Tergite 6 with a single, long, sinuous ventral protuberance, easily visible ventrally without dissection (Fig. 7*B*); surstylus rectangular, upturned, asymmetrical, right surstylus wider (Fig. 7*A,C*); sperm pump elongate, pipe-shaped (Fig. 7*C*) *C. angelikae*, sp. nov.
 – Protuberances on tergite 6 small, not visible without dissection; surstyli and sperm pump not as above 14
- 14(13). Tergites 2–5 shining black, only sparsely pollinose dorsally; sternite 6 raised into ridge medially on left side (Fig. 8*B*); left surstylus expanded laterally (Fig. 8*C*) *C. beneficiens* (Perkins)
 – Tergites 2–5 densely pruinescent, never appearing shining black; sternite 6 without medial ridge (*cf.* Fig. 24*B*); left surstylus not expanded laterally 15
- 15(14). Wing with r-m crossvein located medially to submedially in discal cell; S₃:S₂, 1.1–1.6:1; tergite 6 with raised ventral ridge (Fig. 27*B*); sternite 6 very wide on right side (Fig. 27*B*); surstyli symmetrical, indented medially, with only two or three long dorsomedial bristles (Fig. 27*E–F*); phallic guide asymmetrical with large distally projecting tongue on the right side (Fig. 27*E–G*) *C. lingulatus*, sp. nov.
 – Wing with r-m crossvein located basally in discal cell; S₃:S₂, >1.6:1; tergite 6 with paired ventral protuberances, right protuberance much smaller than left one (*cf.* Fig. 24*B*); sternite 6 narrower on right side (*cf.* Fig. 24*B*); surstyli and phallic guide not as above 16
- 16(15). Surstyli asymmetrical, pigmented evenly throughout; right surstylus swollen into distinctive basal ridge (Fig. 24*C*) *C. helluo* (Perkins)
 – Surstyli symmetrical, with somewhat elongate, pale tips; right surstylus not swollen basally (Fig. 37*C*) *C. trochanteratus* (Becker)
- 17(10). Tegula with more than five hairs; sternites 3–5 narrow, V-shaped, with very long, posterolateral bristles (Fig. 21*D*); cerci with distinctive posterodorsal, sclerotised swelling (Fig. 21*A,C*); right surstylus triangular; left surstylus L-shaped, with long, thin distal arm and small, triangular protuberance at base (Fig. 21*A,C*) *C. gaban*, sp. nov.

- Tegula with two or three hairs; sternites, cerci and surstyli not as above 18
- 18(17). Right surstylus with basal hook bending dorsomedially (*cf.* Fig. 25B–C) 19
- No hook on base of right surstylus 23
- 19(18). Epandrium pruinose 20
- Epandrium glabrous, shining 21
- 20(19). Subepandrial sclerite with a hairy, finger-like projection at the base of the right surstylus (Fig. 18C–D)
..... *C. digitatus*, sp. nov.
- Subepandrial sclerite with no such projection at base (Fig. 25B–C) *C. koebelei* (Perkins)
- 21(19). Tergites 2–4 usually entirely brown pollinose dorsally; tergite 6 with distinctive raised ventromedial protuberance (Fig. 4A); surstyli short and stubby, right surstylus with distinctive, wide, basal hook (Fig. 4C–D); hypandrial apodeme narrow, with ring clasping base of sperm pump arising distally (*cf.* Fig. 22F) *C. ancylus*, sp. nov.
- Tergites 2–4 densely brown pollinose dorsally, with silver posterolateral patches extending well up onto posterior corners of dorsum; tergite 6 and surstyli not exactly as above; hypandrial apodeme wide, with ring clasping base of sperm pump arising medially (*cf.* Fig. 25E) 22
- 22(21). Sternites 2–5 with normal degree of sclerotisation, not shaped as below (Fig. 13A); sternite 6 swollen internally (Fig. 13A); with right lateral C-shaped protuberance sweeping out posterolaterally into pointed tip (Fig. 13A); tergite 6 with no protuberances (Fig. 13A); surstyli with distinctive dorsal ridges, basal protuberances absent; right surstylus with long, thin basal hook (Fig. 13B–C)
..... *C. colophus*, sp. nov.
- Sternites 2–5 very darkly sclerotised (Fig. 26D); sternite 2 small, triangular, with dark medial keel protruding internally (Fig. 26D); sternite 3 very large, with anteromedial gap, edges diverging anterolaterally, with dark medial keel protruding internally (Fig. 26D); sternite 4 very wide, narrow, shallowly V-shaped (Fig. 26D); sternite 6 with raised protuberances on each side of depression, medial protuberance conical, lateral protuberance raised into ridge adjacent to right section of sternite 5, sweeping out posterolaterally into pointed tip (Fig. 26D); tergite 6 with finger-like ventromedial protuberance (Fig. 26D); surstyli with small basal protuberances, dorsal ridges absent; right surstylus with wider basal hook (Fig. 26A,C) *C. lambkinae*, sp. nov.
- 23(18). Pedicel with short dorsal and ventral bristles, PW:BL, >3.5:1; tergite 7 easily visible from above; sternite 6 with three protuberances, a small ventral finger hidden under left side of tergite 5, a stubby dorsal fin projecting anteriorly, and a long, thin, annulated, dorsolateral finger projecting anteriorly (Fig. 29E); epandrium swollen, rounded ventrally and on right side with distal end projecting over base of right surstylus (Fig. 29D); surstyli slightly asymmetrical; curled up on outer edges with distinctive row of hairs on outer surface, with distal, medial corners pointed and projecting sharply inward; base of surstyli upturned medially (Fig. 29B–D); phallus darkly pigmented, ducts clearly separated well back from tips; tips of ducts pointed (Fig. 29A); hypandrial apodeme reduced, very narrow, with weakly sclerotised ring clasping base of sperm pump (Fig. 29A); sperm pump translucent, globular, separate from base of ejaculatory apodeme (Fig. 29A); ejaculatory apodeme three-sided, with distinctive three-lobed base darkened medially (Fig. 62A,F)
..... *C. monas* (Perkins)
- Ventral bristles of pedicel much shorter than dorsal bristles; PW:DBL, 2.8–3.0:1, PW:VBL, 4.7–5.0:1; tergite 7 not visible from above; sternite 6 with no protuberances (Fig. 12B); epandrium not swollen; hypandrium with wide dorsal flaps attaching to phallic guide (Fig. 12D); surstyli asymmetrical, left surstylus more tapered distally, swollen basally with lateral protuberance (Fig. 12D); phallus with normal pigmentation, tips of phallic ducts with swollen caps (Fig. 12E); sperm pump elongate, pipe-shaped with 90° bend (Fig. 12D); ejaculatory apodeme funnel-shaped with V-shaped basal rosette (Fig. 12D)
..... *C. collessi*, sp. nov.
- 24(2). Hind coxa and all trochanters with dense aggregation of long anteroventral hairs (Fig. 17C); fore and mid femora with proximal, posterior cluster of long hairs; tergite 6 with round ventral protuberance, raised on opposite edges (Fig. 17A); sternites 2–5 heart-shaped, covered with long bristles (Fig. 17A); surstyli short, symmetrical, densely haired over entire medial surface (Fig. 17E)
..... *C. dasymelus*, sp. nov.
- Coxae, trochanters, and femora with scattered short hairs (*cf.* Fig. 1I); tergite 6, sternites 2–5 and surstyli not as above ..
..... 25
- 25(24). Epandrium black, entirely pruinose and syntergosternite 8 small, WS8:LT35, 0.7–0.8:1, T5L:S8 L >3:1; tergite 6 with long protuberance projecting from ventral edge of sclerite (Fig. 14E); left surstylus longer than right, narrowest in centre, with bulbous tip (Fig. 14C); phallic guide deflected ventrally at about 30° (Fig. 14B)
..... *C. condylostylus*, sp. nov.
- Epandrium glabrous, shining in most species, reddish brown and pruinose in *C. capillifascis*; syntergosternite 8 usually larger, WS8:LT35, >0.8:1, T5L:S8 L <3:1 in all except *C. scalenus*; tergite 6 and surstyli not as above; phallic guide in same plane as surstyli (*cf.* Fig. 10E)
..... 26
- 26(25). Large flies, body length >4.7 mm, wing length >5.5 mm 27
- Smaller, body length <4.7 mm; wing length <5.5 mm 29
- 27(26). Tegula with two bristles; tergite 6 swollen into a mid-lateral ridge (Fig. 10A); sternites 2–4 small, rectangular, with lateral bristles concentrated on minutely raised posterolateral protuberances (Fig. 10A); sternite 5 larger, much more darkly sclerotised, oval, with long lateral projections bearing terminal tufts of bristles (Fig. 10A); sternite 6 with two prominent tufts of bristles on left side, right side modified, with swollen posterior ridge and sinuous anterolateral protuberance (Fig. 10A); surstyli hollowed out medially; densely haired over entire medial surface (Fig. 10C)
..... *C. capillifascis*, sp. nov.
- Tegula with five or more bristles; tergite 6, sternites 2–6, and surstyli not as above 28
- 28(27). Scutum and scutellum brown pollinose dorsally; tergite 6 with no protuberances (Fig. 34B); sternites 2–5 triangular; darkly sclerotised; densely covered with bristles (Fig. 34B); sternite 6 with medial boot-shaped protuberance and longer right lateral finger (Fig. 34B); gonopods not protruding; tips of phallic ducts simple, each phallic duct with a single backwards pointing protuberance just proximal to tip (Fig. 34C); surstyli almost symmetrical, short, stubby (Fig. 34E); sperm pump without medial bend
..... *C. tasmanicus*, sp. nov.
- Scutum with two silver dorso-central stripes; scutellum brown pollinose medially, silver-grey pollinose around edges; sternite 5 bright orange, shining, developed into large

- blocky, right lateral protuberance, easily visible in ventral view without dissection (Fig. 20A); sternites 3–4 divided, rectangular, with scattered bristles (Fig. 20A); tergite 6 with short, wide, fin-like lateral protuberance (Fig. 20A); sternite 6 with a long, thin finger-like protuberance adjacent to tergite 6 (Fig. 20A); left gonopod with round distal protuberance (Fig. 20C); tips of phallic ducts cut on angle like needles, ducts smooth (*cf.* Fig. 17F); phallus supported medially by membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 20C); left surstylus greatly enlarged, long, sweeping out laterally, with high medial ridge and small basal protuberance; right surstylus much smaller, rectangular, compressed laterally (Fig. 20C); sperm pump elongate, pipe-shaped with 90° bend (Fig. 20C) *C. exallus*, sp. nov.
- 29(26). Wing with r-m crossvein located submedially in discal cell; S₃:S₂, 1.4–1.5:1; tergite 6 reduced, not swollen (Fig. 32C); sternite 6 glabrous, shining orange, considerably modified on right side with large rectangular protuberance just posterior to right side of sternite 5, very wide dorsal to this with medial protuberance and a long, curving dorsal finger (Fig. 32C); sternite 7 orange; syntergosternite 8 mostly black, orange adjacent to sternite 7; cerci almost perpendicular to syntergosternite 8 (Fig. 32A); right surstylus huge, flattened laterally into large curving blade; right surstylus with boot-shaped medial protuberance; left surstylus small, simple, hollowed out medially (Fig. 32A,D) *C. scalenus*, sp. nov.
- Wing with r-m crossvein located medially in discal cell; S₃:S₂, 1.1–1.2:1; tergite 6 swollen medially (Fig. 28B); sternite 6 with right side developed into long, posteriorly projecting, finger-like protuberance (Fig. 28B); sternite 7 and syntergosternite 8 dark brown; cerci in same plane as surstyli (Fig. 28E); surstyli short, symmetrical, densely covered with short hairs over entire medial surface (Fig. 28C) *C. mathiesoni*, sp. nov.
- 30(1). Body length >4.1 mm; FFE, <0.3:1; OL:PL, 1.4–1.6:1 31
- Body length <4.1 mm; FFE, >0.3:1; OL:PL, <1.3:1 or >1.6:1 33
- 31(30). Ovipositor length <1.0 mm; ovipositor as in Fig. 5H *C. tasmanicus*, sp. nov.
- Ovipositor length >1.0 mm 32
- 32(31). FR, >1.2:1; ovipositor with rounded base and slightly declinate piercer (Fig. 5C) *C. capillifascis*, sp. nov.
- FR, <1.2:1; ovipositor with small tubercle on dorsum above cerci, piercer upcurved (Fig. 5J) *C. yeatesi*, sp. nov.
- 33(30). Base of ovipositor short, acutely angled (Fig. 5A,G); OL:PL, <1.3:1; BL:OL, 0.2:0.3:1 34
- Base of ovipositor longer, rounded (*cf.* Fig. 5E); OL:PL, >1.3:1; BL:OL, 0.4–0.5:1 35
- 34(33). FFE, 0.6–0.7:1; BLS:PL, 4.0–4.3:1; OL:PL, 1.1–1.2:1 *C. ancylus*, sp. nov.
- FFE, 0.4–0.5:1; BLS:PL, 3.7–3.8:1; OL:PL, 1.0–1.1:1 *C. koebelei* (Perkins)
- 35(33). Thorax and abdomen covered with long hairs (Figs 5E, 19E) *C. eutrichodes* (Perkins)
- Thorax and abdomen with short hairs 36
- 36(35). Abdomen black, shining, sparsely pruinose; ovipositor with piercer declinate (Fig. 5B) *C. beneficiens* (Perkins)
- Abdomen densely pruinose; ovipositor piercer straight or upcurved (Fig. 5D,F,I) 37
- 37(36). Ovipositor with piercer straight (Fig. 5D) *C. carnatistylus*, sp. nov.
- Ovipositor with piercer upcurved (Fig. 5F,I) 38
- 38(37). BLS:PL, 4.2–4.5:1; OL:PL, 1.6–1.7:1; BL:OL, 0.4:1 *C. helluo* (Perkins)
- BLS:PL, 5.1–6.0:1; OL:PL, 1.7–1.9:1; BL:OL, 0.5:1 *C. trochanteratus* (Becker)

Clistoabdominalis Skevington

Clistoabdominalis Skevington in Skevington & Yeates, 2001: 435.
Type species: *Pipunculus helluo* Perkins, 1905.

Clistoabdominalis ancylus, sp. nov.

(Figs 4A–E, 5A, 6A)

Material examined

Holotype. Australia, Queensland, Barakula SF No. 302, Summit Round Mt, 26°22'13" S, 150°58'09" E, ♂, 8.i.2000, JAS, MM, #7516 (QM T57996).

Allotype. Australia, Queensland, Mt Glorious Biological Centre, main road, [27°19'54" S, 152°45'29" E], rainforest, canopy Malaise trap, ♀, 3–10.x.1997, SW, NP, DW, #3412 (UQ).

Paratypes. **Australia: Queensland:** Carnarvon NP, Mt Rugged Summit, 24°53'52" S, 147°59'55", 1130 m, hilltop, 5♂, 30.xi.1997, JS, CL, #2227 (BMNH), #2228–30, 33 (UQ); Carnarvon NP, Mt Moffatt Section, 24°54'34" S, 148°00'29" E, 900 m amsl, Malaise trap next to water pool, 4♂, 25.xi.1995, MI, SG, #3919–22 (INHS); Carnarvon NP, Moss Garden, [25°00' S, 148°00' E], yellow pans, 1♂, 28.xi.1992, DB, #643 (AMS); Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, hilltop, 108♂, 29.xi.1997, JS, CL, #1275, 91–2, 99, 1301, 10, 24, 33, 41, 48–9, 51, 53, 61, 64, 70–1, 86, 93, 98, 1400, 10–1, 13, 26, 30, 52, 54, 56, 59–62, 65–6, 69–70, 74, 1669, 73, 75, 80–1, 83, 88, 92, 1704, 58–9, 63, 69, 78–9, 82, 88, 93, 1802–3, 5, 10, 1941, 43, 47, 50, 73, 78, 81–2, 87, 92, 2001, 6, 19–20, 22–3, 26, 32, 35, 38, 44, 53, 55, 60, 71, 93, 2100, 4, 8, 17–8, 28, 32–3, 37, 42–3, 49, 56, 61, 67, 70, 76, 84 (UQ), #1473 (BMNH), #2124–5 (QM T57997–8), 1♀, 2.xii.1997, JS, CL, #2090, 1♀, 20.i.1998, JAS, SW, #2775, 22.i.1998, JAS, SW, 72♂, #2403, 10–1, 15, 17, 27, 32–3, 36, 61, 65, 76, 89, 94–5, 97, 2504–6, 11, 15, 18, 25, 32–3, 38, 43, 47, 49, 52, 58, 4–6, 68–70, 73, 75–8, 85, 2758, 81, 87, 96, 2880, 92, 95–6, 2901, 7, 19–20, 25–6, 34, 36–7, 69–71, 75, 78, 81, 83, 88, 93, 98, 3002, 3010, 1♀, #2562 (UQ), 1♂, #2501 (BMNH), 1♂, #2583 (CNC), 10♂, 25.xi.1995, DY, CB, #1, 18–26 (CNC); Isla Gorge NP, 25°11' S, 149°58' E, 320 m, hilltop near lookout, 3♂, 13.xi.1999, JAS, #7253–5 (ISNB); same data as holotype, 12♂, 8.i.2000, JAS, MM, #7507–10 (UQ), #7511 (CAS), #7512–5 (CNC), #17–19 (ISNB); Mt Tinbeerwah E of Cooroy, 26°24' S, 152°59' E, hilltop, 10♂, 7.xi.1998, JAS, #4359–61, 65, 68, 70, 72, 75, 80–1 (UQ); Bunya Mts. NP, Mt Kiangarow, 26°50' S, 151°33' E, [hilltop], 3♂, 29.xi.1998, JAS, #4946, 48–9 (UQ); Mt Glorious Biological Centre, main road, [27°19'54" S, 152°45'29" E], rainforest, ground Malaise trap, 26.ix.–3.x.1997, 1♂, #3121, 1♀, #3122, 21–28.xi.1997, SW, NP, DW, 1♀, #3198 (UQ); Mt Glorious Biological Centre, main road, [27°19'54" S, 152°45'29" E, rainforest], Malaise trap, 1♂, 25.ix.–2.x.1997, 2♂, 16–23.x.1998, NP, DW, #4398, 4401, 4955 (UQ); Mt Glorious Biological Centre, main road, 27°19'54" S, 152°45'29" E, rainforest, canopy Malaise trap, 1♂, 1–10.iii.1996, 1♂, 11–24.iii.1996, 1♂, 3–10.x.1997, GAD, AH, SW, NP, DW, #3411, 7771–2 (UQ); Mt Glorious; bordering Maiala NP, [27°19'54" S, 152°45'29" E], montane rainforest, [Malaise trap], 1.viii.–30.ix.1996, AH, 3♂, #4431–2, 7, 1♀, #4434 (UQ); Mt Glorious, [27°20' S, 152°45' E], 2♂, 1♀, 13.ii.1961, LMG, #2381–3

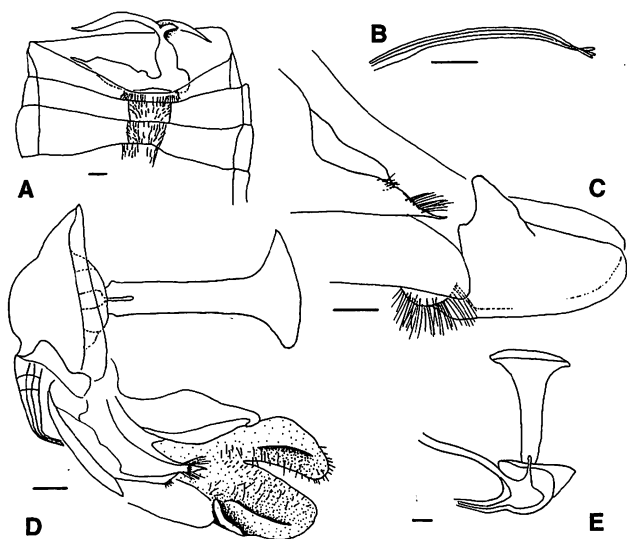


Fig. 4. Male *Clistoabdominalis ancylus* (#24 and 1461). *A*, ventral of abdomen with terminalia removed; *B*, dorsal of phallus; *C*, right lateral of terminalia; *D*, dorsal of terminalia, phallus displaced and not visible; *E*, lateral of sperm pump and ejaculatory apodeme. Scale bars = 0.1 mm.

(BPBM); Scrub Road, Brisbane Forest Park, 27°25' S, 152°50' E, Malaise trap, 1♂, 10–17.x.1997, 1♂, 31.x.–7.xi.1997, 1♂, 23–30.i.1998, SW, NP, #3292, 3337, 3380 (UQ); Brisbane, Mt Coot-tha, 27°29' S, 152°57' E, 170 m, hilltop, 1♂, 20.iv.1997, 1♂, 26.x.1997, 1♂, 7.xii.1997, 1♂, 8.ii.1998, 1♂, 7.iii.1998, 1♂, 19.iv.1998, 1♂, 26.iv.1998, 3♂, 18.iv.1999, 1♂, 15.v.1999, 1♂, 19.vi.1999, 4♂, 17.vii.1999, JAS, #908, 1173, 2305, 3264, 3834, 5741, 6466–7, 7746 (UQ), #3628 (QM T57999), #5803–5 (ANIC), #6464–5 (GDCB), #6475–6 (BPBM); Brisbane, Indooroopilly, CSIRO gully, 27°30' S, 152°58' E, Malaise trap, 3♂, 28.x.–7.xi.1986, 1♂, 7–21.xi.1986, #473–6 (QDPC). **New South Wales:** Warrumbungle NP, [31°14' S, 149°01' E], Malaise trap, 1♂, 19.x.–3.xi.1997, JS, SW, #3327 (UQ); Warrumbungle NP, Split Rock, 31°17'08" S, 148°59'00" E, hilltop, 1♂, 18.i.1999, JAS, #4508 (UQ); Mt Boyce, Blue Mts., [33°37' S, 150°16' E], 1♂, 16.iv.1971, DM, #574 (AMS). **Tasmania:** Bell Mt Near Wilmot, 41°27'56" S, 146°06'22" E, 803 m, hilltop, 1♂, 8.i.1999, JAS, MM, #4549 (UQ); Franklin-Gordon Wild R. NP, Donaghy's Hill, 42°11'52" S, 145°55'55" E, [hilltop], 91♂, 7.i.1999, JAS, MM, #4552–4, 56, 58, 60–77, 79–86, 88–97, 599–613, 615–627, 29–36, 38–49 (UQ), #4559, 4614 (CNC).

Other material examined. **Australia: Queensland:** 3 km NNW Palmer R. [Cross]ing, 1♂, #3988 (GDCB); Mapleton, 1♀, #5061 (MVMA); [Undara?], 1♀, #727 (UQ); Capricorn Coast NP, Rosslyn Head Sect[ion], Kemp Beach, 2♀, #3363–4 (UQ); Carnarvon NP, Mt Moffatt Summit, 2♂, #2127, 46 (UQ); Carnarvon NP, Mt Moffatt Section, 3 km s.e. H[ea]l[dq[ar]t[e]rs, 2♀, #3924–5 (INHS); Isla Gorge NP, 1♀, #7316 (UQ); Maranoa R., west branch, Mt Moffatt section, Carnarvon NP, 1♀, #405 (UQ); Cooloola NP, East Mullen hilltop, 2♂, #3898–9 (UQ); Bribie Island, QDPI Fisheries site, 2♀, #3299, 7795 (UQ); Brisbane Forest Park, 13♀, #3097, 9, 3100, 2, 4, 3340, 2, 4, 65, 3498, 3506, 8, 7774 (UQ); Brisbane, Mt Coot-tha, 1♀, #5809 (UQ); Brisbane, CSIRO Long Pocket Site, 3♀, #444, 70, 81 (QDPC). **New South Wales:** Royal NP, 1♂, #4030 (GDCB). **Australian Capital Territory:** Black Mt, Canberra, 1♀, #3723 (CAS); Canberra, Black Mt, 1♀, #3927 (INHS); **Victoria:** Bells Clearing 6 km S of Aberfeldy, 1♂, #5123 (MVMA). **Tasmania:** 14 km SW by S Wilmot, 1♀, #155 (ANIC); Franklin-Gordon Wild R. NP, Donaghy's Hill, 1♂, #4557

(UQ). **Western Australia:** 12 [miles – 19.2 km] E Harvey, 1♂, #299 (ANIC).

Description based primarily on #1461, 2494, 3412, 3898, 4602, 7516, and 7771; measurements based on #1, 20, 22, 24, 155, 299, 574, 643, 1292, 1299, 1393, 1454, 1462, 1474, 2053, 2117, 2118, 2133, 2167, 2233, 2494, 2503, 2538, 2573, 2892, 2896, 2926, 3122, 3412, 3898, 3988, 4508, 4602, 6467, 7255, 7771, and 7795.

Diagnosis

Male

Autapomorphies. Tergite 6 with distinctive raised ventromedial protuberance (Fig. 4A). Surstyli short and stubby; right surstylus with distinctive basal hook bending dorsomedially (Fig. 4D). Hypandrial apodeme narrow.

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.4–2.1:1. Tergites 2–4 usually entirely brown pollinose dorsally. Tergite 5 extensively silver pollinose laterally and on dorsum, brown pollinose medially. Sternites 2–5 rectangular, covered with long hairs (Fig. 4A). Sternite 6 narrow, not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 4A). Syntergosternite 8 swollen, as wide or wider than tergite 5; WT5:WS8, 0.9–1.0:1. Epandrium mostly glabrous, shining brown. Cerci small and bulbous (Fig. 4C). Phallic guide with small, hairy protuberance on the right side; row of long hairs laterally just proximal to hook (Fig. 4C–D). Ejaculatory apodeme large funnel with basal rosette (Fig. 4E).

Female

Characters shared with a few species. Front facets of eyes moderately enlarged; FFE, 0.6–0.7:1. Tarsomeres of hind leg flattened. Ovipositor piercer slightly upcurved, base very angular, cerci close to sternite 6 (Fig. 5A). B:PL, 4.0–4.3:1.

Description

Male

Body length, 3.1–4.3 mm.

Head. Postpedicel obtuse; brown to bright yellow. Pedicel brown with 3–4 dorsal bristles and 2–4 ventral bristles; PW:DBL, 3.2–4.3:1, PW:VBL, 4–5.2:1. Scape with one dorsal bristle. Labellum dark brown to yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum densely brown pollinose dorsally, usually silver-grey pollinose anterolaterally. Scutellum entirely brown pollinose; with fringe of 6–14 hairs. Halter dark brown to pale yellow.

Legs. Trochanters brown to yellow with only a few scattered hairs. Femora dark brown with narrow yellow apices to yellow with narrow medial brown bands; no ventral spines on fore and hind femora; mid-femur anteroventrally

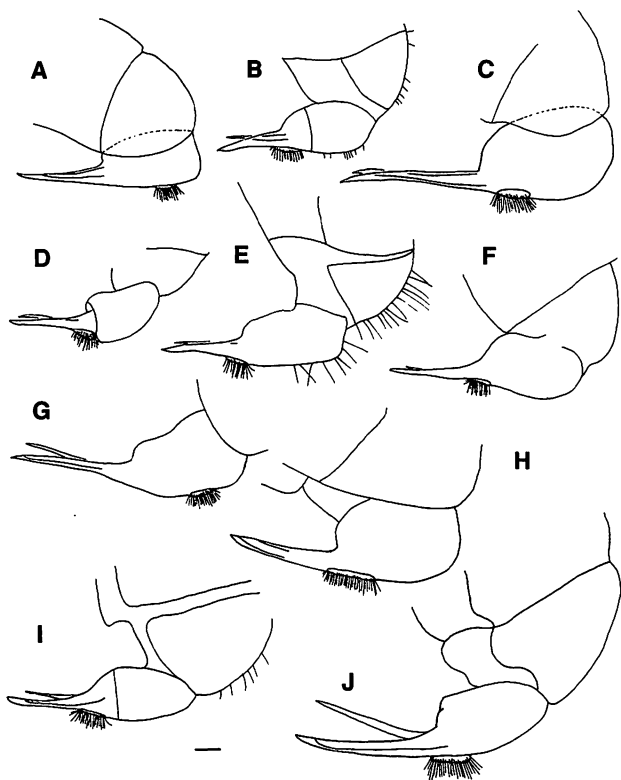


Fig. 5. Female *Clistoabdominalis* species, left lateral of ovipositors. A, *C. ancylus* (#470); B, *C. beneficiens* (#4262); C, *C. capillifascis* (#800); D, *C. carnatistylus* (#8702); E, *C. eutrichodes* (#4149); F, *C. helluo* (#477); G, *C. koebelei* (#3564); H, *C. tasmanicus* (#4696); I, *C. trochanteratus* (#276); J, *C. yeatesi* (#1085). Scale bar = 0.1 mm.

with row of 5–9 black spines on apical half, posteroventrally with row of 7–14 black spines. Tibiae brown with yellow apices to entirely bright yellow; fore and mid tibiae with apical spines.

Wings. Length: 4.0–5.3 mm; $C_4:C_3$, 0.8–1.3:1; $S_3:S_2$, 1.4–2.1:1. Tegula with two bristles.

Abdomen. Tergites 2–4 usually entirely brown pollinose dorsally, occasionally silver posterolateral patches extend onto posterior corners of dorsum. Tergite 5 extensively silver pollinose laterally and on dorsum, brown pollinose medially; asymmetrical, $T5R:T5L$ 1.3–1.7:1. Tergite 6 narrow with separate right lateral plate; with raised ventromedial protuberance (Fig. 4A). Sternites 2–5 rectangular, covered with long hairs (Fig. 4A). Sternites 6 and 7 silver pollinose, not visible from above. Sternite 6 narrow, not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 4A). Syntergosternite 8 dark brown, sparsely brown pollinose, swollen, $WS8:LT35$, 1.2–1.6:1, $WT5:WS8$, 0.9–1.0:1.

Genitalia. Epandrium mostly shining brown, pruinose adjacent to surstyli, wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 2.0–3.0:1. Cerci dull to bright yellow; small and bulbous (Fig. 4C).

Surstyli dark brown to bright yellow; asymmetrical, right surstylus with distinctive basal hook bending dorsomedially; short, almost as deep as long, with a few hairs adjacent to subepandrial sclerite (Fig. 4D). Subepandrial sclerite moderately wide, symmetrical, $WSES:WEP$, 0.3–0.4:1 (Fig. 4D). Hypandrium strongly deflected left (Fig. 4D). Phallic guide straight, with small distal hook; slightly asymmetrical with small, hairy protuberance on the right side; with row of long hairs laterally just proximal to hook (Fig. 4C–D). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 4B). Hypandrial apodeme narrow. Sperm pump round, fused with basal rosette of ejaculatory apodeme (Fig. 4E). Ejaculatory apodeme large funnel with swollen basal rosette (Fig. 4E).

Female

As male except: body length, 2.7–2.9 (4.1) mm; postpedicel yellow, short acuminate. Eyes dichoptic; FR, 1.0:1. FFE, 0.6–0.7:1. Tarsomeres of hind leg flattened. Tergite 6 brown pollinose except for sparse posterolateral silver pollinosity.

Ovipositor. Ovipositor piercer slightly upcurved, base very angular, cerci close to sternite 6 (Fig. 5A). OL, 0.7–1.0 mm; OL:PL, 1.1–1.2:1; BL:OL, 0.2–0.3:1; B:PL, 4.0–4.3:1.

Distribution

Found throughout eastern Australia from north of Cairns to Tasmania. A single male specimen is known from south-western Australia (near Harvey, south of Perth; Fig. 6A).

Remarks

This species is common and widespread in Australia and shows a considerable degree of variation over its range. Specimens collected in rainforest habitats around Brisbane were initially thought to be a separate species because of external features. These specimens have bright yellow legs and antennae; however, the genitalia are identical to non-rainforest specimens of *C. ancylus*. External features such as colour are extremely variable in pipunculids and not surprisingly, after examination of the entire series of *C. ancylus*, intermediate states of these characters were discovered. Two males collected in Cooloola National Park differ from others of the species by having a smaller basal hook on the right surstylus. Although always present in *C. ancylus*, this character showed some variation throughout the species. Despite this, more material should be examined from the heath habitats around Cooloola. This habitat supports a number of endemic species so it would not be surprising if there were an endemic pipunculid.

Females of *C. ancylus* are practically indistinguishable from females of *C. koebelei*. All of the females that were not clearly associated with males are not included in the paratype series. Males from Western Australia and North Queensland

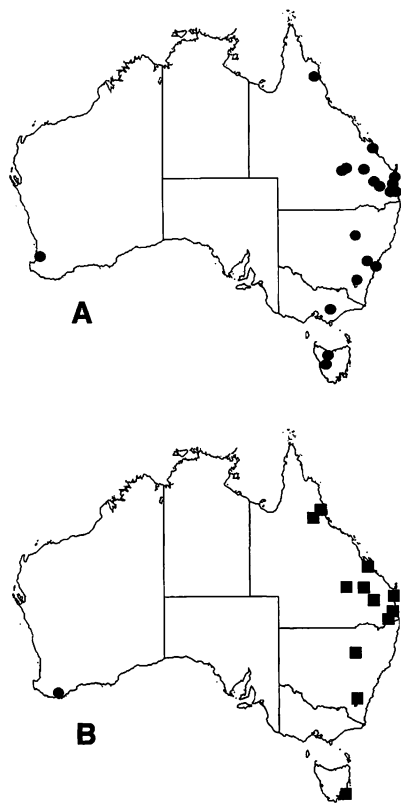


Fig. 6. Distributions of *Clistoabdominalis* species. A, *C. ancylus*; B, ● *C. angelikae*, ■ *C. digitatus*.

are not included in the type series because of their disjunct distributions. More specimens are needed from these areas to support my hypothesis that these are *C. ancylus*. The only other material excluded from the type series is in poor condition.

Clistoabdominalis ancylus has been collected in rainforest, heath, and dry sclerophyll forest. It is a prominent hilltopping species with 342 of 406 known specimens collected on hilltops.

Etymology

From the Greek *ankylos* for 'bent' or 'hooked'; in reference to the distinctive basal hook on the right surstylus in this species. Masculine.

Clistoabdominalis angelikae, sp. nov.

(Fig. 6B, 7A–D)

Material examined

Holotype. Australia, Western Australia, Mt Barker, 34°39'25" S, 117°38'39" E, hilltop, ♂, 27.xii.1999, JAS, #7487 (ANIC).

Paratypes. Australia: Western Australia: same data as holotype, 1♂, #7485 (CNC), 2♂, #7488–9 (UQ).

Description and measurements based on all specimens.

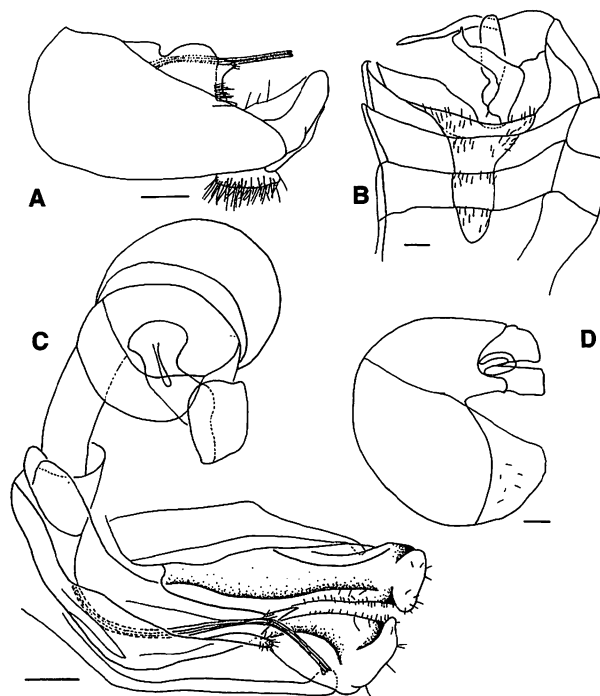


Fig. 7. Male *Clistoabdominalis angelikae* (#7489). A, right lateral of terminalia; B, ventral of abdomen with terminalia removed; C, dorsal of terminalia; D, ventral of distal end of abdomen. Scale bars = 0.1 mm.

Diagnosis

Male

Autapomorphies. Tergite 1 silver pollinose laterally, brown pollinose dorsally. Tergite 6 with a single, long, sinuous ventral protuberance, easily visible ventrally without dissection (Fig. 7B). Surstyli rectangular, upturned; asymmetrical, right surstylus wider; short, longer than deep (Fig. 7C). Sperm pump elongate, pipe-shaped, fused with basal rosette of ejaculatory apodeme (Fig. 7C).

Characters shared with a few species. First segment of hind trochanter with row of long spines. Pedicel with short bristles, PW:VBL, >3.5:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.5–1.6:1. Tergites 2–5 entirely brown pollinose in dorsal view. Tergite 6 swollen medially (Fig. 7B). Sternites 6 and 7 glabrous, shining brown. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 7B). Epandrium glabrous, shining brown, yellow distally. Cerci on 30° angle to surstyli (Fig. 7D). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2:1 (Fig. 7C). Phallic guide with small, hairy protuberance on the right side (Fig. 7C). Ejaculatory apodeme small funnel with basal rosette (Fig. 7C).

Description

Male

Body length, 3.6–3.7 mm.

Head. Postpedicel short acuminate; dark brown. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 2.8–4.0:1, PW:VBL, 4.0–4.5:1. Scape with one dorsal bristle. Labellum dark brown.

Thorax. Postpronotal lobe dull yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 16 hairs. Halter dull yellow.

Legs. Trochanters brown; first segment of hind trochanter with row of long spines. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–6 black spines on apical half, posteroventrally with row of 10–11 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 4.2–4.3 mm; $C_4:C_3$, 0.8–0.9:1; $S_3:S_2$, 1.5–1.6:1. Tegula with two bristles.

Abdomen. Tergite 1 silver pollinose laterally, brown pollinose dorsally. Tergites 2–5 brown pollinose with silver posterolateral patches visible only in lateral view. Tergite 5 asymmetrical, T5R:T5L, 1.2–1.3:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with a single, long, sinuous ventral protuberance, easily visible ventrally without dissection (Fig. 7B). Sternites 2–5 rectangular, with scattered bristles (Fig. 7B). Sternites 6 and 7 polished shining brown, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 7B). Syntergosternite 8 dark brown, sparsely brown pollinose, only slightly swollen, WS8:LT35, 1.0–1.1:1, WT5:WS8, 1.1–1.3:1.

Genitalia. Epandrium shining brown, yellow distally; wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.9:1. Cerci yellow, on 30° angle to surstyli (Fig. 7D). Surstyli dark yellow; rectangular, upturned; asymmetrical, right surstylus wider; short, longer than deep, with a few medial hairs (Fig. 7A,C). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2:1 (Fig. 7C). Hypandrium strongly deflected left (Fig. 7C). Phallic guide straight, with small distal hook; asymmetrical with hairy protuberance on the right side; with row of hairs laterally just proximal to hook (Fig. 7C). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 7A,C). Hypandrial apodeme wide. Sperm pump elongate, pipe-shaped, fused with basal rosette of ejaculatory apodeme (Fig. 7C). Ejaculatory apodeme small funnel with basal rosette (Fig. 7C).

Female

Unknown.

Distribution

Known only from Mount Barker south of Perth in Western Australia (Fig. 6B).

Remarks

The only specimens of *C. angelikae* were collected from a rather unproductive hilltop on the outskirts of Mount Barker. The area is dominated by dry sclerophyll forest and farmland. A large telecommunications complex dominates the top of the hill. Despite the prominence of this hilltop very few Diptera were using it as an aggregation site. The pipunculids that we could find were in a shaded opening in the understorey (under eucalypts) on the north side of the hill. Seven specimens of four species were collected in the same location over the course of four hours: *C. angelikae*, *D. eucalypti*, *Eudorylas* sp., and *Chalarus* sp.

Etymology

Proposed in honour of Angela Skevington, who collected all of the specimens of this species with JS, and who has participated in the collection of over 2800 Australian pipunculids.

Clistoabdominalis beneficiens (Perkins)

(Figs 5B, 8A–E, 9A)

Pipunculus beneficiens Perkins, 1905: 143. – T.l.: Australia, Queensland, Bundaberg. – T.d.: BPBM (Nr 4193).

Pipunculus (Eudorylas) beneficiens Perkins, 1905. – Hardy, 1964, 1989.

Eudorylas beneficiens (Perkins, 1905). – Kapoor *et al.*, 1987; De Meyer, 1996.

Clistoabdominalis beneficiens (Perkins, 1905). – Skevington & Yeates, 2001.

Material examined

Lectotype. Australia, Queensland, Bundaberg, [24°52' S, 152°21' E, excellent condition; pin corroding], ♂, ix.1904, #9332 (BPBM nr 4193).

Paralectotypes. **Australia:** 2♂, 2♀, #4165 (ZMAN); **Queensland:** North Queensland, 1♀, 2♂, #4161–2, 4 (ZMAN); Mid. Queensland, pupariation 1.x.1904, emergence 14.x.1904, puparium and host on same mount, 1♂, 14.x.1904, #4163 (ZMAN); Mid. Queensland, 2♂, 6♀, head of 1 female missing, #4166 (ZMAN); R.C.L. Perkins Coll., B.M. 1942–95, 1♂, 3♀, viii.1904, #4245, 63, 69–70 (BMNH); R.C.L. Perkins Coll., B.M. 1942–95, 18♂, 24♀, #4257–62, 4264–8, 4271–7, 4279–4300 (BMNH); Cairns, [16°55' S, 145°46' E], 3♀, viii.1904, 1♀, ix.1904, #3510–3 (BPBM); Bundaberg, [24°52' S, 152°21' E], R.C.L. Perkins Coll., B.M. 1942–95, 8♂, 5♀, vi.1904, 1♀, x.1904, #4243, 6–8, 50–6, 78 (BMNH); Bundaberg, [24°52' S, 152°21' E, head missing, pin corroding], ♀, ix.1904, #9346 (BPBM); Brisbane, [27°28' S, 153°01' E], R.C.L. Perkins Coll., B.M. 1942–95, 1♀, vi.1904, #4244 (BMNH).

Other material examined. **Australia: Northern Territory:** Larrakeyah, 3♀, 2♂, #111, 116–7, 120–1 (ANIC). **Queensland:** Gordon Ck area, Claudie R. District, 1♀, #553 (UQ); Mt Webb NP, 1♂, #220 (ANIC); 3.5 km SW by S Mt Baird, 1♂, #202 (ANIC); Mt Lewis near Julatten, 1♂, 1♀, #394, 4438 (UQ); 11.3 km up Mt Lewis Road, 1♂, #7118 (UQ); Station C[ree]k, 13 km s.e. Mt Carbine, 1♂, #6506 (QM); Mareeba Shire, Kuranda, Russet Park, 3♀, 2♂, #3713–6, 9 (CAS); Mareeba Shire, Kuranda, 2♂, 1♀, #3709, 11–2 (CAS); Kuranda, 15 km NW Cairns, 1♂, 1♀, #3928–9 (INHS); 24 km SW Ayr, 1♂, #242 (ANIC); 10 m[i]l[e]s S Bowen, 3♂, #244–6 (ANIC); SF ~12 km NNE Eungella, at end of Chelman's Road, 1♂, #7049 (UQ); Eungella Range, 52 m[i]l[e]s – 83.2 km] W Mackay, 1♂, 1♀, #287–9 (ANIC); 1 km S Blue Mt, 1♂, #9100 (QM); Marlborough Ck, 2 km N Marlborough, 3♂, #497–9 (QDPC); Bowenia SF, Byfield, 2♂, #506–7 (QDPC); Dawson R. near Duaringa, 1♂, 3♀, #316–9 (ANIC); Carnarvon NP, Carnarvon Ck camp, 4♂, #620, 42, 50, 54 (AMS); Carnarvon NP, Mt Moffatt section, 4♀, 2♂, #2287–8, 484, 718, 3014, 3494 (UQ), 1♀, #3096 (INHS); 3 km s.e. H[ea]d[ar]t[er]s, 1♂, #3914 (INHS); Carnarvon, 2♂, #411, 6 (UQ); Mary R. Heads n[ea]r Maryborough, 1♀, #4001 (GDCB); Great Sandy NP, Cooloola Section, 1♂, 2♀, #59–61 (UQ); Mt Tinbeerwah E of Cooroy, 1♂, #4355 (UQ); Noosa area, 2♂, #5794–5 (UQ); 2 km s.e. Drillham, 1♂, #509 (QDPC); Bunya Mts, Mt Kiangarow, 1♀, #4427 (UQ); Bunya Mts NP, behind Rices' cabins, 1♂, 2♀, #3490–2 (ISNB); Brisbane R. 4 km N Harlin, 1♂, #431 (QDPC); Bribie I., QDPI Fisheries site, 2♂, 24♀, #847, 855–8, 861, 3191, 97, 3202, 5–6, 3316, 67, 81, 3414–6, 20, 22, 24, 33, 37, 4870, 80, 7841, 8 (UQ); Mt Glorious; bordering Maiala NP, 1♀, #4433 (UQ); Highvale, 1♂, #8 (CNC); Mt Nebo, 1♂, #293 (ANIC); Brisbane Forest Park, 12♂, 7♀, #3289–90, 3351–2, 3371–2, 3383, 5, 3499, 4230–7, 7777, 81 (CNC), 1♂, #3098 (UQ), 1♂, #7317 (ISNB); Brisbane, 3♂, #12, 14–5 (CNC), 1♂, 1♀, #424, 37 (QDPC), 2♂, #457, 62 (UQ), 1♀, #466 (QM); Brisbane, DPI Indooroopilly site, 2♂, #425, 478 (QDPC); St Lucia, along Brisbane R., 1♀, #3926 (INHS); Lake Dyer near Laidley, 1♂, #510 (QDPC); Rosevale Area, 2♂, 1♀, #495–6, 508 (QDPC); Mt Tamborine, 2♂, #42, 44 (QDPC); Mt Greville near Boonah, 1♂, #816 (UQ); West Burleigh, 1♀, #366, 8 (ANIC); Second Palen Ck Crossing from Rathdowney, 1♂, #511 (QDPC); Cougal Ck, Upper Tallebudgera, 2♂, 1♀, #3991, 5, 5285 (GDCB); Springbrook, 1♀, #412 (UQ); Isla Gorge NP, NE corner, 1♀, #6507 (QM). **New South Wales:** Brunswick Heads, 1♂, #278 (ANIC); Eureka, near Lismore, 1♂, #1215 (ASCU); Washpool Ck Crossing, Mt Lindesay H[igh]w[a]y, n[ea]r Tenterfield, 1♂, #3105 (UQ); 5 km s.e. Broadwater, 1♀, #3915 (INHS); The Island, Bellingen, 1♀, #577 (AMS); Gibraltar Range NP, rainforest along track to fire tower, 1♂, #6509 (UQ); Old Mootwingee Gorge, Mootwingee NP, 1♂, 1♀, #1202, 13 (ASCU); Warrumbungle NP, 2♂, #4033–4 (GDCB), 2♀, #5060, 2 (UQ); 2 km N North Haven, 1♀, #3725 (CAS); 6.4 km N Dubbo, 1♂, #572 (AMS); 2 km N Paterson, 2♂, #170–1 (ANIC); NP, 1♀, 2♂, #613, 16, 24 (AMS); Colo Heights, Putty Road, 1♂, #312 (ANIC); Newport, 2♂, 1♀, #4203, 6, 9 (BMNH); B.C.R.I. Rydalmere, 1♂, #1224 (ASCU); North Head, Sydney, 1♀, #582 (AMS); Sydney University, 1♂, #598 (AMS); Bronte, near Sydney, 1♀, #603 (AMS); Fairfield, near Sydney, 1♂, #4037 (GDCB); Canley Vale, 1♀, #4197 (BMNH); N[ea]r Liverpool, Hoxton Park, 2♂, #4199–200 (BMNH); Towra Point, Botany Bay, 1♂, #586 (AMS); Kurnell, 1♂, #592 (AMS); North Cronulla, near Sydney, 1♂, #584 (AMS); Geehi R., 1♂, #253 (ANIC). **Australian Capital Territory:** Black Mt, 2♂, #336, 352 (ANIC); Blundells Ck, 1♀, #227 (ANIC). **Victoria:** Dartmouth Survey, Mitta R., 4♂, 3♀, #5107–13 (MVMA); Dartmouth Survey, Dart/Mitta R. In., 1♀, #5115 (MVMA); Hall's Gap, 1♀, #291 (ANIC); Cheltenham, 1♂, #4205 (BMNH).

Description based primarily on #60, 316, 3372, 4237, 4246, 4265, 4280, 4281, 4294, 5794, and 9332; measurements based on #59, 171, 220, 227, 245, 246, 293, 312, 336, 352, 509, 510, 584, 586, 592, 598,

1202, 1213, 3372, 4033, 4037, 4199, 4205, 4237, 4246, 4265, 4280, 5107, 5285, 5794, 5795, 6506, 6509, 7049, 7118, 60, 316, 3206, 3416, 3510, 4281, and 4294.

Diagnosis

Male

Autapomorphies. Tergites 2–5 shining black, only sparsely pollinose dorsally.

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. First segment of hind trochanter with row of small spines (*cf.* Fig. 1G). Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.9–2.1:1. Tergite 6 swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 8B). Sternites 2–5 densely covered with peg-like bristles (Fig. 8B). Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6; raised into ridge medially on left side (Fig. 8B). Epandrium glabrous, shining black to brown. Left surstylus expanded laterally (Fig. 8C). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, <0.2:1 (Fig. 8C). Phallic guide with small, hairy protuberance on the right side (Fig. 8C). Ejaculatory apodeme large funnel (Fig. 8C).

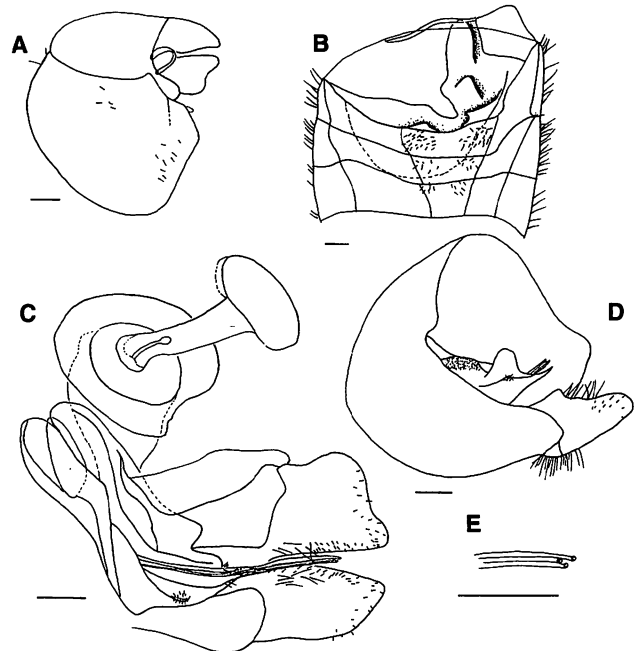


Fig. 8. Male *Clistoabdominalis beneficiens* (#3372 and 4265). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, dorsal of terminalia; *D*, right lateral of terminalia; *E*, dorsal of tip of phallus. Scale bars = 0.1 mm.

Female

Autapomorphies. Tergites 2–6 shining black, only sparsely pollinose dorsally.

Characters shared with a few species. Tarsomeres of hind leg flattened. Ovipositor piercer straight to slightly down curved, base cylindrical (Fig. 5B).

Description

Male

Body length, 2.5–3.5 (3.9) mm.

Head. Postpedicel acuminate; brown to yellow. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.0–4.3:1, PW:VBL, 3.0–5.2:1. Scape with 1 dorsal bristle. Labellum brown to yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 10–16 prominent hairs. Halter yellow to yellowish brown.

Legs. Trochanters brown; first segment of hind trochanter with row of small spines (*cf.* Fig. 1G). Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 1–4 black spines on apical half, posteroventrally with row of 6–10 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.2–4.2 mm; $C_4:C_3$, 1.1–1.2:1; $S_3:S_2$, 1.9–2.1:1. Tegula with 2–3 bristles.

Abdomen. Tergites 2–5 shining black, only sparsely brown pollinose dorsally; with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 asymmetrical, $T5R:T5L$, 1.4–1.6:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (but left protuberance varying in size; Fig. 8B). Sternites 2–5 rectangular, densely covered with peg-like bristles (Fig. 8B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6; raised into ridge medially on left side (Fig. 8B). Syntergosternite 8 black, sparsely brown pollinose, only slightly swollen, $WS8:LT35$, 1.0–1.2:1, $WT5:WS8$, 1.1:1.

Genitalia. Epandrium glabrous, shining black to brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 3.6:1. Cerci brownish yellow. Surstyli brown; asymmetrical; left surstylus expanded laterally; short, longer than deep, with a few medial hairs near junction with subepandrial sclerite (Fig. 8C). Subepandrial sclerite narrow, asymmetrical, offset to the right; $WSES:WEP$, 0.1–0.2:1 (Fig. 8C). Hypandrium strongly deflected left (Fig. 8C). Phallic guide straight, with small distal hook; slightly asymmetrical with small protuberance on the right side; with two or three short hairs laterally just proximal to hook

(Fig. 8C–D). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts slightly swollen (Fig. 8C–D). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 8C). Ejaculatory apodeme large funnel with basal rosette (Fig. 8C).

Female

As male except: eyes dichoptic; FR, 0.9–1.0:1. FFE, 0.5–0.6:1. Tarsomeres of hind leg flattened. Tergite 6 shining black dorsally, silver pollinose posterolaterally.

Ovipositor. Ovipositor piercer straight to slightly declinate, base cylindrical (Fig. 5B). OL, 0.5–0.6 mm; OL:PL, 1.7–1.9:1; BL:OL, 0.5:1; B:PL, 5.2–6.0:1.

Distribution

Found throughout eastern Australia from Cape York to southern Victoria. Five specimens have been collected in the Northern Territory in Larrakeyah near Darwin (Fig. 9A).

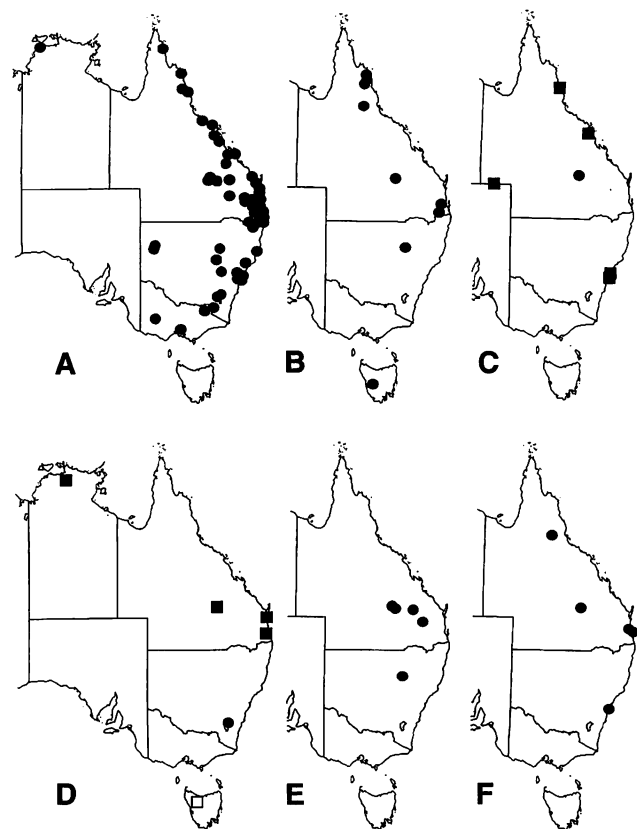


Fig. 9. Distributions of *Clistoabdominalis* species. A, *C. beneficiens*; B, *C. capillifascis*; C, *C. carnatistylus*, *C. lambkinae*; D, *C. collessi*, *C. scintillatus*, *C. tasmanicus*; E, *C. colophus*; F, *C. condylostylus*.

Remarks

Clistoabdominalis beneficiens is a common species in most eastern Australian environments. Specimens have been collected in the following habitats: tropical and subtropical rainforests (lowland and upland), rainforest meadows and edges, dry sclerophyll forest, riverine forest, sand dunes, mangroves, sandy heath, sedges along an irrigation channel in an agricultural area, and even on a window ledge in the heart of Brisbane. Hilltopping is virtually unknown in this species. Only one specimen out of 268 was collected on a hilltop (Mount Greville near Brisbane). Given the lack of other specimens at hilltop aggregation sites this single record is likely an artefact. Many species that occur near hilltops undoubtedly wander through these sites from time to time whether or not they are active hilltopping species.

Perkins (1905) observed 'countless numbers' of this species threading among grass stems in a dry streambed near Cairns at the end of August. This area apparently had small patches of green grass at intervals on which large numbers of various leafhoppers were feeding. A similar report from grasses on sandhills at Bundaberg was reported by Koebele and published in Perkins (1905).

Perkins (1905; 1906b) noted that he and Mr Koebele reared *C. beneficiens* from 'various common jassids, adult and nymphal, *Phrynophyes* (Cicadellidae, Deltocephalinae, Stenometopiini), *Deltocephalus* (Deltocephalinae, Deltocephalini), and *Athysanus* (Deltocephalinae, Athysanini)' (Appendix 1). None of the specimens were identified to species in these publications and only one unidentified hopper specimen is directly associated with any of Perkins' specimens (#4163). These generic references are problematic since *Athysanus* and *Phrynophyes* are not currently considered to occur in Australia (Fletcher 2000). Thus all that is certain is that *C. beneficiens* has been reared from at least three species of deltocephalines, at least one of which is likely in the genus *Deltocephalus*. The one specimen that I have with rearing data (#4163) indicates that it took 15 days between pupariation and eclosion.

Hardy (1964) designated a lectotype (referred to as 'type' in his paper) for *C. beneficiens*. This specimen was selected from six specimens that he was aware of from Perkins' syntype series (all of the BPBM syntypes). In fact, there are 83 syntypes (lectotype and 82 paralectotypes) that I am aware of. Sixty-one are in the BMNH, 16 are in ZMAN, and six are in the BPBM (including the lectotype).

Clistoabdominalis beneficiens is very closely related to *C. eutrichodes*. The low branch support for this relationship (BrS 1; Fig. 2) does not convey the fact that they are nearly identical. The genitalia of the two species are identical and the only external difference is the degree of pilosity. *Clistoabdominalis eutrichodes* is so densely pilose that it appears to be a species of *Pipunculus* at first glance.

Clistoabdominalis capillifascis, sp. nov.

(Figs 5C, 9B, 10A–E)

Material examined

Holotype. Australia, Queensland, Undara Volcanic NP, Bluff, [18°19' S, 144°44' E], 770 m, hilltop, ♂, 19.vii.1998, JRS, #3965 (QM T99011).

Allotype. Australia, Queensland, 14.6 km E Lakeland Downs, 15°46' S, 144°57' E, 270 m, hilltop; open, dry savanna (rangeland), ♀, 8.vi.1997, in copula, on pin with paratype male, JAS, #800 (UQ).

Paratypes. **Australia: Queensland:** 5 km E Normanby R. on Battlecamp Road NW of Cooktown, 15°17' S, 144°52' E, hilltop, 5♂, 6.vi.1997, JAS, #756–60 (UQ), 4♂, #761–64 (CNC), 2♂, #765–6 (ISNB); same data as allotype, 1♂, #796, 1♂, in copula, on pin with allotype ♀, #800 (UQ); 12 km N Palmer Riv[er], 16°01' S, 144°48' E, vine forest, 1♂, 18.v.1989, GAD, #3984 (GDCB); 3 km NNW Palmer R. [Cross]ing, 16°04' S, 144°47' E, 1♂, 17.v.1989, GAD, #3986 (GDCB); same data as holotype, 1♂, 11.vi.1997, JAS, #934, 2♂, 19.vii.1998, JRS, #3964, 79 (UQ); Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, 1♂, 27.xi.1997, 6♂, 29.xi.1997, 3♂, 2.xii.1997, JS, CL, #1445, 7–9, 51, 64, 1809, 2084–5, 2158 (UQ); Carnarvon NP, Mt Moffatt Section, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, 2♂, 22.i.1998, JAS, SW, #2663, 2710 (UQ); Carnarvon NP, Mt Moffatt Section, southernmost of 3 Sisters, summit, 25°06'36" S, 148°05'40" E, 2♂, 23.i.1998, JAS, SW, #2719–20 (UQ); Mt Glorious Biological Centre, main road, [27°19'54" S, 152°45'29" E], rainforest, canopy Malaise trap, 1♂, 5–12.xii.1997, SW, NP, DW, #3199 (UQ); Mt Greville, 28°05' S, 152°30' E, 770 m, hilltop, 1♂, 6.iv.1997, JS, #808 (UQ). **New South Wales:** Siding Spring Observatory Near Warrumbungle NP, [31°16' S, 149°03' E], hilltop, 1♂, 18.xii.1998, JAS, #4546 (UQ). **Tasmania:** Franklin-Gordon Wild R. NP, Donaghy's Hill, 42°11'52" S, 145°55'55" E, [hilltop], 1♂, 7.i.1999, JAS, MM, #4578 (UQ).

Description based primarily on #756, 796, 800, 2084, 3199, and 3964–5; measurements based on #756, 796, 800, 934, 1445, 1449, 2084–5, 3199, 3964–5, 4546, and 4578.

*Diagnosis**Male*

Autapomorphies. Tergite 6 swollen into a mid-lateral ridge (Fig. 10A). Sternites 2–4 small, rectangular, with lateral bristles concentrated on minutely raised posterolateral protuberances (Fig. 10A). Sternite 5 larger, much more darkly sclerotised, oval, with long lateral projections bearing terminal tufts of bristles (Fig. 10A). Sternite 6 slightly enlarged, swollen somewhat internally; with two prominent tufts of bristles on left side; right side modified, with swollen posterior ridge and sinuous anterolateral protuberance (Fig. 10A). Surstyli slightly asymmetrical, left surstylus slightly more bulbous; hollowed out medially; densely haired over entire medial surface (Fig. 10C). Phallic guide with small, hairy, dorsolateral flaps, slightly larger on right side (Fig. 10C).

Characters shared with a few species. Body length, 4.8–5.6 mm. Pedicel with long bristles, PW:BL, <2.8:1. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Wing with r-m crossvein located

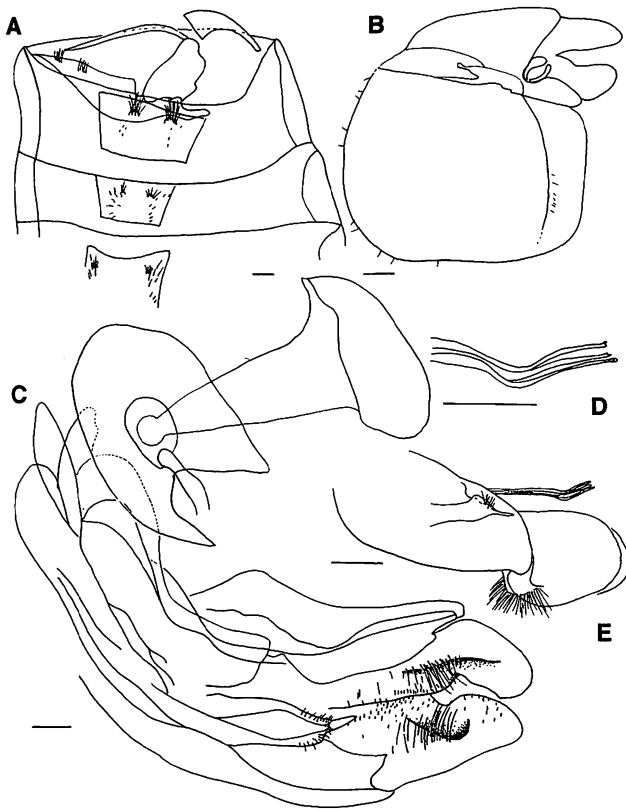


Fig. 10. Male *Clistoabdominalis capillifascis* (#3199 and 4578). *A*, ventral of abdomen with terminalia removed; *B*, ventral of distal end of abdomen; *C*, dorsal of terminalia; *D*, dorsal of tip of phallus; *E*, right lateral of terminalia. Scale bars = 0.1 mm.

submedially in discal cell; $S_3:S_2$, 1.3–1.5:1. Tergite 6 hollowed out into bowl-like depression ventrally (Fig. 10A). Epandrium reddish brown; entirely pruinose. Subepandrial sclerite wide, asymmetrical, offset to the right distally but twisting to the left; $WSES:WEP$, 0.5:1 (Fig. 10C). Tips of phallic ducts spatulate, angled like needles (Fig. 10D). Ejaculatory apodeme large funnel with basal rosette (Fig. 10C).

Female

Autapomorphies. Frons much narrower at ocelli than above antennae, FR , 1.3:1. Ovipositor piercer slightly declinate, base nearly round (Fig. 5C).

Characters shared with a few species. Ovipositor very long, length 1.0 mm.

Description

Male

Body length, 4.8–5.6 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 4–5 dorsal bristles and 2–4 ventral bristles; $PW:DBL$, 1.8–2.6:1, $PW:VBL$, 1.5–2.7:1. Scape with 1–2 dorsal bristles. Labellum brown to yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 14–20 hairs. Halter brown.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 6–8 black spines on apical half, posteroventrally with row of 14–22 black spines. Tibiae dark yellow, with narrow brown medial ring; apical spines absent.

Wings. Length: 5.5–6.2 mm; $C_4:C_3$, 0.8–0.9:1; $S_3:S_2$, 1.3–1.5:1. Tegula with two bristles.

Abdomen. Tergites 2–4 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 with posterior two thirds silver pollinose, anterior one third brown pollinose, brown most extensive medially, sometimes reaching posterior edge of tergite, asymmetrical, $T5R:T5L$, 1.2–1.5:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen into a mid-lateral ridge; hollowed out into bowl-like depression ventrally (Fig. 10A). Sternites 2–4 small, rectangular, with lateral bristles concentrated on minutely raised posterolateral protuberances (Fig. 10A). Sternite 5 larger, much more darkly sclerotised, oval, with long lateral projections bearing terminal tufts of bristles (Fig. 10A). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 slightly enlarged, swollen somewhat internally; with two prominent tufts of bristles on left side; right side modified, with swollen posterior ridge and sinuous anterolateral protuberance (Fig. 10A). Syntergosternite 8 dark brown, sparsely brown pollinose, swollen, $WS8:LT35$, 1.3–1.4:1, $WT5:WS8$, 1.0–1.1:1.

Genitalia. Epandrium reddish brown; entirely pruinose; wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 3.2:1. Cerci bright yellow. Surstyli dark brown to black; slightly asymmetrical, left surstylus slightly more bulbous; hollowed out medially; short, almost as deep as long, densely haired over entire medial surface (Fig. 10C). Subepandrial sclerite wide, asymmetrical, offset to the right distally but twisting to the left; $WSES:WEP$, 0.5:1 (Fig. 10C). Hypandrium strongly deflected left (Fig. 10C). Phallic guide straight, with small distal hook; slightly asymmetrical with small, hairy, dorsolateral flaps, slightly larger on right side; with row of short hairs laterally just proximal to hook (Fig. 10C,E). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts spatulate, angled like needles (Fig. 10C–E). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 10C). Ejaculatory apodeme large funnel with basal rosette (Fig. 10C).

Female

As male except: body length, 4.4 mm. Postpedicel acuminate; yellow. Eyes dichoptic; FR, 1.3:1. FFE, 0.3:1.

Ovipositor. Ovipositor piercer slightly declinate, base nearly round (Fig. 5C). OL, 1.0 mm; OL:PL, 1.4:1; BL:OL, 0.4:1; B:PL, 4.2:1.

Distribution

Known from a few scattered records throughout eastern Australia from the Cairns area to Tasmania (Fig. 9B).

Remarks

Most of the specimens of this rarely collected species come from hilltops in dry sclerophyll forest (35 of 38). Other specimens have been taken in rainforest and vine forest.

Etymology

Derived from the Latin *capillus*, 'hair', and *fascis*, 'bundle, packet'; in reference to the protuberance bearing a brush of hairs on sternite 5 of males of this species. Masculine.

Clistoabdominalis carnatistylus, sp. nov.

(Figs 5D, 9C, 11A–F)

Material examined.

Holotype. Australia, New South Wales, Careel Bay, [33°37' S, 151°19' E], *Casuarina* swamp, ♂, 27.x.1962, DM, #575 (AMS).

Allotype. Same data as holotype, ♀, 9.vi.1962, #625 (AMS).

Paratypes. **Australia: Queensland:** Mareeba Shire, Kuranda, Russet Park, [16°49' S, 145°38' E], 460 m, flight trap, Thomas W. Davies Collection donated to California Academy of Sciences 1987, 1♂, 13.x.1987, TD, #3720 (CAS); Gargett, [21°10' S, 148°45' E], on *Eucalyptus* sp., 1♂, 16.viii.1970, EE, #3114 (UQ); near Birdsville racetrack, [25°54' S, 139°21' E], meadow with scattered small trees, recent rains in area, pipunculids around trees], 1♂, 3.ix.1997, JAS, AZ, CL, SW, #875 (CNC); New South Wales: same data as holotype, 1♂, 14.iii.1963, #585 (AMS), 1♂, 9.vi.1962, #617 (AMS), 1♀, 9.vi.1962, #8702 (AMS); Careel Bay, Avalon, [33°37' S, 151°19' E], 1♂, 1♀, 25.iv.1967, DM, GH, #573, 602 (AMS); Towra Point, Botany Bay, [34°00' S, 151°10' E], 1♂, 21–20.v.1977, JG, #489 (QDPC).

Description and measurements based on all specimens.

*Diagnosis**Male*

Autapomorphies. Tergite 6 with three ventral protuberances (Fig. 11B). Left surstylus expanded laterally into distinctive flap (Fig. 11C). Sperm pump cylindrical, very elongate (Fig. 11C).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >4:1. First segment of hind trochanter with row of small spines (*cf.* Fig. 1G). Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; S₃:S₂, 2.0–2.2:1. Tergite 6 swollen medially (Fig. 11B).

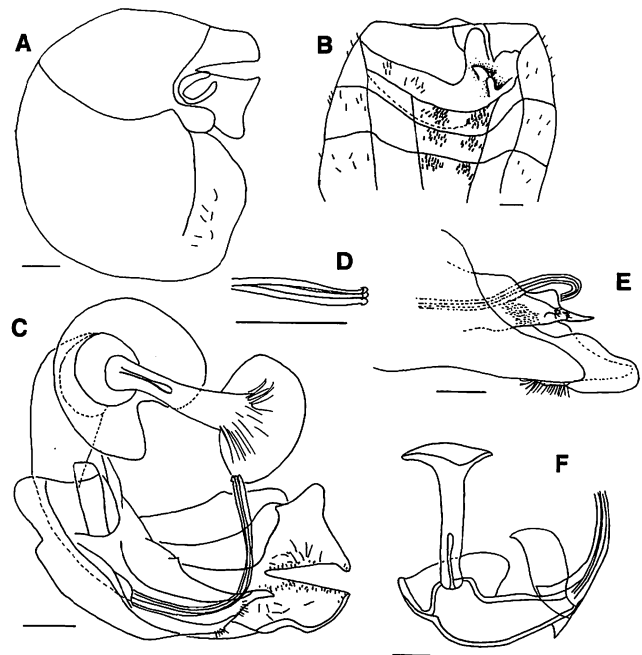


Fig. 11. Male *Clistoabdominalis carnatistylus* (#573 and 3720). A, ventral of distal end of abdomen; B, ventral of abdomen with terminalia removed; C, dorsal of terminalia; D, dorsal of tip of phallus; E, right lateral of terminalia; F, lateral of sperm pump and ejaculatory apodeme. Scale bars = 0.1 mm.

Sternites 2–5 densely covered with peg-like bristles (Fig. 11B). Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 11B). Epandrium pruinose. Cerci angled at 45° (Fig. 11A). Subepandrial sclerite moderately wide, asymmetrical, offset to the right; WSES:WEP, 0.3–0.4:1 (Fig. 11C). Phallic guide with small, hairy protuberance on the right side (Fig. 11C,E). Tips of phallic ducts conical (Fig. 11D). Ejaculatory apodeme large funnel with basal rosette (Fig. 11C,F).

Female

Characters shared with a few species. Ovipositor piercer straight, base cylindrical (Fig. 5D). FFE, 0.4–0.5:1; BL:OL, 0.5:1; B:PL, 4.3–4.7:1.

*Description**Male*

Body length, 2.6–3.0 mm.

Head. Postpedicel obtuse; brown. Pedicel brown with 3–4 dorsal bristles and two ventral bristles; PW:DBL, 4.3–4.7:1, PW:VBL, 4.0–6.5:1. Scape with one dorsal bristle. Labellum brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 10–14 hairs. Halter yellowish brown.

Legs. Trochanters brown; first segment of hind trochanter with row of small spines (*cf.* Fig. 1G). Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 3–5 black spines on apical half, posteroventrally with row of 5–12 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.2–3.4 mm; $C_4:C_3$, 0.9–1.2:1; $S_3:S_2$, 2.0–2.2:1. Tegula with two bristles.

Abdomen. Tergites 2–5 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 asymmetrical, T5R:T5L, 1.2:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with three ventral protuberances (Fig. 11B). Sternites 2–5 rectangular, densely covered with peg-like bristles (Fig. 11B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 11B). Syntergosternite 8 dark brown, sparsely brown pollinose, only slightly swollen, WS8:LT35, 1.0:1, WT5:WS8, 1.2:1.

Genitalia. Epandrium pruinescent, brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.9–3.0:1. Cerci yellow, angled at 45° (Fig. 11A). Surstyli yellow; asymmetrical; left surstylus expanded laterally into distinctive flap; short, longer than deep, with scattered medial hairs (Fig. 11C). Subepandrial sclerite moderately wide, asymmetrical, offset to the right; WSES:WEP, 0.3–0.4:1 (Fig. 11C). Hypandrium strongly deflected left (Fig. 11C). Phallic guide straight, with small distal hook; slightly asymmetrical with small protuberance on the right side; with row of short hairs laterally just proximal to hook (Fig. 11C,E). Phallus trifold, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts conical (Fig. 11C–D). Hypandrial apodeme wide (Fig. 11F). Sperm pump cylindrical, very elongate, fused with basal rosette of ejaculatory apodeme (Fig. 11C,F). Ejaculatory apodeme large funnel with basal rosette (Fig. 11C,F).

Female

As male except: eyes dichoptic; FR, 0.9–1.1:1. FFE, 0.4–0.5:1.

Ovipositor. Ovipositor piercer straight, base cylindrical (Fig. 5D). OL, 0.6 mm; OL:PL, 1.7–2.1:1; BL:OL, 0.5:1; B:PL, 4.3–4.7:1.

Distribution

Scattered records occur along the east coast from near Cairns to the Sydney area. A single specimen was collected in south-west Queensland near Birdsville (Fig. 9C).

Remarks

Clistoabdominalis carnatistylus has been collected in a *Casuarina* swamp, on *Eucalyptus* trees, and around small *Eucalyptus* trees in a meadow. None has been captured on hilltops.

Etymology

From the Latin *carnatus* for 'fleshy' or 'fat'; in reference to the swollen left surstylus in this species. Masculine.

Clistoabdominalis collessi, sp. nov.

(Figs 9D, 12A–F)

Material examined

Holotype. Australia, Australian Capital Territory, Black Mt, [35°16' S, 149°06' E], Malaise trap, Malaise site 2, ♂, 21.ii.1980, DC, #334 (ANIC).

Paratypes. Australia: Australian Capital Territory: same data as holotype, 1♂, 21.ii.1980, #335 (CNC), 1♂, 18.iii.1980, #338 (ANIC).

Description and measurements based on all specimens.

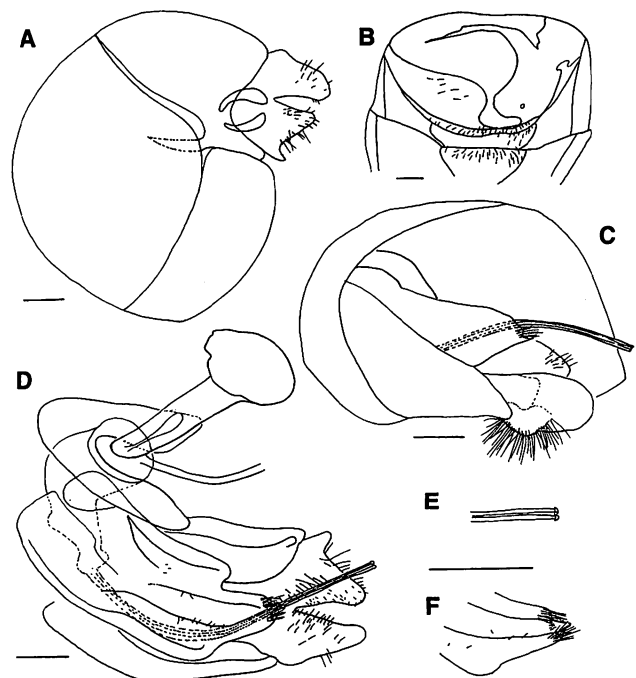


Fig. 12. Male *Clistoabdominalis collessi* (#334 and 335). A, ventral of distal end of abdomen; B, ventral of abdomen with terminalia removed; C, right lateral of terminalia; D, dorsal of terminalia; E, dorsal of tip of phallus; F, dorsal of tip of phallic guide. Scale bars = 0.1 mm.

*Diagnosis**Male*

Autapomorphies. Sternite 7 and sytergosternite 8 weakly fused. Cerci wide (Fig. 12A). Surstyli distinctive; left surstylus more tapered distally; swollen basally with lateral protuberance; with numerous, long medial hairs, and a few long hairs along lateral edge of left surstylus (Fig. 12D). Hypandrium with wide dorsal flaps attaching to phallic guide (Fig. 12D). Tips of phallic ducts with swollen caps (Fig. 12E). Sperm pump elongate, pipe-shaped with 90° bend (Fig. 12D). Ejaculatory apodeme with V-shaped basal rosette (Fig. 12D).

Characters shared with a few species. Ventral bristles of pedicel much shorter than dorsal bristles; PW:DBL, 2.8–3.0:1, PW:VBL, 4.7–5.0:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.5–1.9:1. Tergite 6 narrow dorsally, wider laterally, fused ventrally with right lateral plate; smooth; without ventral protuberances; with small ventral hole (Fig. 12B). Sternites 2–5 with longest bristles along posterior edge (Fig. 12B). Sternite 6 moderately wide, not swollen internally (Fig. 12B). Epandrium glabrous, shining brown. Subepandrial sclerite moderately wide, asymmetrical, offset to the right; WSES:WEP, 0.3–0.4:1 (Fig. 12D). Ejaculatory apodeme funnel-shaped (Fig. 12D).

*Description**Male*

Body length, 3.0–3.6 mm.

Head. Postpedicel obtuse; dark brown basally, pale brown distally. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 2.8–3.0:1, PW:VBL, 4.7–5.0:1. Scape with one dorsal bristle. Labellum dark to light brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum sparsely brown pollinose; with fringe of 10–12 hairs. Halter pale brown to yellowish.

Legs. Trochanters brown, with scattered hairs ventrally. Femora dark brown with yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 7–9 black spines on apical half, posteroventrally with row of 7–8 black spines. Tibiae yellow; fore and mid tibiae with apical spines.

Wings. Length: 3.8–4.2 mm; $C_4:C_3$, 0.8–0.9:1; $S_3:S_2$, 1.5–1.9:1. Tegula with two bristles.

Abdomen. Tergites 2–5 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 asymmetrical, T5R:T5L, 1.2:1. Tergite 6 narrow dorsally, wider laterally, fused ventrally with right lateral plate; smooth; without ventral protuberances; with small ventral hole (Fig. 12B).

Sternites 2–5 rectangular, with longest bristles along posterior edge (Fig. 12B). Sternites 6 and 7 black, not visible from above. Sternite 7 and sytergosternite 8 weakly fused. Sternite 6 moderately wide, not swollen internally (Fig. 12B). Sytergosternite 8 dark brown, only slightly swollen, WS8:LT35, 0.9:1, WT5:WS8, 1.4:1.

Genitalia. Epandrium shining brown, not visible in dorsal view; asymmetrical, ER:EL, 2.5–3.0:1. Cerci bright yellow, wide (Fig. 12A). Surstyli dark brown; asymmetrical; left surstylus more tapered distally; swollen basally with lateral protuberance; short, longer than deep, with numerous, long medial hairs, and a few long hairs along lateral edge of left surstylus (Fig. 12C–D). Subepandrial sclerite moderate width, asymmetrical, offset to the right; WSES:WEP, 0.3–0.4:1 (Fig. 12D). Hypandrium deflected left, with wide dorsal flaps attaching to phallic guide (Fig. 12D). Phallic guide straight, wide, with small distal hook; symmetrical; with row of hairs laterally just proximal to hook (Fig. 12C–D,F). Phallus trifid, projecting to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts with swollen caps (Fig. 12C–E). Hypandrial apodeme wide. Sperm pump elongate, pipe-shaped with 90° bend; fused with basal rosette of ejaculatory apodeme (Fig. 12D). Ejaculatory apodeme funnel-shaped with V-shaped basal rosette (Fig. 12D).

Female

Unknown.

Distribution

Known only from Black Mountain in Canberra, Australian Capital Territory (Fig. 9D).

Remarks

All three specimens were collected in Malaise traps in dry sclerophyll forest. The Canberra area is not noted for endemic species so we should expect to find this species in other parts of south-eastern Australia in the future.

Etymology

Proposed in honour of Don H. Colless, a prolific collector of Australian Pipunculidae and the sole collector of this species.

Clistoabdominalis colophus, sp. nov.

(Figs 9E, 13A–D)

Material examined

Holotype. Australia, Queensland, Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, ♂, 2.xii.1997, JS, CL, #2162 (QM T99012).

Paratypes. Australia: Queensland: same data as holotype, 2♂, 27.xi.1997, JS, CL, #1697, 1714 (ISNB), 4♂, 29.xi.1997, JS, CL, #1289, 1314, 17, 1409 (CNC), 17♂, 2.xii.1997, JS, CL, #1928, 32, 9, 2016, 30–1, 3, 57, 69, 92, 2109, 20, 3, 31, 8, 44, 2♂, 20.i.1998, JAS, SW, #2954, 74 (UQ); Carnarvon NP, Mt Moffatt Section, southernmost of 3 Sisters, summit, 25°06'36" S, 148°05'40" E, 1♂, 23.i.1998, JAS, SW, #2736 (UQ); Isla Gorge NP, 25°11' S, 149°58' E, 320 m, hilltop near lookout, 2♂, 13.xi.1999, JAS, #7282, 5 (UQ); Barakula SF No. 302, Summit Round Mt, 26°22'13" S, 150°58'09" E, [head missing], 1♂, 8.i.2000, JAS, MM, #7525 (UQ). **New South Wales:** Warrumbungle NP, Split Rock, 31°17'08" S, 148°59'00" E, hilltop, 1♂, 18.i.1999, JAS, #4527 (UQ).

Description based primarily on #1314, 1932, 2031, 2069, 2092, 2162, and 7282; measurements based on #1289, 1314, 1697, 1932, 2031, 2069, 2092, 2120, 2162, 2954, 4527, and 7282.

Diagnosis

Male

Autapomorphies. Surstyli short and stubby, with distinctive dorsal ridges; right surstylus with single long, thin basal hook bending dorsomedially (Fig. 13B–C).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; S₃:S₂, 1.6–1.8:1. Tergite 6 with no protuberances (Fig. 13A). Sternite 5 divided into two small sections; with scattered small bristles (Fig. 13A). Sternite 6 swollen internally; with right lateral C-shaped protuberance sweeping out posterolaterally into

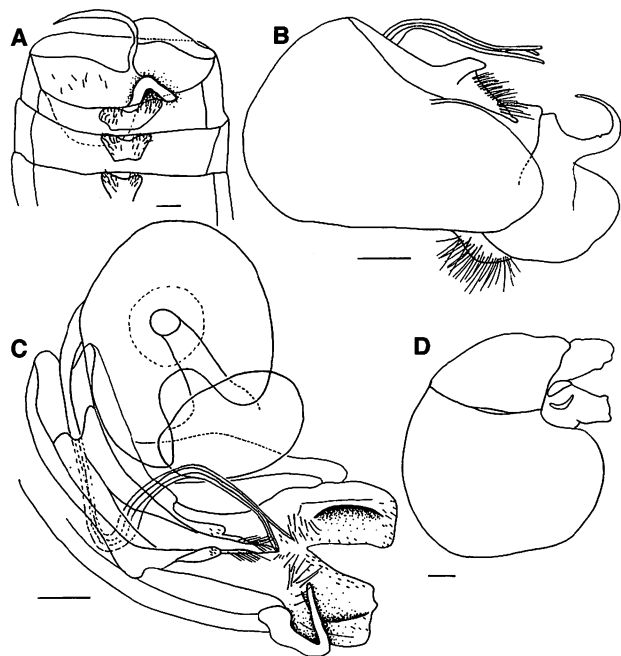


Fig. 13. Male *Clistoabdominalis colophus* (#1932 and 2031). A, ventral of abdomen with terminalia removed; B, right lateral of terminalia; C, dorsal of terminalia; D, ventral of distal end of abdomen. Scale bars = 0.1 mm.

pointed tip (Fig. 13A). Epandrium glabrous, shining brown. Cerci small and bulbous (Fig. 13B,D). Surstyli yellow to brownish yellow. Subepandrial sclerite moderately wide, darkly sclerotised; symmetrical, WSES:WEP, 0.4:1 (Fig. 13C). Phallic guide with large dorsolateral flaps, slightly larger on right side; row of long hairs laterally just proximal to hook (Fig. 13B–C). Hypandrial apodeme very wide, with ring clasping base of sperm pump arising medially (cf. Fig. 25E). Ejaculatory apodeme large funnel with basal rosette (Fig. 13C).

Description

Male

Body length, 3.1–3.7 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with three dorsal bristles and three ventral bristles; PW:DBL, 3.0–4.3:1, PW:VBL, 3.0–4.3:1. Scape with one dorsal bristle. Labellum yellow to brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose, sometimes with silver pollinose posterior edge; with fringe of eight hairs. Halter yellow to brown.

Legs. Trochanters brown; first segment of hind trochanter with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 2–5 black spines on apical half, posteroventrally with row of 6–10 black spines. Tibiae yellow; slightly darkened medially; fore and mid tibiae with apical spines.

Wings. Length: 3.5–3.8 mm; C₄:C₃, 0.8–1.0:1; S₃:S₂, 1.6–1.8:1. Tegula with two bristles.

Abdomen. Tergites 2–5 densely brown pollinose dorsally, with silver posterolateral patches extending well up onto posterior corners of dorsum; dorsal silver patches on tergite 5 more extensive. Tergite 5 asymmetrical, T5R:T5L, 1.5:1. Tergite 6 narrow with separate right lateral plate; with no protuberances (Fig. 13A). Sternites 2–4 small, triangular; with scattered small bristles (Fig. 13A). Sternite 5 divided into two small sections; with scattered small bristles (Fig. 13A). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 swollen internally; with right lateral C-shaped protuberance sweeping out posterolaterally into pointed tip (Fig. 13A). Syntergosternite 8 dark brown, sparsely brown pollinose, swollen, WS8:LT35, 1.2–1.3:1, WT5:WS8, 1.0:1.

Genitalia. Epandrium shining brown; wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.7–2.8:1. Cerci yellow; small and bulbous (Fig. 13B,D). Surstyli yellow to brownish yellow; short and stubby, with distinctive dorsal ridges; asymmetrical, right surstylus with single long, thin basal hook bending dorsomedially; short, almost as deep as long, with a few basal hairs (Fig. 13B–C).

Subepandrial sclerite wide, darkly sclerotised; symmetrical, WSES:WEP, 0.4:1 (Fig. 13C). Hypandrium strongly deflected left (Fig. 13C). Phallic guide straight, with small distal hook; asymmetrical with large dorsolateral flaps, slightly larger on right side; with row of long hairs laterally just proximal to hook (Fig. 13B–C). Phallus trifold, projecting nearly to tips of surstyli; ducts closely associated throughout most of length although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 13B–C). Hypandrial apodeme very wide, with ring clasp base of sperm pump arising medially (*cf.* Fig. 25E). Sperm pump round, fused with basal rosette of ejaculatory apodeme. Ejaculatory apodeme large funnel with basal rosette (Fig. 13C).

Female

Unknown.

Distribution

Known from inland locations in south-east Queensland and north-east New South Wales (Fig. 9E).

Remarks

Clistoabdominalis colophus is part of the *C. koebelei* species-group (Fig. 2). All members of this group are hilltopping species and *C. colophus* has never been captured away from its hilltopping sites in dry sclerophyll forest. Species within the *koebelei*-group are often collected together and on four different days all five species were captured at Mount Moffatt in Carnarvon National Park.

Etymology

Derived from the Greek *kolophos*, 'summit, top'; in reference to the hilltopping behaviour of all known specimens. Masculine.

Clistoabdominalis condylostylus, sp. nov.

(Figs 9F, 14A–E)

Material examined

Holotype. Australia, Queensland, Moreton Island, Mt Tempest, 27°09' S, 153°24' E, 285 m, hilltop [in heath], ♂, 21.ix.1997, JAS, #1090 (QM T99013).

Paratypes. **Australia: Queensland:** Undara Volcanic NP, Bluff, [18°19' S, 144°44' E], 770 m, hilltop, 2♂, 11.vi.1997, JAS, #772, 6 (UQ); Mt Moffatt NP, Marlong Arch, 24°59'28'S, 147°53'48'E, 820 m, 1♂, 19.xi.1995, CB, #72 (QM T99014); Mt Beerburum, 26°56' S, 152°56' E, hilltop, 2♂, 22.iv.1997, JS, CL, #830–1 (UQ); same data as holotype, 4♂, 20.ix.1997, JAS, #1070, 2, 83, 6 (CNC), 3♂, 21.ix.1997, JAS, #1091–2, 4 (ISNB), 8♂, 22.iii.1998, JAS, #3783–90 (UQ). **New South Wales:** Royal NP, [34°04' S, 151°04' E], 1♂, 29.viii.1976, GAD, #4029 (GDCB).

Description and measurements based on #72, 772, 776, 830, 1086, and 1090–1.

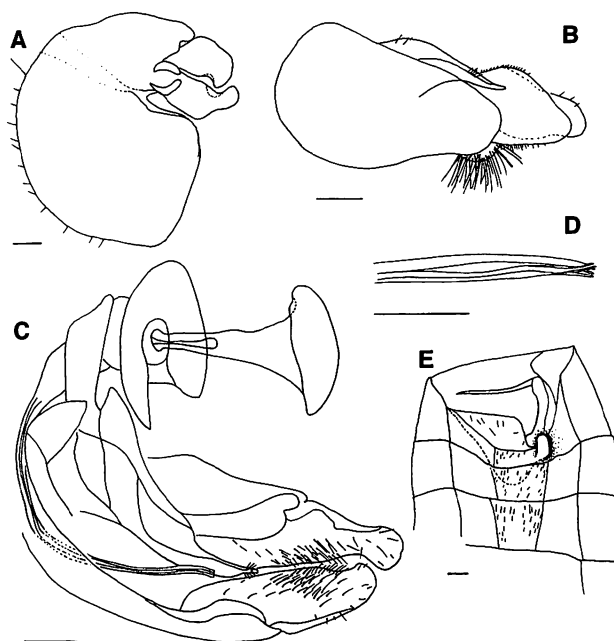


Fig. 14. Male *Clistoabdominalis condylostylus* (#72 and 772). A, ventral of distal end of abdomen; B, right lateral of terminalia; C, dorsal of terminalia; D, dorsal of tip of phallus; E, ventral of abdomen with terminalia removed. Scale bars = 0.1 mm.

Diagnosis

Male

Autapomorphies. Tergite 6 with long protuberance projecting from ventral edge of sclerite (Fig. 14E). Right surstylus simple, tapering to blunt tip; left surstylus longer, narrowest in centre, with bulbous tip; with long, dense, medial hairs (Fig. 14C). Phallic guide symmetrical; deflected ventrally at about 30° (Fig. 14B–C).

Characters shared with a few species. Pedicel with long bristles, PW:BL <2.8:1. Scutum brown pollinose dorsally, silver-grey pollinose anterolaterally and posterolaterally. Scutellum brown pollinose medially, silver pollinose around border. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Wing with r-m crossvein located medially in discal cell; $S_3:S_2$, 1.1–1.2:1. Syntergosternite 8 small, WS8:LT35, 0.7–0.8:1. Epandrium black; entirely pruinose. Subepandrial sclerite wide, asymmetrical, offset to the right; WSES:WEP, 0.4–0.6:1 (Fig. 14C). Ejaculatory apodeme large funnel with basal rosette (Fig. 14C).

Description

Male

Body length, 3.6–5.1 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 1.9–2.3:1, PW:VBL, 1.8–2.7:1. Scape with one dorsal bristle. Labellum dark brown to yellowish brown.

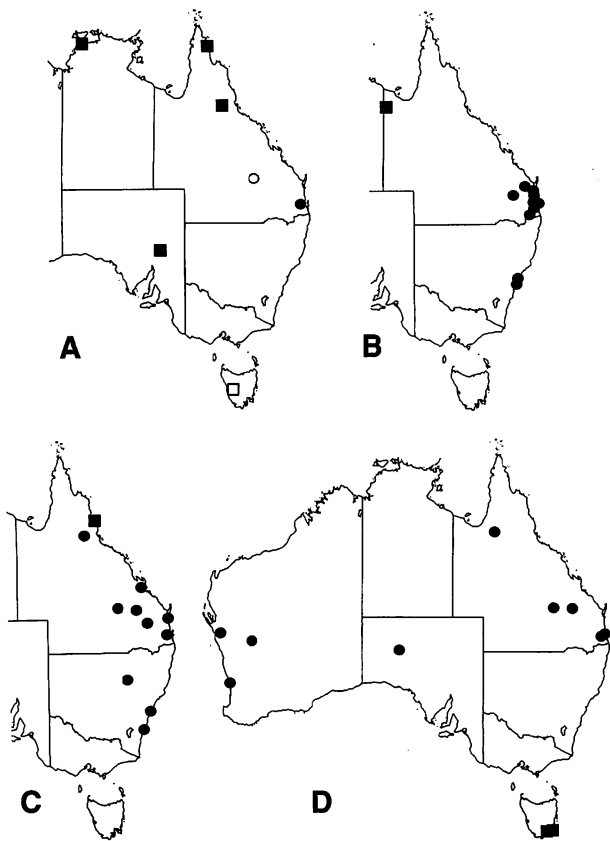


Fig. 16. Distributions of *Clistoabdominalis* species. A, ○ *C. dasymelus*, ● *C. gaban*, ■ *C. nutatus*, □ *C. scalenus*; B, ■ *C. danielsi*, ● *C. yeatesi*; C, ■ *C. eutrichodes*, ● *C. koebelei*; D, ■ *C. exallus*, ● *C. lingulatus*.

focus on this habitat and possibly on nearby hills. Given that all of the other species in the *nutatus*-group form hilltop aggregations it is reasonable to expect *C. danielsi* to hilltop too.

Etymology

Proposed in honour of Greg Daniels, one of the collectors of the only specimen of this species, and a prolific collector of Australian Diptera.

Clistoabdominalis dasymelus, sp. nov.

(Figs 16A, 17A–F)

Material examined

Holotype. Australia, Queensland, Mt Moffat[t] NP, Mt Moffat[t] Summit, [25°04' S, 148°03' E], ♂, 15.xii.1987, DY, #34 (QM T99016).

Paratype. Australia: Queensland: 1♂, same data as holotype, #32 (UQ).

Other material examined. Australia: Queensland: 1♂, same data as holotype [specimen disarticulated for drawing], #33 (CNC).

Description and measurements based on all specimens.

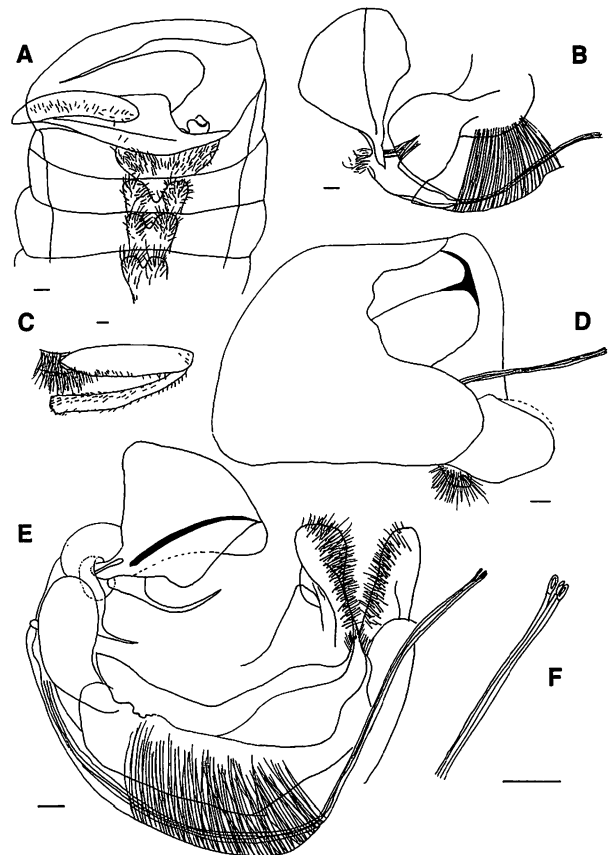


Fig. 17. Male *Clistoabdominalis dasymelus* (#32–34). A, ventral of abdomen with terminalia removed; B, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme; C, anterolateral view of hind leg; D, right lateral of terminalia; E, dorsal of terminalia; F, dorsal of tip of phallus. Scale bars = 0.1 mm.

Diagnosis

Male

Autapomorphies. Hind coxa and all trochanters with dense aggregation of long anteroventral hairs (Fig. 17C). Fore and mid femora with proximal, posterior cluster of long hairs. Tergite 5 silver pollinose on all but small anteromedial brown pollinose patch; very asymmetrical, T5R:T5L, 3.1:1. Tergite 6 with round ventral protuberance, raised on opposite edges (Fig. 17A). Sternites 2–5 heart-shaped, covered with long bristles (Fig. 17A). Surstyli symmetrical; short, almost as deep as long; densely haired over entire medial surface (Fig. 17E).

Characters shared with a few species. Body length, 5.0–5.6 mm. Pedicel with long bristles, PW:BL, <3:1. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally, along posterior edge, and in two dorsocentral stripes. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Sternite 6 narrow, not swollen internally (Fig. 17A). Syntergosternite 8 very swollen, WT5:WS8, 0.8:1. Epandrium glabrous, shining reddish brown. Phallic guide with row of long hairs laterally

just proximal to hook (Fig. 17E). Tips of phallic ducts cut on angle like needles (Fig. 17F). Phallus supported medially by darkly pigmented membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 17B,E). Sperm pump teardrop-shaped, not fused with basal rosette of ejaculatory apodeme (Fig. 17B). Ejaculatory apodeme large, 3-sided (Fig. 17B,D–E).

Description

Male

Body length, 5.0–5.6 mm.

Head. Postpedicel obtuse; brown. Pedicel brown with 4–5 dorsal bristles and 2–3 ventral bristles; PW:DBL, 2.1–2.8:1, PW:VBL, 1.6–2.4:1. Scape with one dorsal bristle. Labellum brownish yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally, along posterior edge, and in two dorsocentral stripes. Scutellum sparsely brown pollinose posteriorly, silver-grey pollinose along anterior edge; with fringe of 16–20 hairs. Halter brown.

Legs. Hind coxa with dense aggregation of long anteroventral hairs. Trochanters brown with dense aggregation of long, ventral hairs (Fig. 17C). Femora brown with yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–9 black spines on apical half, posteroventrally with row of 10–16 black spines on apical half; fore and mid femora with proximal, posterior cluster of long hairs. Tibiae brown with yellow apices; fore and mid tibiae with no apical spines.

Wings. Length: 5.5–6.3 mm; C₄:C₃, 0.8:1; S₃:S₂, 1.3–1.4:1. Tegula with two bristles.

Abdomen. Tergites 2–4 brown pollinose dorsally and anterolaterally, silver posterolaterally. Tergite 5 silver pollinose on all but small anteromedial brown pollinose patch; very asymmetrical, T5R:T5L, 3.1:1. Tergite 6 very narrow dorsally, widening ventrally, with round ventral protuberance, raised on opposite edges (Fig. 17A). Sternites 2–5 heart-shaped, covered with long bristles (Fig. 17A). Sternites 6 and 7 silver pollinose, not visible from above. Sternite 6 narrow, not swollen internally (Fig. 17A). Syntergosternite 8 dark brown, sparsely silver pollinose, very swollen, WS8:LT35, 1.8:1, WT5:WS8, 0.8:1.

Genitalia. Epandrium glabrous, shining reddish brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.1:1. Cerci dull yellow. Surstyli dark brown apically, shining yellowish brown proximally; symmetrical; short, almost as deep as long; densely haired over entire medial surface (Fig. 17E). Subepandrial sclerite moderately wide, symmetrical, WSES:WEP, 0.3–0.4:1. Hypandrium strongly deflected left (Fig. 17E). Phallic guide straight, with small distal hook; symmetrical, with row of long hairs laterally just proximal to hook (Fig. 17E). Phallus

trifid, projecting to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts cut on angle like needles (Fig. 17F). Phallus supported medially by darkly pigmented membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 17B,E). Hypandrial apodeme a wide, darkly sclerotised sheet connecting distally with sperm pump (Fig. 17B). Sperm pump teardrop-shaped, not fused with basal rosette of ejaculatory apodeme (Fig. 17B). Ejaculatory apodeme large, 3-sided, with basal rosette (Fig. 17B,D–E).

Female

Unknown.

Distribution

Known only from Carnarvon National Park in Queensland (Fig. 16A).

Remarks

With a suite of external autapomorphies to choose from, this is undoubtedly the most distinctive species of *Clistoabdominalis*. Unfortunately, it is apparently not common even in Carnarvon National Park where the type series was collected. A decade after the type specimens were collected, collectors from the University of Queensland returned to Carnarvon and heavily sampled the pipunculids there (1672 specimens). We collected a number of new species and every species previously captured in the park except for *C. dactylus*. We spent several days collecting in the type locality in late November/early December 1997 and January 1998. It is unlikely that we overlooked such a conspicuous species. The habitat in the area around Mount Moffatt is all dry sclerophyll forest. Fires commonly modify the vegetation of the area so it may be that *C. dactylus* numbers vary in response to host numbers that are influenced by these fires. More work in the area is necessary to test this hypothesis.

Etymology

From the Greek *dasys* for 'hairy' or 'shaggy' and *melos* for 'limb'; in reference to the distinctive hairy trochanters of this species. Neuter.

Clistoabdominalis digitatus, sp. nov.

(Figs 6B, 18A–D)

Material examined

Holotype. Australia, Queensland, Carnarvon NP, Mt Moffatt Section, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, ♂, 22.i.1998, JAS, SW, #2407 (QM T99017).

Paratypes. **Australia: Queensland:** Tumoulin SF, 17°34'12" S, 145°29'33" E, Malaise trap, 1♂, 15–20.xi.1999, MM, #7715 (UQ);

Undara Volcanic NP, Bluff, [18°19' S, 144°44'E], 770 m, hilltop, 5♂, 11.vi.1997, JAS, #666–7, 80–2, 2♂, 19.vii.1998, JRS, #3961, 3 (UQ); Mt Etna, summit, 23°09'35" S, 150°27'06" E, 284 m, 1♂, 19.ix.1999, JAS, #6990 (UQ); same data as holotype, 2♂, 27.xi.1997, JS, CL, #1743, 6, 35♂, 29.xi.1997, JS, CL, #1272, 6, 83, 93, 1302, 7–8, 12, 22, 5, 7, 9, 39, 43, 59, 66, 8–9, 72–4, 80, 3–4, 8, 97, 1407, 12, 4–5, 7, 9, 22–3, 42, 15♂, 2.xii.1997, JS, CL, #2002, 7, 9, 18, 21, 41, 7, 64, 8, 95, 9, 2141, 8, 81–2 (UQ), 17♂, 20.i.1998, JAS, SW, #2760, 70, 3, 7, 89, 92, 2911–2, 4–5, 30, 42, 7–8, 65, 7–8 (ISNB), 21♂, 22.i.1998, JAS, SW, #2400, 8, 20, 6, 30, 7, 9, 57, 66, 8, 75, 7, 82, 91, 2507, 14, 9, 21, 51, 61, 79 (CNC); Carnarvon NP, Mt Moffatt Section, southernmost of 3 Sisters, summit, 25°06'36" S, 148°05'40" E, 1♂, 23.i.1998, JAS, SW, #2745 (UQ); Isla Gorge NP, 25°11' S, 149°58' E, 320 m, hilltop near lookout, 3♂, 13.xi.1999, JAS, #7294, 6–7 (UQ); Cooloolo NP, East Mullen hilltop, 26°00' S, 152°59' E, 129 m, [hilltop in dry sclerophyll], 5♂, 12.iv.1998, JAS, #3907, 9–10, 12–3 (UQ); Barakula SF No. 302, Summit Round Mt, 26°22'13" S, 150°58'09" E, [hilltop], 3♂, 8.i.2000, JAS, MM, #7520, 2, 6 (UQ); Mt Glorious, Scrub Ck Road, Brisbane Forest Park, 27°25' S, 152°50' E, Mal[aise] trap, 1♂, 12–29.x.1998, NP, #7780 (UQ); Brisbane, Mt Coot-tha, 27°29'16" S, 152°57'02" E, 170 m, hilltop, 2♂, 27.i.1998, JAS, #3053, 73, 1♂, 4.ix.1999, JAS, #7194 (UQ); Mt Greville, 28°05' S, 152°30' E, 770 m, hilltop, 5♂, 6.iv.1997, JS, #802–3, 6–7, 9 (UQ). **Australian Capital Territory:** Black Mt, [35°16' S, 149°06" E], Malaise trap, Malaise site 1, 1♂, 1.iv.1980, DC, #355 (ANIC); Warrumbungle NP, Split Rock, 31°17'08" S, 148°59'00" E, hilltop, 1♂, 18.i.1999, JAS, #4516 (UQ). **Tasmania:** Eaglehawk Neck, [43°02' S, 147°55' E], 1♂, 22.iv.1916, C. Cole, #4444 (MVMA).

Other material examined. **Australia: Queensland:** same location as holotype, 6♂, #1427, 764, 953, 97, 2029, 2145 (UQ); Brisbane, Mt Coot-tha, 1♂, #3063 (UQ).

Description based primarily on #667, 2018, 2407, 2437, 2507, 3053, and 7297; measurements based on #355, 666–7, 681–2, 1369, 1407, 1417, 1953, 2018, 2041, 2095, 2141, 2407, 2437, 2507, 2930, 3053, 4444, 4516, 7297, and 7715.

Diagnosis

Male

Autapomorphies. Subepandrial sclerite with a hairy, finger-like projection at the base of the right surstylus; very wide, WSES:WEP, > 0.6:1 (Fig. 18C–D).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.6–2.1:1. Tergites 2–4 entirely brown pollinose dorsally. Tergite 6 with raised ventromedial protuberance (Fig. 18B). Sternite 6 narrow, not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 18B). Syntergosternite 8 swollen, WT5:WS8, 0.9–1.0:1. Epandrium entirely pruinose to shining brown along junction with syntergosternite 8. Cerci small and bulbous (Fig. 18D). Surstyli brown to black; asymmetrical, short and stubby, right surstylus with single basal hook bending dorsomedially (Fig. 18C–D). Subepandrial sclerite darkly sclerotised; asymmetrical (Fig. 18C). Phallic guide with large dorsolateral flaps, largest on right side; with row of long hairs laterally just proximal to hook (Fig. 18C–D). Hypandrial apodeme wide, with ring clasping base of sperm

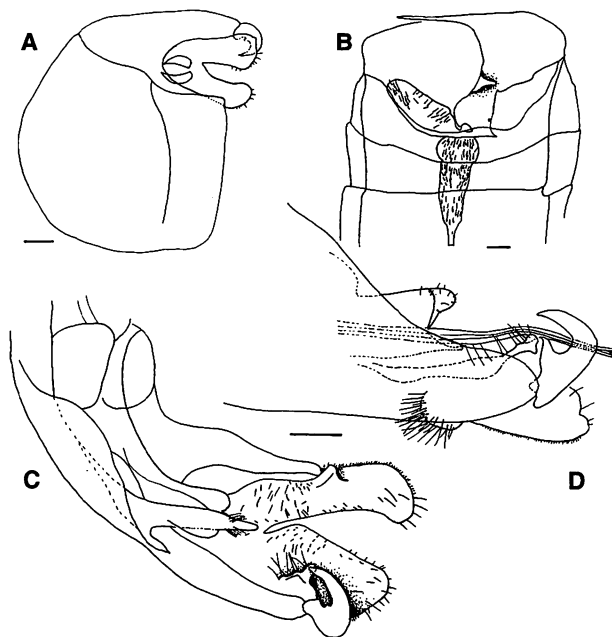


Fig. 18. Male *Clistoabdominalis digitatus* (#3053 and 7297). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, dorsal of terminalia, phallus removed; *D*, right lateral of terminalia. Scale bars = 0.1 mm.

pump arising medially (*cf.* Fig. 25E). Ejaculatory apodeme large funnel (*cf.* Fig. 4D)

Description

Male

Body length, 2.8–3.5 mm.

Head. Postpedicel obtuse; brown to yellowish brown. Pedicel brown with three dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.2–4.5:1, PW:VBL, 3.4–4.3:1. Scape with one dorsal bristle. Labellum brown to yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum densely brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum entirely brown pollinose to silver pollinose along anterior edge; with fringe of 4–10 hairs. Halter brown to yellow.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–7 black spines on apical half, posteroventrally with row of 9–11 black spines. Tibiae yellow; fore and mid tibiae with apical spines.

Wings. Length: 3.3–3.9 mm; $C_4:C_3$, 1.0–1.2:1; $S_3:S_2$, 1.6–2.1:1. Tegula with two bristles.

Abdomen. Tergites 2–4 entirely brown pollinose dorsally, silver pollinose posterolaterally. Tergite 5 brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; asymmetrical, T5R:T5L, 1.2–1.4:1. Tergite 6 narrow with separate right

lateral plate; with raised ventromedial protuberance (Fig. 18B). Sternites 2–5 rectangular, covered with bristles (Fig. 18B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 narrow, not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 18B). Syntergosternite 8 dark brown, sparsely brown pollinose, swollen, WS8:LT35, 1.2–1.5:1, WT5:WS8, 0.9–1.0:1.

Genitalia. Epandrium entirely pruinose to shining brown only along junction with syntergosternite 8; wrapping around dorsally so that slightly visible in dorsal view; asymmetrical, ER:EL, 3.0–3.4:1. Cerci brownish yellow; small and bulbous (Fig. 18A, D). Surstyli brown to black; asymmetrical, short and stubby, right surstylus with single basal hook bending dorsomedially; short, almost as deep as long, with a few long medial and distal hairs (Fig. 18C–D). Subepandrial sclerite very wide, darkly sclerotised; WSES:WEP, 0.7–0.8:1; asymmetrical; with a hairy, finger-like projection at the base of the right surstylus (Fig. 18C–D). Hypandrium strongly deflected left (Fig. 18C). Phallic guide straight, with small distal hook; asymmetrical with large dorsolateral flaps, largest on right side; with row of long hairs laterally just proximal to hook (Fig. 18C–D). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 18D). Hypandrial apodeme wide, with ring clasping base of sperm pump arising medially (*cf.* Fig. 25E). Sperm pump round, fused with basal rosette of ejaculatory apodeme (*cf.* Fig. 4D). Ejaculatory apodeme large funnel with basal rosette (*cf.* Fig. 4D).

Female

Unknown.

Distribution

Clistoabdominalis digitatus occurs from its northern limit on the Atherton Tableland, south through eastern Queensland, New South Wales, the Australian Capital Territory, and Tasmania (Fig. 6B).

Remarks

This species has been collected only in dry sclerophyll forest. It is prevalent on hilltops with 129 of 133 specimens taken in this situation. *Clistoabdominalis koebeleri* is very similar, with only subtle differences in the surstyli and the subepandrial sclerite. The most distinctive feature that differentiates these putative sister species is the hairy, finger-like protuberance at the base of the right surstylus in *C. digitatus*. It varies somewhat in length but is consistently present in all specimens. To complicate the issue, the two species usually occur together. There is a possibility that they are conspecific and this feature is simply a polymorphism.

There is no evidence of such a genitalic polymorphism in any other pipunculid species so I feel confident in treating these forms as two species here. However, it would be interesting to examine the genetic population structure of these two species to test this species concept.

Etymology

Derived from the Latin *digitatus*, ‘having fingers’; in reference to the finger-like projection on the subepandrial sclerite at the base of the right surstylus. Masculine.

Clistoabdominalis eutrichodes (Perkins)

(Figs 5E, 16C, 19A–E)

- Pipunculus eutrichodes* Perkins, 1906a: 494. – T.I.: Australia, Queensland, Kuranda, near Cairns. – T.d.: BPBM (Nr 4202).
Pipunculus (Eudorylas) eutrichodes Perkins, 1906a. – Hardy, 1964, 1989.
Eudorylas eutrichodes (Perkins, 1906a). – De Meyer, 1996.
Clistoabdominalis eutrichodes (Perkins, 1906a). – Skevington & Yeates, 2001.

Material examined

Lectotype. Australia, Queensland, Cairns, Kur[anda, 16°49' S, 145°38' E, right wing missing; pin corroding], ♂, viii.1904, #9338 (BPBM nr 4202).

Paralectotypes. **Australia: Queensland:** North Queensland, 1 ♂, 1 ♀, #4148–9 (ZMAN); Cairns, [16°55' S, 145°46' E], 2 ♀, vii.1904, 1 ♂, 1 ♀, viii.1904, #3539–42 (BPBM).

Description and measurements based on all specimens.

Diagnosis

Male

Autapomorphies. Entire dorsum of thorax and abdomen covered with long hairs (Fig. 19E).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. Trochanters with scattered hairs ventrally. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; S₃:S₂, 1.8–2.1:1. Tergite 6 swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 19B). Sternites 2–5 densely covered with peg-like bristles (Fig. 19B). Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6; raised into ridge medially on left side (Fig. 19B). Epandrium glabrous, shining brown to reddish brown. Left surstylus expanded laterally (Fig. 19D). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, < 0.2:1 (Fig. 19D). Phallic guide with small, hairy protuberance on the right side (Fig. 19D). Ejaculatory apodeme large funnel (Fig. 19D).

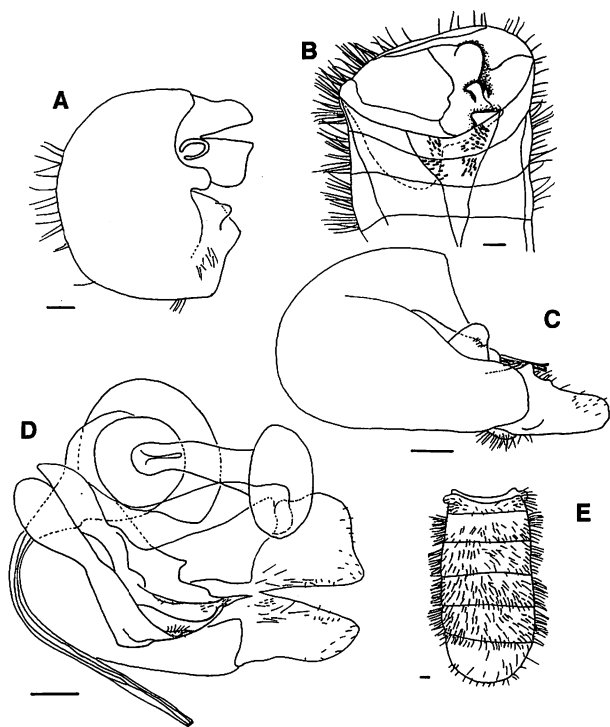


Fig. 19. Male *Clistoabdominalis eutrichodes* (#4148). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, right lateral of terminalia; *D*, dorsal of terminalia, phallus displaced laterally; *E*, dorsal of abdomen. Scale bars = 0.1 mm.

Female

Characters shared with a few species. Tarsomeres of hind leg flattened. Ovipositor piercer slightly down curved, base cylindrical (Fig. 5E).

Description

Male

Body length, 2.6–3.5 mm.

Head. Postpedicel short acuminate; yellow. Pedicel brown with 2–5 dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.2–4.0:1, PW:VBL, 3.7–6.0:1. Scape with one dorsal bristle. Labellum yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally; entirely covered dorsally with long hairs. Scutellum brown pollinose; entirely covered with long hairs, fringe with 24–28 hairs. Halter yellow.

Legs. Trochanters brown, with scattered hairs ventrally. Femora brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–5 black spines on apical half, posteroventrally with row of 9–10 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.3–4.1 mm; $C_4:C_3$, 1.0–1.3:1; $S_3:S_2$, 1.8–2.1:1. Tegula with two bristles.

Abdomen. Tergite 1 entirely covered with long hairs (Fig. 19E). Tergites 2–5 lightly brown pollinose dorsally, appearing shining black in patches; with silver posterolateral patches extending onto posterior corners of dorsum; entirely covered with long hairs (Fig. 19E). Tergite 5 asymmetrical, T5R:T5L, 1.4:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 19B). Sternites 2–5 rectangular, densely covered with peg-like bristles (Fig. 19B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6; raised into ridge medially on left side (Fig. 19B). Syntergosternite 8 dark brown, sparsely brown pollinose, only slightly swollen, WS8:LT35, 1.0:1, WT5:WS8, 1.0:1; covered with long hairs (Fig. 19E).

Genitalia. Epandrium shining brown to reddish brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 3.0:1. Cerci yellow. Surstyli brown; asymmetrical; left surstylus expanded laterally; short, longer than deep, with 8–10 dorsomedial hairs basally (Fig. 19C–D). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2:1 (Fig. 19D). Hypandrium strongly deflected left (Fig. 19D). Phallic guide straight, with small distal hook; slightly asymmetrical with small protuberance on the right side; with 2 or 3 short hairs laterally just proximal to hook (Fig. 19D). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 19C–D). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 19D). Ejaculatory apodeme large funnel with basal rosette (Fig. 19D).

Female

As male except: eyes dichoptic; FR, 1.0–1.1:1. FFE, 0.6:1. Tarsomeres of hind leg flattened. Tergite 6 shining black dorsally, silver pollinose posterolaterally.

Ovipositor. Ovipositor piercer slightly down curved; base cylindrical (Fig. 5E). OL, 0.6 mm; OL:PL, 2.0:1; BL:OL, 0.5–0.6:1; B:PL, 4.4–5.2:1.

Distribution

All known specimens are from the type series from the Cairns area in North Queensland (Fig. 16C).

Remarks

This species is virtually identical to *C. beneficiens* except for the long hairs covering the thorax and abdomen and the lack of spines on hind trochanter. Hardy (1964) designated the lectotype (referred to as ‘type’ in his paper) for *C. eutrichodes*.

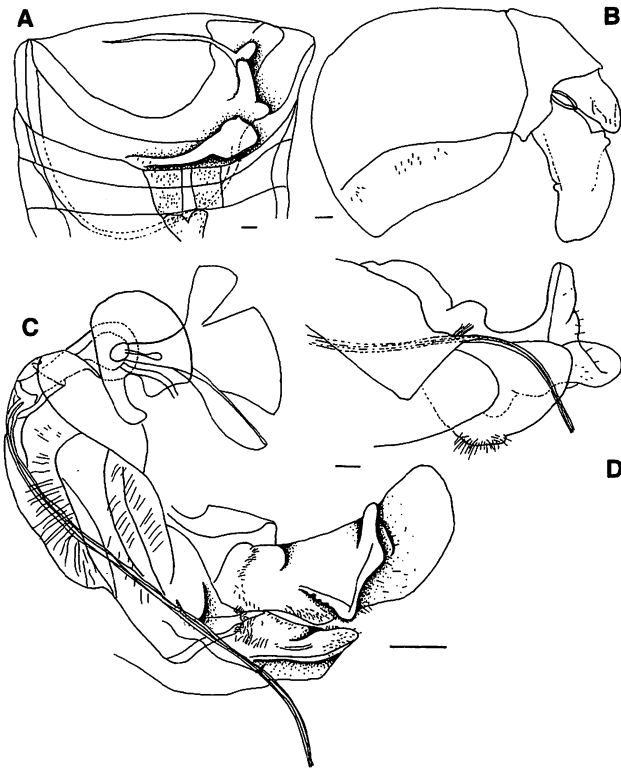


Fig. 20. Male *Clistoabdominalis exallus* (#4446). *A*, ventral of abdomen with terminalia removed; *B*, ventral of distal end of abdomen; *C*, dorsal of terminalia; *D*, right lateral of terminalia. Scale bars = 0.1 mm.

Clistoabdominalis exallus, sp. nov.

(Figs 16*D*, 20*A–D*)

Material examined

Holotype. Australia, Tasmania, N Bruny Island, Waterview Hill, 43°05'35" S, 147°21'04" E, hilltop, ♂, 31.xii.1998, JAS, MM, #4548 (ANIC).

Paratype. Australia: Tasmania: Eaglehawk Neck, [43°02' S, 147°55' E], 1♂, 22.iv.1916, C. Cole, #4446 (MVMA).

Description and measurements based on both specimens.

Diagnosis

Male

Autapomorphies. Tergite 6 with short, wide, fin-like lateral protuberance (Fig. 20*A*). Sternite 5 bright orange, shining; developed into large blocky, right lateral protuberance, easily visible in ventral view without dissection (Fig. 20*A*). Sternites 3–4 divided, rectangular, with scattered bristles (Fig. 20*A*). Sternites 6 and 7 black laterally, orange ventrally; silver pollinose posterolaterally, shining anterolaterally and ventrally. Cerci elongate (Fig. 20*B*). Left surstylus greatly enlarged, long, sweeping out laterally, with high medial ridge and small basal

protuberance; right surstylus much smaller, rectangular, compressed laterally; both surstyli with numerous short, medial hairs (Fig. 20*B–D*). Subepandrial sclerite hollowed out medially. Base of right hypandrial lobe with sclerotised flap projecting posteriorly (Fig. 20*C*). Sperm pump elongate, pipe-shaped with 90° bend (Fig. 20*C*).

Characters shared with a few species. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally, along posterior edge, and in two dorsocentral stripes. Scutellum brown pollinose medially, silver-grey pollinose around edges. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Wing with r-m crossvein located submedially in discal cell; $S_3:S_2$, 1.3–1.4:1. Tegula with five bristles. Tergite 6 fused with right lateral plate (Fig. 20*A*). Sternite 6 enlarged, swollen internally; with distinctive, thickened edge; ventral protuberance a long, thin finger adjacent to tergite 6 (Fig. 20*A*). Synergosternite 8 swollen, $WT5:WS8$, 1.0:1. Epandrium shining reddish brown. Left gonopod with round distal protuberance (Fig. 20*C*). Tips of phallic ducts cut on angle like needle (*cf.* Fig. 17*F*). Phallus supported medially by membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 20*C*). Ejaculatory apodeme three-sided; one side extremely short so that appears almost flat in lateral view (Fig. 20*C*).

Description

Male

Body length, 5.4 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 4–6 dorsal bristles and 2–4 ventral bristles; $PW:DBL$, 2.6–3.5:1, $PW:VBL$, 2.6–3.5:1. Scape with 1–2 dorsal bristles. Labellum brownish yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally, along posterior edge, and in two dorsocentral stripes. Scutellum brown pollinose medially, silver-grey pollinose around edges; with fringe of 14–16 hairs. Halter brown.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 10 black spines on apical half, posteroventrally with row of 11–13 black spines. Tibiae yellow to slightly darkened medially; apical spines absent.

Wings. Length: 6.7–6.9 mm; $C_4:C_3$, 0.6–0.7:1; $S_3:S_2$, 1.3–1.4:1. Tegula with five bristles.

Abdomen. Tergites 2–5 mostly densely brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; silver most extensive dorsally on tergite 5. Tergite 5 asymmetrical, $T5R:T5L$, 1.3:1. Tergite 6 narrow dorsally, wider laterally and fused with right lateral plate; with short, wide, fin-like lateral protuberance (Fig.

20A). Sternite 5 highly modified; bright orange, shining; developed into large blocky, right lateral protuberance, easily visible in ventral view without dissection (Fig. 20A). Sternites 3–4 divided, rectangular, with scattered bristles (Fig. 20A). Sternite 2 small, V-shaped, with scattered bristles (Fig. 20A). Sternites 6 and 7 black laterally, orange ventrally; silver pollinose posterolaterally, shining anterolaterally and ventrally; not visible from above. Sternite 6 enlarged, swollen internally, with distinctive, thickened edge; ventral protuberance a long, thin finger adjacent to tergite 6; point of fusion of sternite 6 and tergite 6 difficult to see (Fig. 20A). Syntergosternite 8 dark brown, with mixed brown and silver pollinosity, swollen, WS8:LT35, 1.6:1, WT5:WS8, 1.0:1.

Genitalia. Epandrium shining reddish brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.2:1. Cerci yellow, elongate (Fig. 20B). Surstyli yellow; asymmetrical; left surstylus greatly enlarged, long and sweeping out laterally, with high medial ridge and small basal protuberance; right surstylus much smaller, rectangular, compressed laterally; both surstyli with numerous short, medial hairs (Fig. 20B–D). Subepandrial sclerite moderately wide; hollowed out medially; slightly asymmetrical, offset to the right; WSES:WEP, 0.3:1. Hypandrium strongly deflected left; base of right hypandrial lobe with sclerotised flap projecting posteriorly; left gonopod with round distal protuberance (Fig. 20C). Phallic guide straight, with small distal hook; slightly asymmetrical; dorsal hypandrium extension onto phallic guide more prominent on left side; row of short hairs laterally just proximal to hook (Fig. 20C–D). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts cut on angle like needle (Fig. 20C–D; cf. Fig. 17F). Phallus supported medially by membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 20C). Hypandrial apodeme wide. Sperm pump elongate, pipe-shaped with 90° bend; fused with basal rosette of ejaculatory apodeme (Fig. 20C). Ejaculatory apodeme apparently three-sided; one side extremely short so that appears almost flat in lateral view; basal rosette U-shaped (Fig. 20C).

Female

Unknown.

Distribution

Endemic to south-eastern Tasmania (Fig. 16D).

Remarks

One of the two specimens was captured hilltopping. Unlike most pipunculids which tend to stay low over shrubs when hilltopping, this male was hovering approximately 5.5 m above open ground under mature *Eucalyptus* trees. It was not disturbed by several attempts to catch it and quickly returned

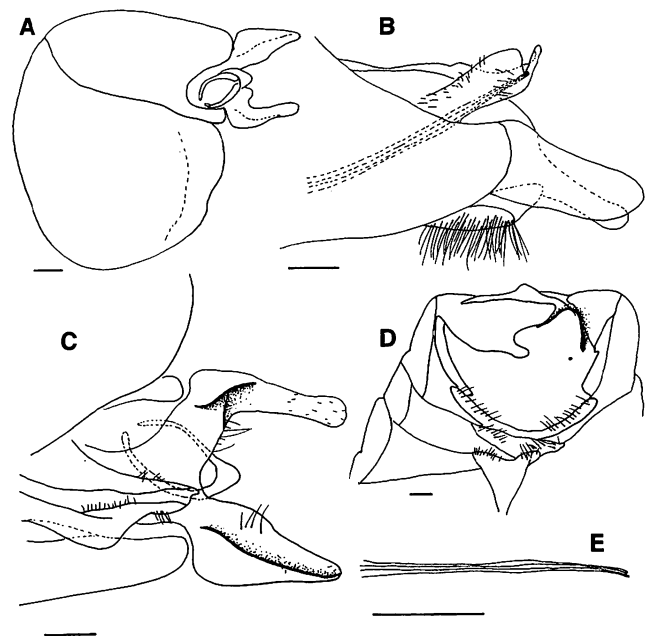


Fig. 21. Male *Clistoabdominalis gaban* (#3136). A, ventral of distal end of abdomen; B, right lateral of terminalia; C, dorsal of terminalia, phallus removed; D, ventral of abdomen with terminalia removed; E, dorsal of phallus. Scale bars = 0.1 mm.

to the same spot after each disturbance. Given that the day was overcast and cool, it should be easy to find more of these flies when the conditions are better.

Etymology

Derived from the Greek *exallos*, 'quite different'; in reference to the unusual surstyli of this species. Neuter.

Clistoabdominalis gaban, sp. nov.

(Figs 16A, 21A–E)

Material examined

Holotype. Australia, Queensland, Mt Glorious Biological Centre, main road, [27°19'54" S, 152°45'29" E], rainforest, canopy Malaise trap, ♂, 16–23.i.1998, SW, NP, DW, #3136 (QM T99018).

Description and measurements based on holotype.

Diagnosis

Male

Autapomorphies. Sternites 3–5 narrow, V-shaped, with very long, posterolateral bristles (Fig. 21D). Cerci with distinctive posterodorsal, sclerotised swelling (Fig. 21B–C). Right surstylus triangular; left surstylus L-shaped, with long, thin distal arm and small, triangular protuberance at base (Fig. 21A,C).

Characters shared with a few species. Trochanters yellow. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.5:1. Tegula with 10 bristles. Tergite 6 swollen medially (Fig. 21D). Sternite 6 enlarged but not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 21D). Syntergosternite 8 swollen, $WT_5:WS_8$, 1.1:1. Subepandrial sclerite narrow, asymmetrical, offset to the right; $WSES:WEP$, 0.2:1 (Fig. 21C). Phallic guide with large, moderately hairy dorsolateral flap on right side (Fig. 21B–C). Ejaculatory apodeme large funnel (cf. Fig. 19D).

Description

Male

Body length, ~3.9 mm.

Head. Postpedicel short acuminate; bright yellow. Pedicel brown with three dorsal bristles; $PW:DBL$, 3.0:1. Labellum yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, sparsely silver-pollinose anterolaterally. Scutellum brown pollinose; with fringe of 12 hairs. Halter yellow.

Legs. Trochanters yellow; with scattered bristles. Femora brown with yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 7–9 black spines on apical half, posteroventrally with row of 11–12 black spines. Tibiae yellow; fore and mid tibiae with apical spines.

Wings. Length: 5.1 mm; $C_4:C_3$, 0.7:1; $S_3:S_2$, 1.5:1. Tegula with 10 bristles.

Abdomen. Tergites 2–3 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Vestiture of tergites 4–5 not seen, specimen dissected. Tergite 5 asymmetrical, $T5R:T5L$, 1.4:1. Tergite 6 narrow dorsally, wider laterally with separate right lateral plate; swollen medially (Fig. 21D). Sternites 3–5 narrow, V-shaped, with very long, posterolateral bristles (Fig. 21D). Sternite 2 triangular with posterolateral bristles. Sternites 6 and 7 not visible from above. Sternite 6 enlarged but not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 21D). Syntergosternite 8 swollen, $WS_8:LT_{35}$, 1.0:1, $WT_5:WS_8$, 1.1:1.

Genitalia. Epandrium wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 3.3:1. Cerci with distinctive posterodorsal, sclerotised swelling (Fig. 21B–C). Surstyli asymmetrical; right surstylus triangular; left surstylus L-shaped, with long, thin distal arm; base of left surstylus with small, triangular protuberance; surstyli with about five medial bristles (Fig. 21A–C). Subepandrial sclerite narrow, asymmetrical, offset to the right; $WSES:WEP$, 0.2:1 (Fig. 21C). Hypandrium strongly

deflected left. Phallic guide straight, with narrow distal hook; asymmetrical, with large, moderately hairy dorsolateral flap on right side (Fig. 21B–C). Phallus trifold, very narrow, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 21E). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (cf. Fig. 19D). Ejaculatory apodeme large funnel with basal rosette (cf. Fig. 19D).

Female

Unknown.

Distribution

Known only from Mount Glorious in south-east Queensland (Fig. 16A).

Remarks

This species is almost certainly quite rare and may be specific to rainforests. Considerable collecting in dry sclerophyll forests around south-east Queensland did not turn up any specimens and a year-long Malaise trapping program in Mount Glorious rainforests produced only a single specimen. Although this is the only species of *Clistoabdominalis* with this type of collecting history, several species of *Dasydorylas* have similar patterns of distribution and have been rarely collected only in rainforests (Skevington 2000). Pipunculids in this Australian habitat need to be the focus of more work.

Etymology

Derived from the Bundjalung Aboriginal term for 'rainforest'; in reference to the habitat where the sole specimen was collected. Neuter.

Clistoabdominalis gremialis, sp. nov.

(Figs 22A–F, 23A)

Material examined

Holotype. Australia, Queensland, Brisbane, Mt Coot-tha, 27°29'16" S, 152°57'02" E, 170 m, hilltop, ♂, 15.v.1999, JAS, #5751 (QM T99019).

Paratypes. **Australia: Northern Territory:** Darwin, Ben's Hill, 4.2 km S of Stuart Highway on Berrimah Road, 12°28'26" S, 130°55'2" E, [hilltop], 0715–0800 hours, 3♂, 22.ix.1998, JAS, #4059, 61, 6 (UQ); Kakadu NP, Mirrai Lookout, 12°52'01" S, 132°42'12" E, hilltop, 4♂, 27.ix.1998, JAS, #4120, 34, 42, 4 (UQ); 1.8 km NW of Bird Billabong Trail Carpark, W of Mary R. bridge on Arnhem Highway, 12°52'07" S, 131°37'09" E, hilltop, 2♂, 25.ix.1998, JAS, #4077, 9 (UQ). **Queensland:** Bunya Mts. NP, Mt Kiangarow, 26°50' S, 151°33' E, [hilltop], 4♂, 29.xi.1998, JAS, #4943–5, 7 (ISNB); 14.6 km E Lakeland Downs, 15°46' S, 144°57' E, 270 m, hilltop; open, dry savanna (rangeland), 3♂, 8.vi.1997, JAS, #387, 786, 93 (UQ); 12 km N Palmer Riv[er], 16°01' S, 144°48' E, vine forest, 1♂, 18.v.1989, GAD, #3985

(GDCB); Undara Volcanic NP, Bluff, [18°19' S, 144°44' E], 770 m, hilltop, 4♂, 11.vi.1997, JAS, #389, 91–2, 669, 1♂, 19.vii.1998, JRS, #3960 (UQ); Carnarvon NP, Mt Rugged Summit, 24°53'52" S, 147°59'55" E, 1130 m, 2♂, 30.xi.1997, JS, CL, #2231–2 (UQ); Carnarvon NP, Sugarloaf Mt summit, 24°53'55" S, 147°56'43" E, 2♂, 1.xii.1997, JS, CL, #2262, 7 (UQ); Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, hilltop, 2♂, 27.xi.1997, 7♂, 29.xi.1997, 21♂, 2.xii.1997, JS, CL, #1296, 1315, 9, 21, 38, 67, 94, 1711, 20, 1958, 66, 86, 88, 2017, 36–7, 42, 51–2, 6, 65–6, 75, 8, 81–3, 2122, 36, 52 (UQ); Carnarvon NP, Mt Moffatt Section, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, 11♂, 20.i.1998, 17♂, 22.i.1998, JAS, SW, #2397, 9, 2414, 21, 42, 6, 52, 62, 7, 96, 2510, 2, 6–7, 41–2, 81, 2755, 9, 69, 90, 4, 2910, 8, 39, 49, 57, 62 (UQ); Carnarvon NP, Mt Moffatt Section, southernmost of 3 Sisters, summit, 25°06'36" S, 148°05'40" E, 3♂, 23.i.1998, JAS, SW, #2738, 44, 50 (ISNB); Isla Gorge NP, 25°11' S, 149°58' E, 320 m, hilltop near lookout, 10♂, 13.xi.1999, JAS, #7259–66, 79, 81 (CNC); Barakula SF No. 302, Summit Round Mt, 26°22'13" S, 150°58'09" E, 4♂, 18.viii.1999, 2♂, 8.i.2000, JAS, MM, #7521, 3, 732–5 (UQ); Mt Tinbeerwah E of Cooroy, 26°24' S, 152°59' E, hilltop, 1♂, 7.xi.1998, JAS, #4356 (UQ); Mt Glorious, [27°20' S, 152°45' E], rainforest, Malaise trap, 1♂, 1.i.–28.ii.1997, #907 (UQ); same data as holotype, 1♂, 9.viii.1997, CL, #828, 14♂, 10.viii.1997, JAS, SW, #694–9, 706–13, 2♂, 16.viii.1997, JAS, CL, #744–5, 1♂, 16.ix.1997, JS, #1200, 3♂, 25.viii.1997, JAS, #821–3, 22♂, 8.ix.1997, JAS, #931, 55, 63, 5–7, 72–3, 7, 86, 8, 91, 9, 1003–4, 9, 11, 4–5, 39, 43, 63, 5♂, 25.ix.1997, JAS, #1186, 89–90, 3, 3♂, 26.x.1997, JS, #1175, 7, 82, 2♂, 9.xi.1997, JAS, #2375–6, 15♂, 27.i.1998, JAS, #3052, 8, 60–2, 4, 7–9, 71, 8, 80–1, 5, 7, 1♂, 8.ii.1998, JAS, #3242, 12♂, 7.iii.1998, JAS, #3629–31, 5, 39–42, 5–7, 3♂, 1.iv.1998, JS, #3827–9, 10♂, 19.iv.1998, JS, #3830–1, 8, 42, 9, 66, 69–70, 3, 8, 3♂, 26.iv.1998, CL, #7747–9, 2♂, 5.ix.1998, A. Skevington, #4053–4, 1♂, 18.iv.1999, JAS, #5802, 22♂, 15.v.1999, JAS, #5745, 47–50, 52–62, 4–9, 1♂, 19.vi.1999, JAS, #6479, 1♂, 17.vii.1999, JAS, #6463 (UQ); [The] Summit, [28°35' S, 150°04' E], 1♂, 3.xi.1960, EE, #423 (UQ). **New South Wales:** Gibraltar Range NP, [Raspberry Lookout, 29°29' S, 152°20' E], 1♂, 23.i.2000, JAS, #6511 (UQ); New England NP, [30°31' S, 152°27' E], sclerophyll forest, 1♂, 11.ii.1968, DC, #168 (ANIC); Siding Spring Observatory Near Warrumbungle NP, [31°16' S, 149°03' E], hilltop, 9♂, 18.xii.1998, JAS, #4533–6, 40–1, 3–5 (CNC); Warrumbungle NP, Split Rock, 31°17'08" S, 148°59'00" E, hilltop, 22♂, 18.i.1999, JAS, #4500, 2–5, 7, 10–2, 5, 17–22, 4, 5, 29–32 (UQ).

Other material examined. Australia: Queensland: Undara Volcanic NP, Bluff, 3♂, #393, 668, 74 (UQ); Carnarvon NP, Mt Moffatt Summit, 2♂, #2070, 7 (UQ); Brisbane, Mt Coot-tha, 2♂, #1188, 3650 (UQ).

Description based primarily on #786, 2231, 3642, 4142, 4518, 5751, 7279, and 7281; measurements based on #387, 391–3, 423, 668–9, 674, 786, 2231, 2262, 3642, 4142, 4518, 5748–9, 5755, 6463, 6479, 6511, 7279, and 7281.

Diagnosis

Male

Autapomorphies. Tergite 6 with a single ventral protuberance (Fig. 22B). Sternites 2–5 with bristles forming clusters in posterolateral corners (Fig. 22B). Surstyli symmetrical, short, simple (Fig. 22C).

Characters shared with a few species. First segment of hind trochanter with row of long spines. Pedicel with short bristles, PW:BL, >3:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing

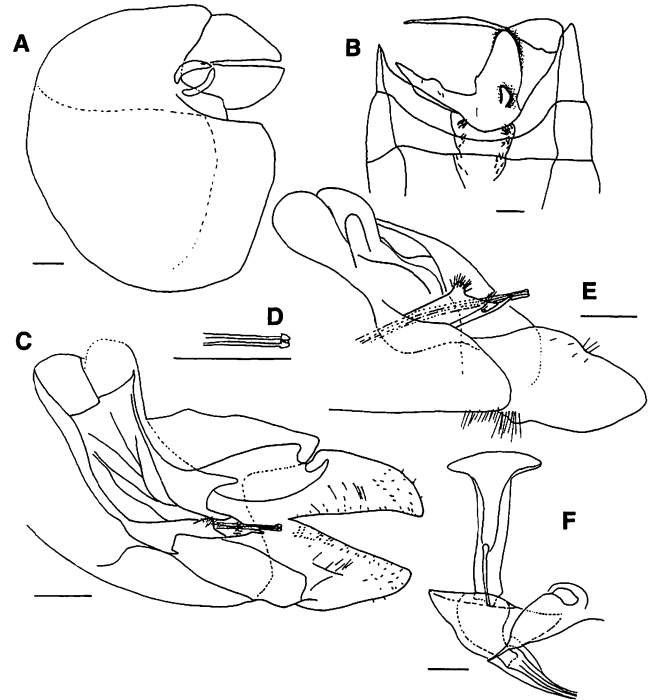


Fig. 22. Male *Clistoabdominalis gremialis* (#786 and 7279). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, dorsal of terminalia; *D*, dorsal of tip of phallus; *E*, right lateral of terminalia; *F*, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme. Scale bars = 0.1 mm.

with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.4–1.5:1. Tergite 6 swollen medially (Fig. 22B). Sternites 6 and 7 shining black. Sternite 6 enlarged, moderately swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 22B). Epandrium shining black. Subepandrial sclerite moderately wide, asymmetrical, offset slightly to the right; WSES:WEP, 0.4:1 (Fig. 22C). Phallic guide with hairy protuberance on the right side (Fig. 22C). Tips of phallic ducts conical (Fig. 22D). Ejaculatory apodeme large funnel (Fig. 22F).

Description

Male

Body length, 2.7–3.6 mm.

Head. Postpedicel short acuminate; dark brown to brown with yellow tip. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.2–4.3:1, PW:VBL, 3.2–4.3:1. Scape with one dorsal bristle. Labellum dark brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum mostly brown pollinose, sparsely silver pollinose along anterior edge; with fringe of 4–8 hairs. Halter brown to yellow.

Legs. Trochanters brown; first segment of hind trochanter with row of long spines. Femora dark brown with

narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of seven black spines on apical half, posteroventrally with row of 8–11 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.4–3.9 mm; $C_4:C_3$, 0.8–0.9:1; $S_3:S_2$, 1.4–1.5:1. Tegula with two bristles.

Abdomen. Tergites 2–5 mostly densely brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 asymmetrical, $T5R:T5L$, 1.4–1.5:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with a single ventral protuberance (Fig. 22B). Sternites 2–5 rectangular, with bristles forming clusters in posterolateral corners (Fig. 22B). Sternites 6 and 7 shining black, not visible from above. Sternite 6 enlarged, moderately swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 22B). Syntergosternite 8 dark brown, sparsely brown pollinose, only slightly swollen, $WS8:LT35$, 1.1:1, $WT5:WS8$, 1.0:1.

Genitalia. Epandrium shining black, wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 3.5:1. Cerci dull brownish yellow. Surstyli dark yellowish brown; symmetrical; short, longer than deep, with a few medial hairs (Fig. 22C,E). Subepandrial sclerite moderately wide, asymmetrical, offset slightly to the right; $WSES:WEP$, 0.4:1 (Fig. 22C). Hypandrium strongly deflected left (Fig. 22C). Phallic guide straight, with small distal hook; slightly asymmetrical with small, hairy protuberance on the right side; with row of short hairs laterally just proximal to hook (Fig. 22C,E). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts conical (Fig. 22C–E). Hypandrial apodeme wide (Fig. 22F). Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 22F). Ejaculatory apodeme large funnel with basal rosette (Fig. 22F).

Female

Unknown.

Distribution

Found in north-eastern New South Wales, eastern Queensland, and north of 13° S in the Northern Territory (Fig. 23A).

Remarks

Clistoabdominalis gremialis is a common species on hilltops in dry sclerophyll forests (264 of 269 specimens). One specimen was collected in rainforest and one in vine forest. Aside from these two records, this species seems almost exclusive to dry sclerophyll areas that are at least slightly inland. Considerable collecting at coastal sites (in heath and dry sclerophyll habitats) did not turn up any of these flies.

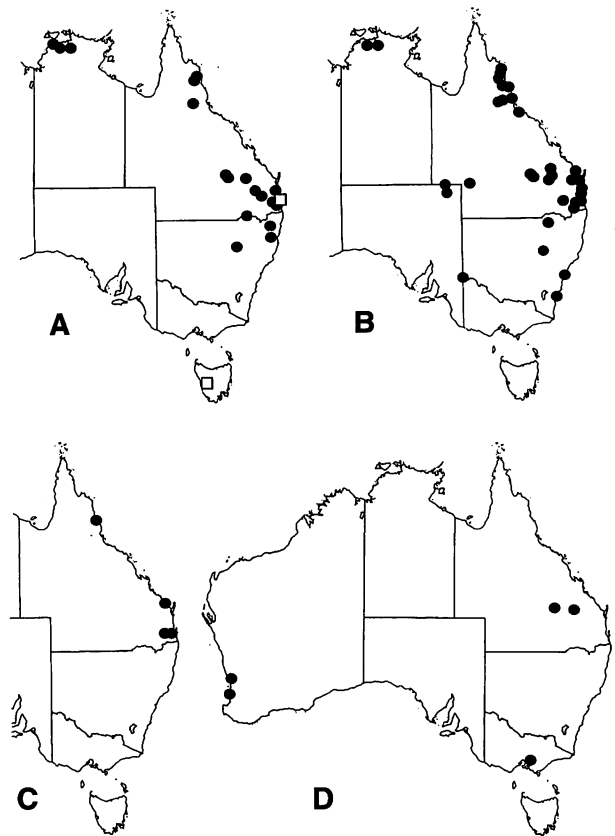


Fig. 23. Distributions of *Clistoabdominalis* species. A, ● *C. gremialis*, □ *C. mathiesoni*; B, *C. helluo*; C, *C. monas*; D, *C. octiparvus*.

Clistoabdominalis gremialis is referred to as *Eudorylas* sp. B in Skevington and Yeates (2000) and in the GenBank sequence database (<http://www.ncbi.nlm.nih.gov/Genbank/index.html>).

Etymology

Derived from the Latin *gremialis*, ‘growing in a cluster from a stump’; in reference to the distinctive clusters of bristles on tergites 2–5. Neuter.

Clistoabdominalis helluo (Perkins)

(Figs 1A–B, E–G, 5F, 23B, 24A–E)

Pipunculus helluo Perkins, 1905: 144. – T.l.: Australia, Queensland, Bundaberg. – T.d.: BPBM (Nr 4204).

Pipunculus (Eudorylas) helluo Perkins, 1905. – Hardy, 1964, 1989. *Eudorylas helluo* (Perkins, 1905). – Kapoor *et al.*, 1987; De Meyer, 1996.

Clistoabdominalis helluo (Perkins, 1905). – Skevington & Yeates, 2001.

Material examined

Lectotype. Australia, Queensland, Bundaberg, [24°52' S, 152°21' E, excellent condition; pin corroding], ♂, xi.1904, #9331 (BPBM Nr 4204).

Paralectotypes. **Australia: New South Wales:** Sydney, [33°53' S, 151°13' E], R.C.L. Perkins Coll., B.M. 1942–95, 2362, Fulgorid on *Ricinocarpus pinifolius*, [female in poor condition preserved with puparium, pupariation date] 10.ii.1905, 1♀, 28.ii.1905, #4319 (BMNH); Sydney, [33°53' S, 151°13' E, headless; puparium on point with specimen,] Fulgorid on *Ricinocarpus pinifolius*, [pupariation date] 8.ii.1905, 1♀, 26.ii.1905, #4179 (ZMAN). **Queensland:** Cairns, [16°55' S, 145°46' E], 3♂, vii.1904, 1♂, 2♀, viii.1904, #3545, 9, 53 [abdomen missing], #3555–7 (BPBM); Mid. Queensland, 1♂, 1♀, #4177, 89 (ZMAN); Bundaberg, [24°52' S, 152°21' E], 1♀, vi.1904, 2♂, 3♀, ix.1904, 2♂, 1♀, xi.1904, #3543–4, 6–7, 52, 59–61, 9345 (BPBM); Bundaberg, [24°52' S, 152°21' E], R.C.L. Perkins Coll., B.M. 1942–95, 4♂, 1♀, xi.1904, #4316 (BMNH); [Bundaberg], Sandhills, [24°52' S, 152°21' E, pupariation on] 2.x.1904, [part of puparium and hopper on card with pipunculid], 1♂, 20.x.1904, #3548 (BPBM); [Bundaberg], Sandhills, [24°52' S, 152°21' E], 2326, on *Syphanta* [sic., puparium formed on] 30.x.1904, [puparium on minuten with pipunculid], 1♂, 13.xi.1904, #3551 (BPBM); [Bundaberg], Sandhills, [24°52' S, 152°21' E], HO from *Syphanta* [sic.], 1♂, xi.1904, #3554 (BPBM); [Bundaberg], Sandhills, [24°52' S, 152°21' E], 2319, [puparium formed] 4.x.1904, 1♂, 16.x.1904, #3558 (BPBM); [Bundaberg], Sandhills, [24°52' S, 152°21' E], [puparium formed] 23.ix.1904, 1♀, 9.x.1904, #3563 (BPBM); Bundaberg, [24°52' S, 152°21' E], R.C.L. Perkins Coll., B.M. 1942–95, [puparium formed] 7.x.1904, bred from *Siphanta* or *Frons*, 1♀, 31.x.1904, #4317 (BMNH); Bundaberg, [24°52' S, 152°21' E], R.C.L. Perkins Coll., B.M. 1942–95, [with puparium], 1♂, #4318 (BMNH).

Other material examined. **Australia:** 1♂, #3562, [paralectotype of *C. monas*] (BPBM); **Northern Territory:** Kakadu NP, Mirrai Lookout, 31♂, #4085, 7–8, 90–3, 5–9, 4101–3 (UQ), #4105–7, 9–12, 4 (ISNB), #4116–8, 21, 31, 3, 40, 7 (CNC); 1.8 km NW of Bird Billabong Trail Carpark, W of Mary R. bridge on Arnhem Highway, 1♂, #4078 (UQ). **Queensland:** n[ea]r Teddington Weir S of Maryborough, 1♀, #5143 (GDCB); 1♂, #4178 (ZMAN); 7 km N Hope Vale Mission, 1♀, #195 (ANIC); 14.6 km E Lakeland Downs, 12♂, #386, 783–5, 88–91 (UQ), #794, 7–9 (CNC); 3 km NNW Palmer R. [Cross]ing, 1♂, #3987 (GDCB); Southedge 12 km NW Mareeba, 2♀, #634, 7 (AMS); Cairns, 1♀, #2387 (BPBM); Dunk I., 1♂, #418 (UQ); Black Mt, 6.7 km W of Croyden, 4♂, #381–4 (UQ); Undara Volcanic NP, Bluff, 7♂, #390, 675–7, 9, 775, 7 (UQ); Ross R., Hermit Park, Townsville, 1♀, #409 (UQ); Brigalow Development Area, Moura, 1♀, #513 (QDPC); Bundaberg, 1♂, #3550 (BPBM); Tantitha, Bundaberg, 1♀, #125 (ANIC); Carnarvon NP, Mt Moffatt Summit, 26♂, 1♀, #1273–4, 87, 1306, 18, 23, 45, 87, 1708, 10, 31, 68, 1925, 2061, 2110, 68, 75, 2405, 19, 34, 63, 78, 84, 2955, 63, 85, 89–90 (UQ); Carnarvon NP, Hilltop N of Tombs, 2♂, #2189, 91 (UQ); Carnarvon NP, Mt Moffatt Section, southernmost of 3 Sisters, summit, 7♂, #2728–30, 39, 46–8 (CNC); Isla Gorge NP, 16♂, #7267–78, 80, 3–4, 6 (UQ); Mt Walsh NP, Mt Walsh summit, 2♂, #7912–3 (ISNB); 6 km N Taroom, 1♀, #4014 (GDCB); Tanbar Waterhole, 1♀, #7892 (UQ); near Birdsville racetrack, 6♂, #870–4, 7 (UQ); Mt Tinbeerwah E of Cooroy, 1♂, #4357 (UQ); Mt Beerburum summit, 1♂, #2377 (UQ); Bribie I., QDPI Fisheries site, 113♂, 186♀, #837–46, 48–51, 53–4, 59–60, 915–24, 3123–4, 49–50, 2–6, 8, 60–90, 2–4, 6, 3200–1, 3, 7, 8, 10, 12–3, 5–8, 21–32, 3300–1, 13–5, 7–9, 21, 86–92, 6–8, 3400–5, 7–8, 13, 7–9, 23, 5, 7–9, 31–2, 4–6, 9, 43, 5–7, 49–58, 60–1, 4, 6, 8–9, 71, 3–4, 76–83, 85–9, 3501–5, 4391, 4869, 71–9, 81–94, 7783–94, 7796–7808, 11–4, 6, 18–40, 2–7, 49–50, 52–90 (UQ), 11♂, 14♀, #3150, 2–6, 8, 60–6, 74–84 (CNC), 2♂, 5♀, #3167–73 (ISNB); Mt Glorious, Scrub Ck Road, Brisbane Forest Park, 1♀, #5042 (UQ); Brisbane, 3♂, 2♀, #450,

6, 8, 63, 3116 (UQ); Brisbane, Mt Coot-tha, 35♂, #743, 932, 64, 8, 75, 80, 1, 3, 1002, 31, 51, 4, 1180, 4, 3054, 3637, 3835, 59, 68, 72, 81, 84–5, 5742–4, 63, 70, 6468, 80, 7186, 7205–8 (UQ); Brisbane, DPI Indooroopilly site, 4♂, 4♀, #427–8, 32, 6, 40, 3, 72, 7 (QDPC); Cecil Plains, 1♀, #517 (QDPC); Kenmore, Brisbane, 1♂, #557 (UQ); Rosewood, 1♂, #262 (ANIC); Cunningham's Gap Via Aratula, 1♂, #4395 (UQ). **New South Wales:** 20 km N of Moree, 5♀, #7894–8 (UQ); Goonoo SF, 8 km S Mendooran, 1♀, #590 (AMS); Murray Riv[er] 50 mls [80 km] W of Wentworth, 1♀, #5135 (MVMA); 4.8 km S Kioloa, N Durras, 5♀, #280–4 (ANIC). **South Australia:** Koonchera Dune near Koonchera Waterhole, 3♂, #900–2 (UQ).

Description based primarily on #932, 3222, 3478, 3548, 4317, 7286, and 9331; measurements based on #262, 381, 383, 386, 418, 675, 676, 677, 679, 840, 932, 3222, 3478, 3481, 3544, 3545, 3548, 3550, 3562, 4078, 4317, 5742, 5763, 5770, 6480, 7206, 7208, and 7286.

Diagnosis

Male

Autapomorphies. Right surstylus swollen into distinctive basal ridge (Fig. 24C).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. First segment of hind trochanter with row of small spines (Fig. 1G). Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, (1.5) 1.7–2.1:1. Tergite 6 swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 24B). Sternites 2–5 densely covered with peg-

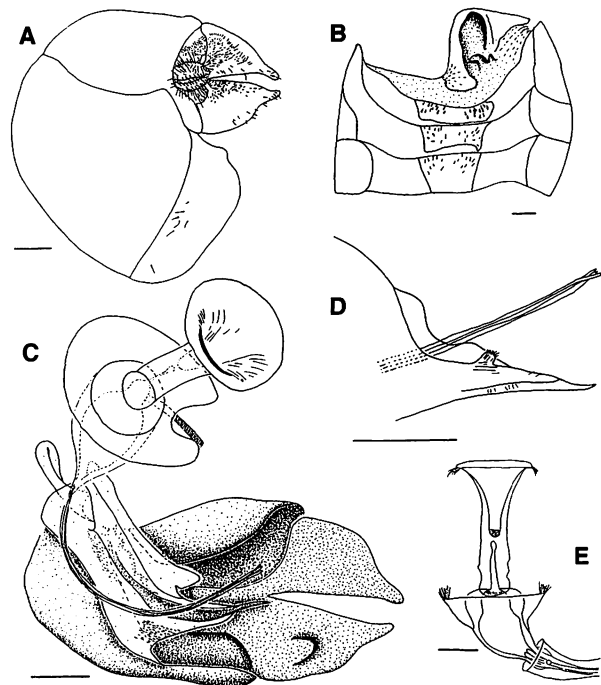


Fig. 24. Male *Clistoabdominalis helluo* (#386 and 3544). A, ventral of distal end of abdomen; B, ventral of abdomen with terminalia removed; C, dorsal of terminalia; D, right lateral of terminalia; E, lateral of sperm pump and ejaculatory apodeme. Scale bars = 0.1 mm.

like bristles (Fig. 24B). Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 24B). Epandrium glabrous, shining brown to reddish brown. Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, <0.2:1 (Fig. 24C). Phallic guide with small, hairy protuberance on the right side (Fig. 24C–D). Ejaculatory apodeme large funnel (Fig. 24C, E).

Female

Characters shared with a few species. Ovipositor piercer slightly upcurved, base cylindrical (Fig. 5F). OL, 0.6–0.8 mm; OL:PL, 1.6–1.7:1; BL:OL, 0.4:1; B:PL, 4.2–4.5:1.

Description

Male

Body length, 2.7–3.7 mm.

Head. Postpedicel acuminate; brown to yellow. Pedicel brown with 3–7 dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.2–4.3:1, PW:VBL, 3.5–6.5:1. Scape with one dorsal bristle. Labellum dark brown to yellow.

Thorax. Postpronotal lobe bright yellow to dull yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum mostly brown pollinose, sparsely silver pollinose along anterior edge; with fringe of 10–14 hairs. Halter brown to yellow.

Legs. Trochanters brown; first segment of hind trochanter with row of small spines (Fig. 1G). Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 5–8 black spines on apical half, posteroventrally with row of 7–10 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.4–4.3 mm; C₄:C₃, 1.0–1.2:1; S₃:S₂, (1.5) 1.7–2.0:1. Tegula with two bristles.

Abdomen. Tergites 2–5 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 asymmetrical, T5R:T5L, 1.1–1.6:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 24B). Sternites 2–5 rectangular, with scattered peg-like bristles (Fig. 24B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 24B). Syntergosternite 8 dark brown, sparsely brown pollinose, only slightly swollen, WS8:LT35, 1.1–1.2:1, WT5:WS8, 1.1–1.2:1.

Genitalia. Epandrium shining brown to reddish brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.1–2.9:1. Cerci dull to bright yellow.

Surstyli dark brown to dull yellow; slightly asymmetrical; right surstylus swollen into distinctive basal ridge; short, longer than deep, with a few basal hairs (Fig. 24A,C). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2:1 (Fig. 24C). Hypandrium strongly deflected left (Fig. 24C). Phallic guide straight, with small distal hook; slightly asymmetrical with small protuberance on the right side; with row of short hairs laterally just proximal to hook (Fig. 24C–D). Phallus trifold, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 24C–D). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 24C,E). Ejaculatory apodeme large funnel with basal rosette (Fig. 24C,E).

Female

As male except: body length, 2.6–3.2 mm. Eyes dichoptic; FR, 0.9–1.0:1. FFE, 0.5–0.6:1. Tergite 6 brown pollinose on anterior half, silver pollinose on posterior half on all except narrow medial stripe.

Ovipositor. Ovipositor piercer slightly upcurved, base cylindrical (Fig. 5F). OL, 0.6–0.8 mm; OL:PL, 1.6–1.7:1; BL:OL, 0.4:1; B:PL, 4.2–4.5:1.

Distribution

Widely distributed in Queensland and New South Wales with additional records from eastern South Australia and north of 13° S in the Northern Territory (Fig. 23B).

Remarks

Clistoabdominalis helluo is a successful species that has managed to occupy most eastern Australian habitats including inland dunes, arid grasslands, dry sclerophyll forests, dry heath, wallum heath, mangrove forests, and agricultural areas (cotton fields). It is commonly encountered on hilltops (149 of 548 specimens). Perkins (1905) observed *C. helluo* swarming even in deep shade in a wood at Bundaberg where a species of *Siphanta* (Flatidae, Flatinae) was breeding in large numbers on *Ficus* and other trees.

Perkins and Koebele reared a number of specimens for which data are available. Perkins (1905) stated that they reared *C. helluo* from *Colgar peracutum* (Walker) (Auchenorrhyncha, Flatidae, Flatinae) and *Gaetulia chrysopoides* (Walker) (Auchenorrhyncha, Issidae, Nogodininae) nymphs (Appendix 1). Hardy (1964) had some of these leafhoppers re-examined by J. W. Evans at the Australian Museum and the best determination available at that time was that there were specimens of an unknown genus of Deldocephalini (Auchenorrhyncha, Cicadellidae, Deldocephalinae) and an unknown fulgoroid genus. Although this suggests that the initial identifications were in error, it does not necessarily ensure this. Among the specimens that I

have are individuals labelled 'bred from *Siphanta*' and 'Fulgorid on *Ricinocarpus pinifolius* (Euphorbiaceae)'. *Siphanta* is a flatid genus (Flatidae, Flatinae) that is not mentioned in Perkins (1905, 1906a, 1906b). It is clear that Perkins had specimens of *C. helluo* from many hosts and Evans may not have examined all of them. The most conservative estimate of host use in this species must thus be attributed to the list provided by Dr J. W. Evans in Hardy (1964), while the most liberal assessment of host use would suggest that there are at least three fulgoroid hosts and one cicadellid host. In any case, this pipunculid has an unusually diverse diet, using hosts from at least two subfamilies and up to three families.

Rearing data from labels indicates that the mean development time of *C. helluo* from puparium to adult was 17.6 days ($n = 7$). All specimens were reared between mid-September and late February. Puparia are preserved on pins with six adult specimens (#3548, 3551, 3554, 4179, 4318–9).

Hardy (1964) designated a lectotype (referred to as 'type' in his paper) for *C. helluo*. These specimens were selected from 23 specimens that he was aware of from Perkins' syntype series (all of the BPBM syntypes). There are 34 syntypes of which I am aware (lectotype and 33 paralectotypes). Eight are in the BMNH, three are in ZMAN, and 23 are in the BPBM (including the lectotype and paralectotype).

Clistoabdominalis helluo is referred to as *Eudorylas* sp. A in Skevington and Yeates (2000) and in the GenBank sequence database (<http://www.ncbi.nlm.nih.gov/Genbank/index.html>).

Clistoabdominalis koebelei (Perkins)

(Figs 5G, 16C, 25A–F)

Pipunculus koebelei Perkins, 1905: 144. – T.l.: Australia, New South Wales, Sydney. – T.d.: BPBM (Nr 4208).

Pipunculus (Eudorylas) koebelei Perkins, 1905. – Hardy, 1964, 1989.

Eudorylas koebelei (Perkins, 1905). – Kapoor *et al.*, 1987. Error for *Eudorylas koebelei*.

Eudorylas koebelei (Perkins, 1905). – De Meyer, 1996.

Clistoabdominalis koebelei (Perkins, 1905). – Skevington & Yeates, 2001.

Material examined

Lectotype. Australia, New South Wales, Sydney, [33°53' S, 151°13' E], 2359, [excellent condition, puparium on separate minuten], ♂, 8.ii.1905, #9330 (BPBM nr 4208).

Paralectotypes. **Australia: New South Wales:** Sydney, Sandhills, [33°53' S, 151°13' E], 2359, [puparium on pin with adult], 1 ♀, 16.ii.1905, #4160 (ZMAN); [Sydney], Sandhills, [33°53' S, 151°13' E], 2359, [puparium on pin with adult; wings missing, legs damaged], 1 ♀, 28.ii.1905, #4159 (ZMAN), 2372, 1 ♀, ii.1905, #3564 (BPBM).

Other material examined. **Australia: Queensland:** Undara Volcanic NP, Bluff, 1 ♂, #678 (UQ); Mt Etna, summit, 32 ♂, #6982, 5–8, 91, 4–5, 6998–7000, 6, 8, 9, 11, 4, 6, 18–21, 3, 25–34 (UQ); Carnarvon NP, Mt Moffatt Summit, 93 ♂, #1278, 80, 90, 4, 1303–4, 13,

16, 31, 5, 7, 44, 6, 63, 75, 8, 82, 90–1, 1402, 4, 32–4, 8, 41, 1696, 1706–7, 9, 16, 22, 5, 7–8, 36–7, 9, 42, 7, 9, 51, 3–5, 7, 1926, 30, 42, 54, 59–60, 2–4, 75–6, 84, 95–6, 2000, 4, 10, 2, 27, 43, 6, 8, 58, 67, 74, 6, 79–80, 8, 94, 6–7, 2101–3, 5, 13, 9, 26, 35, 9, 54, 63–4, 9, 74, 9 (UQ); 1 ♂, #1288 (GDCB); 39 ♂, #2751–2, 4, 61, 5, 71, 4, 80, 2–3, 6, 8, 93, 2797–2800, 2909, 17, 21–3, 9, 33, 41, 3, 53, 61, 6, 73, 7, 79–80, 4, 7, 94, 3003, 6, 15 (CNC); 37 ♂, #2401, 18, 22–5, 8–9, 31, 45, 50–1, 54–6, 69–70, 2, 8, 83, 90, 3, 2498–2500, 3, 13, 23–4, 8, 30, 9, 44, 54, 6–7, 84 (ISNB); Isla Gorge NP, 9 ♂, #7287–93, 5, 8 (UQ); Cooloolool NP, East Mullen hilltop, 3 ♂, #3903, 8, 11 (UQ); Barakula SF No. 302, Summit Round Mt, 3 ♂, #7524, 7–8 (UQ); Brisbane, 1 ♂, #3115 (UQ); Brisbane, Mt Coot-tha, 72 ♂, #689–90, 2–3, 746–53, 811–3, 829, 33–4, 1042, 1169, 78–9, 85, 7, 92, 3055–7, 65–6, 76, 92, 241, 8, 847, 5723–37, 806–8, 6459–62, 77–8, 7187, 195–204, 742–3 (UQ), 1 ♂, #691 (GDCB); Brisbane, DPI Indooroopilly site, 3 ♂, #426, 34–5 (QDPC); Brisbane, St. Lucia, 1 ♂, #482 (UQ); Brisbane, Kenmore, 1 ♂, #484 (UQ). **New South Wales:** Warrumbungle NP, 1 ♂, #3326 (UQ); Bendalong, 1 ♂, #4024 (GDCB).

Description based primarily on #689, 834, 1753, 2074, 3115, 3564, 4160, and 9330; measurements based on #482, 678, 689, 834, 1375, 1434, 1716, 1742, 1753, 1963, 1995, 2074, 2179, 3115, 3326, 3564, 4160, and 9330.

Diagnosis

Male

Characters shared with a few species. Pedicel with short bristles, at least PW:VBL, >3:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; S₃:S₂, 1.5–1.7:1. Tergites 2–4 entirely brown pollinose dorsally. Tergite 6 with ventromedial edge smooth to slightly raised into protuberance (Fig. 25A). Sternite 6 narrow, not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 25A). Syntergosternite 8 swollen, WT5:WS8, 1.0:1. Epandrium pruinescent, shining brown only along junction with syntergosternite 8. Cerci small and bulbous (Fig. 25B,F). Surstyli usually bright yellow, occasionally brown; asymmetrical, short and stubby; right surstylus with basal three-toothed hook bending dorsomedially (Fig. 25B–C). Subepandrial sclerite wide, darkly sclerotised; symmetrical, WSES:WEP, 0.5:1. Phallic guide with large dorsolateral flaps, largest on right side; with row of long hairs laterally just proximal to hook (Fig. 25B–C). Hypandrial apodeme wide, with ring clasping base of sperm pump arising medially (Fig. 25E). Ejaculatory apodeme large funnel (Fig. 25C,E).

Female

Characters shared with a few species. Tarsomeres of hind leg flattened. Ovipositor piercer slightly upcurved, base very angular, cerci close to sternite 6 (Fig. 5G).

Description

Male

Body length, 3.1–3.4 mm.

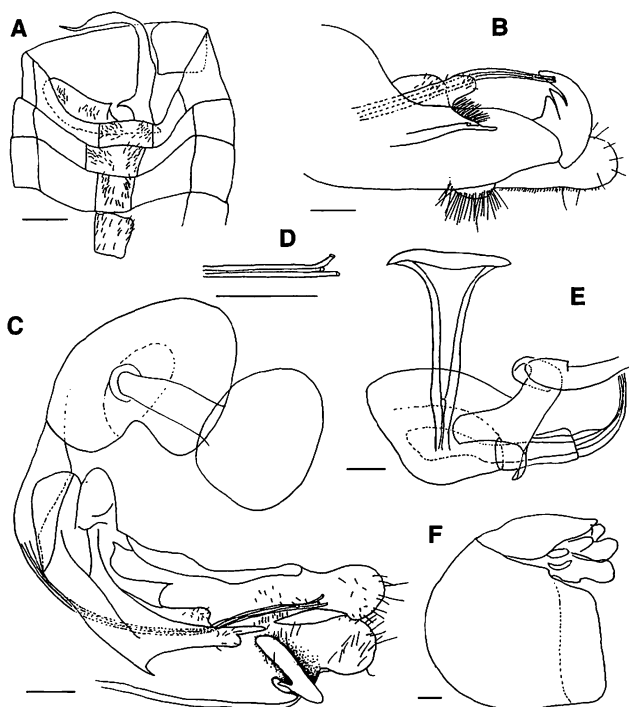


Fig. 25. Male *Clistoabdominalis koebelei* (#689 and 753). *A*, ventral of abdomen with terminalia removed; *B*, right lateral of terminalia; *C*, dorsal of terminalia; *D*, dorsal of tip of phallus; *E*, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme; *F*, ventral of distal end of abdomen. Scale bars = 0.1 mm.

Head. Postpedicel obtuse; brown. Pedicel brown with 3–4 dorsal bristles and 2–4 ventral bristles; PW:DBL, 2.6–3.2:1, PW:VBL, 3.2–3.7:1. Scape with one dorsal bristle. Labellum brown to yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum densely brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum entirely brown pollinose; with fringe of 6–12 hairs. Halter brownish yellow.

Legs. Trochanters brown; first segment of hind trochanter with row of weak hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 6–8 black spines on apical half, posteroventrally with row of 10–12 black spines. Tibiae yellow; fore and mid tibiae with apical spines.

Wings. Length: 3.7–4.2 mm; $C_4:C_3$, 0.9–1.0:1; $S_3:S_2$, 1.5–1.7:1. Tegula with two bristles.

Abdomen. Tergites 2–4 entirely brown pollinose dorsally, silver pollinose posterolaterally. Tergite 5 brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; asymmetrical, $T5R:T5L$, 1.3–1.5:1. Tergite 6 narrow with separate right lateral plate; smooth edge to slightly raised ventromedial protuberance (Fig. 25*A*). Sternites 2–5 rectangular, covered with bristles (Fig. 25*A*). Sternites 6 and 7 sparsely silver

pollinose, not visible from above. Sternite 6 narrow, not swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 25*A*). Syntergosternite 8 dark brown, sparsely brown pollinose, swollen, $WS8:LT35$, 1.2–1.4:1, $WT5:WS8$, 1.0:1.

Genitalia. Epandrium pruinose, shining brown only along junction with syntergosternite 8; wrapping around dorsally so that slightly visible in dorsal view; asymmetrical, $ER:EL$, 3.7:1. Cerci bright yellow; small and bulbous (Fig. 25*B,F*). Surstyli usually bright yellow, occasionally brown; asymmetrical, short and stubby, right surstylus with distinctive basal three-toothed hook bending dorsomedially; short, almost as deep as long, with a few long medial and distal hairs (Fig. 25*B–C,F*). Subepandrial sclerite wide, darkly sclerotised; symmetrical, $WSES:WEP$, 0.5:1. Hypandrium strongly deflected left (Fig. 25*C*). Phallic guide straight, with small distal hook; asymmetrical with large dorsolateral flaps, largest on right side; with row of long hairs laterally just proximal to hook (Fig. 25*B–C*). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 25*B–D*). Hypandrial apodeme wide, with ring clasping base of sperm pump arising medially (Fig. 25*E*). Sperm pump round, fused with basal rosette of ejaculatory apodeme (Fig. 25*C,E*). Ejaculatory apodeme large funnel with basal rosette (Fig. 25*C,E*).

Female

As male except: body length, 2.8–2.9 mm; postpedicel yellow, acuminate. Eyes dichoptic; FR , 1.0:1. FFE , 0.4–0.5:1. Tarsomeres of hind leg flattened. Tergite 6 brown pollinose on anterior one half; posterior one half silver pollinose.

Ovipositor. Ovipositor piercer slightly upcurved, base very angular, cerci close to sternite 6 (Fig. 5*G*). OL , 0.8 mm; $OL:PL$, 1.0–1.1:1; $BL:OL$, 0.2:1; $B:PL$, 3.7–3.8:1.

Distribution

Found throughout eastern Queensland and New South Wales as far north as Undara Volcanic National Park and as far south as the Sydney area (Fig. 16*C*).

Remarks

Most specimens of *C. koebelei* were captured on hilltops in dry sclerophyll forest (289 of 301).

Perkins (1905) stated that he reared specimens of this species from *Thaumatoscopus* and *Vulturinus*. Dr J. W. Evans re-examined some of these leafhoppers for Hardy (1964) and determined that they were either a species of *Neodartus* or *Vulturinus*. The specimens were in poor condition and were apparently difficult to identify. Given that Evans likely did not see all of the material that Perkins examined, this leaves Perkins' (1905) original identifications as the best to date;

(i.e. Evans may have examined the *Vulturnus* specimens but did not necessarily see the specimens that Perkins identified as *Thaumatoscopus*). Despite these identification problems, all of these genera are within the Penthimiinae (Cicadellidae). Future ecological work on *C. koebeleri* should thus focus on leafhoppers in this subfamily.

Rearing records are provided for two of the specimens that I have. One specimen emerged after 20 days in the puparium (a male; #9330) and the other emerged after 40 days (a female; #4159). Both formed puparia on January 20, 1905. This result is typical for pipunculid species, with females taking longer to emerge than males (Benton 1975; May 1979; Huq 1986). Three puparia are on pins with adults (#4159–60, 9330).

Hardy (1964) designated a lectotype (referred to as type in his paper) for *C. koebeleri*.

Clistoabdominalis lambkinae, sp. nov.

(Figs 9C, 26A–E)

Material examined

Holotype. Australia, Queensland, Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, ♂, 2.xii.1997, JS, CL, #2049 (QM T99020).

Paratypes. **Australia: Queensland:** same data as holotype, 22♂, 27.xi.1997, JS, CL, #1684, 98–9, 1700, 2, 3, 5, 12–3, 7–9, 21, 3–4, 29–30, 3, 41, 5, 50, 6, 16♂, 29.xi.1997, JS, CL, #1281–2, 6, 98, 1300, 11, 20, 32, 42, 54, 79, 85, 99, 1403, 18, 24, 12♂, 2.xii.1997, JS, CL, #1937, 56–7, 70, 2, 90, 2014, 50, 4, 89, 2159, 72, 10♂, 20.i.1998, JAS, SW, #2753, 7, 2801–2, 2952, 72, 92, 6, 3001, 5 (UQ), 4♂, 22.i.1998, JAS, SW, #2393, 6, 2406, 9 (CNC), 4♂, 22.i.1998, JAS, SW, #2473, 92, 2522, 53 (ISNB).

Description based primarily on #1311, 1342, 1733, 2049, 2054, and 2172; measurements based on #1298, 1311, 1320, 1332, 1342, 1354, 1385, 1399, 1403, 1418, 1684, 1698, 1702, 1712–3, 1717–9, 1721, 1733, 1937, 2049, 2054, 2172, 2406, 2409, 2473, 2522, 2553, 2753, 2757, 2802, 2952, 2996, and 3001.

Diagnosis

Male

Autapomorphies. Sternites 2–5 very darkly sclerotised (Fig. 26D). Sternite 2 small, triangular; with dark medial keel protruding internally (Fig. 26D). Sternite 3 very large, with anteromedial gap, edges diverging anterolaterally; with dark medial keel protruding internally (Fig. 26D). Sternite 4 very wide, narrow, shallowly V-shaped (Fig. 26D). Sternite 5 divided into two small sections; long bristles clustered posteromedially (Fig. 26D). Sternite 6 with raised protuberances on each side of depression; medial protuberance conical; lateral protuberance raised into ridge adjacent to right section of sternite 5, sweeping out posterolaterally into pointed tip (Fig. 26D). Surstyli with small basal protuberances (Fig. 26A,C).

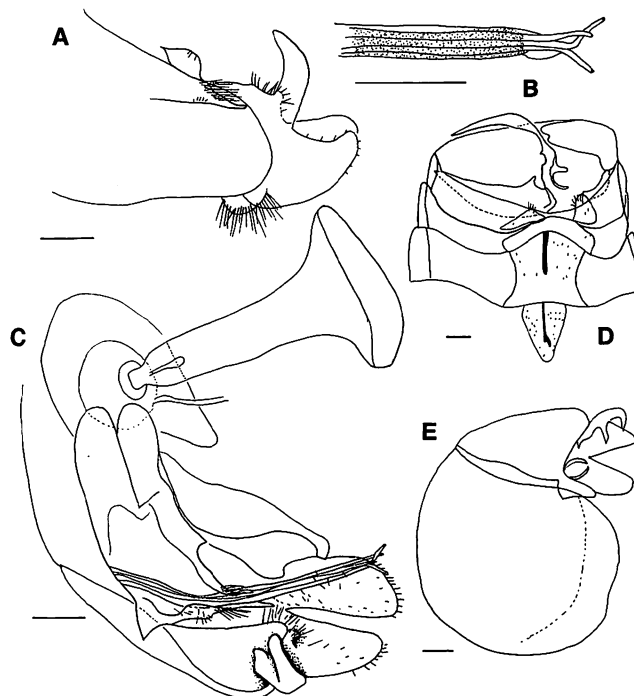


Fig. 26. Male *Clistoabdominalis lambkinae* (#1311 and 1342). *A*, right lateral of terminalia; *B*, dorsal of phallus; *C*, dorsal of terminalia; *D*, ventral of abdomen with terminalia removed; *E*, ventral of distal end of abdomen. Scale bars = 0.1 mm.

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.7–1.8:1. Tergite 6 with finger-like ventromedial protuberance (Fig. 26D). Sternite 6 swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 26D). Syntergosternite 8 swollen, WT5:WS8, 1.0:1. Epandrium shining brown. Cerci small and bulbous (Fig. 26A,E). Surstyli yellow to brownish yellow; short and stubby; asymmetrical, right surstylus with single basal hook bending dorsomedially (Fig. 26A,C,E). Subepandrial sclerite wide, darkly sclerotised; symmetrical, WSES:WEP, 0.4:1 (Fig. 26C). Phallic guide with large dorsolateral flaps, largest on right side; with row of long hairs laterally just proximal to hook (Fig. 26A,C). Hypandrial apodeme wide, with ring clasping base of sperm pump arising medially (cf. Fig. 25E). Ejaculatory apodeme large funnel (Fig. 26C).

Description

Male

Body length, 3.1–3.5 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with three dorsal bristles and three ventral bristles; PW:DBL, 3.0–4.0:1, PW:VBL, 3.4–4.0:1. Scape with one dorsal bristle. Labellum yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum densely brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose, sometimes with silver pollinose posterior edge; with fringe of 6–10 hairs. Halter yellow.

Legs. Trochanters brown; first segment of hind trochanter with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–6 black spines on apical half, posteroventrally with row of 7–9 black spines. Tibiae yellow; slightly darkened medially; fore and mid tibiae with apical spines.

Wings. Length: 3.6–3.8 mm; $C_4:C_3$, 0.6–0.9:1; $S_3:S_2$, 1.7–1.8:1. Tegula with two bristles.

Abdomen. Tergites 2–5 densely brown pollinose dorsally, with silver posterolateral patches extending well up onto posterior corners of dorsum; dorsal silver patches on tergite 5 more extensive. Tergite 5 asymmetrical, T5R:T5L, 1.6–1.8:1. Tergite 6 narrow with separate right lateral plate; with finger-like ventromedial protuberance (Fig. 26D). Sternites 2–5 all different shapes, very darkly sclerotised; sternites 2–4 with scattered small bristles (Fig. 26D). Sternite 2 small, triangular; with dark medial keel protruding internally (Fig. 26D). Sternite 3 very large, with anteromedial gap, edges diverging anterolaterally; with dark medial keel protruding internally (Fig. 26D). Sternite 4 very wide, narrow, shallowly V-shaped (Fig. 26D). Sternite 5 divided into two small sections; long bristles clustered posteromedially (Fig. 26D). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 swollen internally; with bowl-like depression on right side near point of fusion with tergite 6; raised protuberances on each side of depression; medial protuberance conical; lateral protuberance raised into ridge adjacent to right section of sternite 5, sweeping out posterolaterally into pointed tip (Fig. 26D). Syntergosternite 8 dark brown, sparsely brown pollinose, swollen, WS8:LT35, 1.2–1.3:1, WT5:WS8, 1.0:1.

Genitalia. Epandrium shining brown; wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 3.2–3.6:1. Cerci bright yellow; small and bulbous (Fig. 26A,E). Surstyli yellow to brownish yellow; short and stubby, with small basal protuberances; asymmetrical, right surstylus with single basal hook bending dorsomedially; short, almost as deep as long, with a few medial and distal hairs (Fig. 26A,C,E). Subepandrial sclerite wide, darkly sclerotised; symmetrical, WSES:WEP, 0.4:1 (Fig. 26C). Hypandrium strongly deflected left (Fig. 26C). Phallic guide straight, with small distal hook; asymmetrical with large dorsolateral flaps, largest on right side; with row of long hairs laterally just proximal to hook (Fig. 26A,C). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated throughout most of length although distinctly separate distal to sperm pump; ducts clearly separate for greater than one half length of surstyli; tips of ducts simple

(Fig. 26B–C). Hypandrial apodeme very wide, with ring clasping base of sperm pump arising medially (*cf.* Fig. 25E). Sperm pump round, fused with basal rosette of ejaculatory apodeme (Fig. 26C). Ejaculatory apodeme large funnel with basal rosette (Fig. 26C).

Female

Unknown.

Distribution

The only known specimens are from Mount Moffatt in south-central Queensland (Fig. 9C).

Remarks

All 69 specimens were collected hilltopping in dry sclerophyll forest.

Etymology

Proposed in honour of Chris Lambkin, who was involved with the collection of most specimens of this species.

Clistoabdominalis lingulatus, sp. nov.

(Figs 16D, 27A–H)

Material examined

Holotype. Australia, Western Australia, Mt Magnet, Mt Waramboo, 28°01'55" S, 117°49'23" E, hilltop, ♂, 14.xii.1999, JS, #7436 (ANIC).

Paratypes. **Australia: Queensland:** Black Mt, 6.7 km W of Crocyden, 18°09'S, 142°12'E, 195 m, hilltop in dry, open savanna, 1 ♂, 12.vi.1997, JAS, #380 (UQ); Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, 1 ♂, 29.xi.1997, JS, CL, #1453 (UQ), 2 ♂, 20.i.1998, JAS, SW, #2886, 2913 (UQ), 1 ♂, 20.i.1998, JAS, SW, #2991 (CNC), 1 ♂, 22.i.1998, JAS, SW, #2438 (ISNB); Isla Gorge NP, 25°11' S, 149°58' E, 320 m, 1 ♂, 12.ix.1992, GD, #4012 (GDCB); 4 km WNW of Mt Cotton, 27°26' S, 153°10' E, 1 ♂, 4.ix.1986, GD, #4039 (GDCB); Brisbane, Mt Coot-tha, 27°29' S, 152°57' E, 170 m, hilltop, 10:15 am–10:45 am, 1 ♂, 8.xi.1997, JAS, #996 (UQ). **South Australia:** Between Tallaringa Well and Emu, [28°50' S, 132°44' E], vehicle net, 1 ♂, 14.iv.1994, JF, #562 (SAM). **Western Australia:** 105.6 km N of Northhampton, 27°27'19" S, 114°41'28" E, hilltop in *Banksia* scrub, 10 ♂, 13.xii.1999, JS, #7417 (UQ), #7421–3, 6 (CNC); same data as holotype, 10 ♂, #7428, 7437 (UQ), #7433 (WAM), #7439–41 (ISNB), #7444, 7446–8 (CNC); Neerabup Lake NP, 31°38'25" S, 115°43'18" E, Malaise trap, 2 ♂, 8–18.xii.1999, JAS, CL, PB, #7650 (UQ), #7651 (CNC).

Description based on #7421, 7436, 7437, 7440, 7441, 7444, 7447, 7650, and 7651; measurements based on #996, 1453, 2438, 2886, 1913, 2991, 4012, 4039, 7421, 7437, 7440, 7441, 7444, 7447, 7650, and 7651.

Diagnosis

Male

Autapomorphies. Surstyli symmetrical; short to moderately long, longer than deep, with only two or three

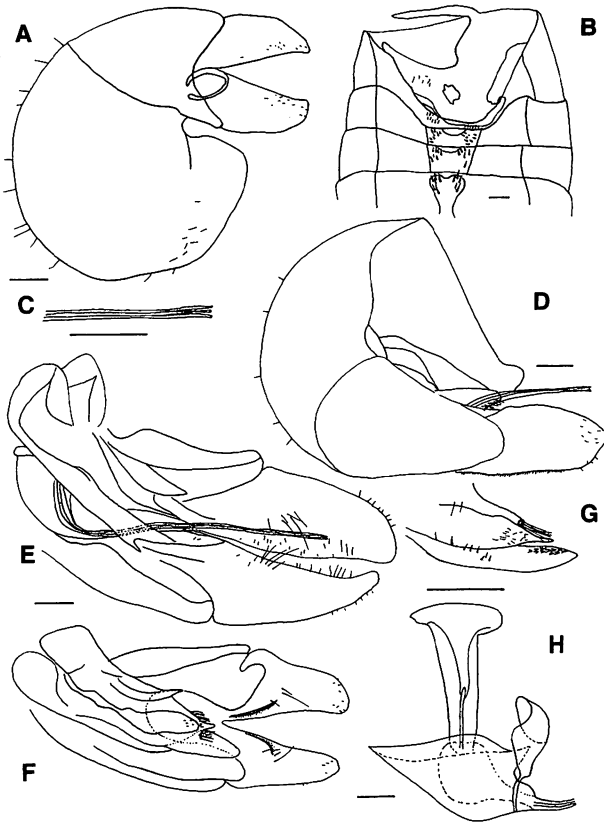


Fig. 27. Male *Clistoabdominalis lingulatus* A, ventral of distal end of abdomen (#562); B, ventral of abdomen with terminalia removed (#2991); C, dorsal of phallus (#7650); D, right lateral of terminalia (#380); E, dorsal of terminalia (#2991); F, dorsal of terminalia, phallus removed (to show variation in surstyli shape and phallic guide) (#7650); G, dorsal of tip of phallic guide (#380); H, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme (#7650). Scale bars = 0.1 mm.

long dorsomedial bristles (Fig. 27E–F). Phallic guide asymmetrical with large protruding tongue on the right side (Fig. 27E–G).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. First segment of hind trochanter with row of small spines (cf. Fig. 1G). Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located medially in discal cell; $S_3:S_2$, 1.1–1.6:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; with raised ventral ridge (Fig. 27B). Sternites 2–5 rectangular, with bristles restricted to posterolateral corners (Fig. 27B). Sternite 6 narrow; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 27B). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2–0.3:1 (Fig. 27E–F). Ejaculatory apodeme large funnel (Fig. 27H).

Description

Male

Body length, 2.8–4.3 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 3–5 dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.5–5.2:1, PW:VBL, 3.5–6.5:1. Scape with one dorsal bristle. Labellum brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose, silver along anterior edge; with fringe of 6–12 hairs. Halter yellow.

Legs. Trochanters brown; first segment of hind trochanter with row of small spines (cf. Fig. 1G). Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 5–7 black spines on apical half, posteroventrally with row of 7–9 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.0–4.7 mm; $C_4:C_3$, 0.9–1.4:1; $S_3:S_2$, 1.1–1.6:1. Tegula with two bristles.

Abdomen. Tergite 2 silver pollinose laterally and usually anterodorsally, brown pollinose anterodorsally to over entire dorsum. Tergites 3–4 brown pollinose dorsally; with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 sometimes like tergites 3–4, more often almost entirely silver with narrow medial brown pollinose band; asymmetrical, T5R:T5L, 1.3–1.5:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; with raised ventral ridge (Fig. 27B). Sternites 2–5 rectangular, with bristles restricted to posterolateral corners (Fig. 27B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 narrow; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 27B). Syntergosternite 8 black, sparsely brown pollinose, only slightly swollen, WS8:LT35, 1.0–1.2:1, WT5:WS8, 1.1–1.2:1.

Genitalia. Epandrium glabrous, shining brown, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 3.0–4.5:1. Cerci yellow. Surstyli brown to brownish yellow; symmetrical; short to moderately long, longer than deep, with only two or three long dorsomedial bristles (Fig. 27A, D–F). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2–0.3:1 (Fig. 27E–F). Hypandrium strongly deflected left (Fig. 27E–F). Phallic guide straight, with small distal hook; asymmetrical with large protruding tongue on the right side; with a cluster of short hairs laterally just proximal to hook (Fig. 27E–G). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 27D–E). Hypandrial apodeme wide (Fig. 27H). Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 27H). Ejaculatory apodeme large funnel with basal rosette (Fig. 27H).

Female

Unknown.

Distribution

Widespread in Australia but known from relatively few scattered locations in Queensland, South Australia and Western Australia (Fig. 16D).

Remarks

I am reasonably confident that the material described above is from one species but there is more variation in surstyli shape than normally occurs in *Clistoabdominalis* species (Fig. 27E–F). These differences are not discrete and a range of intermediates exist. The variation also has no geographical basis and specimens with both extremes of surstyli shape were collected together in most collection localities. Eastern specimens are identical to the western specimens except for a notable size difference. Eastern specimens are bigger, suggesting that host use varies between the geographically separate populations.

All specimens were found in dry habitats, ranging from dry sclerophyll to *Banksia* dominated scrub. Twenty-three of the 28 specimens were captured on hilltops.

Etymology

From the Latin *lingulatus* for 'tongue-like'; in reference to the distinctive tongue-like extension on the right side of the phallic guide. Masculine.

Clistoabdominalis mathiesoni, sp. nov.

(Figs 23A, 28A–E)

Material examined

Holotype. Australia, Tasmania, Franklin-Gordon Wild R. NP, Donaghy's Hill, 42°11'52" S, 145°55'55" E, [hilltop], ♂, 7.i.1999, JAS, MM, #4598 (ANIC).

Paratypes. **Australia: Queensland:** Moreton Island, Mt Tempest, 27°09' S, 153°24' E, 285 m, hilltop, 2♂, 20.ix.1997, JAS, #1076, 8 (UQ), 1♂, #1080 (ISNB), 1♂, #1081 (CNC). **Tasmania:** same data as holotype, 1♂, #4551 (UQ), 1♂, #4587 (CNC).

Description and measurements based on all specimens.

*Diagnosis**Male*

Autapomorphies. Tergite 6 swollen medially (Fig. 28B). Sternite 6 with right side developed into long, posteriorly projecting, finger-like protuberance (Fig. 28B).

Characters shared with a few species. Pedicel with long bristles, PW:BL, <3.0:1. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Wing with r-m crossvein located medially in discal cell; S₃:S₂, 1.1–1.2:1. Tergite 6 fused with right lateral plate (Fig. 28B).

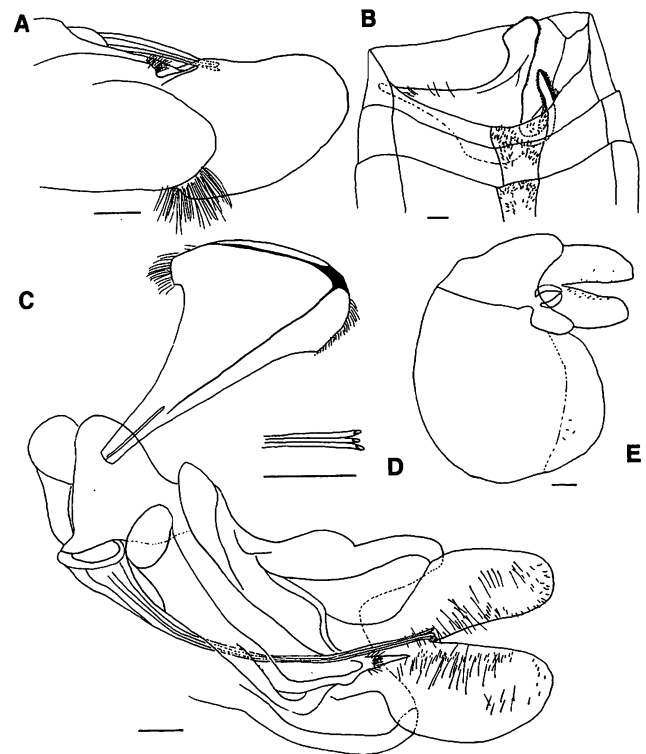


Fig. 28. Male *Clistoabdominalis mathiesoni* (#1076 and 4551). A, right lateral of terminalia; B, ventral of abdomen with terminalia removed; C, dorsal of terminalia; D, dorsal of tip of phallus; E, ventral of distal end of abdomen. Scale bars = 0.1 mm.

Synergosternite 8 swollen, WT5:WS8, 1.1:1. Epandrium shining yellow, reddish towards the edges. Surstyli yellow; symmetrical; short, almost as deep as long; densely covered with short hairs over entire medial surface (Fig. 28C). Subepandrial sclerite moderately wide, asymmetrical, offset to the right; WSES:WEP, 0.3:1 (Fig. 28C). Phallic guide with right edge somewhat swollen, covered with small hairs; group of long hairs laterally just proximal to hook (Fig. 28A,C). Tips of phallic ducts cut on angle like needles (Fig. 28D). Ejaculatory apodeme narrow, three-sided; one side very short so that appears almost flat in lateral view (Fig. 28C).

*Description**Male*

Body length, 3.9–4.4 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 4–5 dorsal bristles and two ventral bristles; PW:DBL, 2.4–2.8:1, PW:VBL, 2.2–3.0:1. Scape with one dorsal bristle. Labellum brown to brownish yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 16–20 hairs. Halter dark brown.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–6 black spines on apical half, posteroventrally with row of 9–12 black spines. Tibiae brown with yellow apices to yellow with dark medial band; apical spines absent.

Wings. Length: 4.7–5.4 mm; $C_4:C_3$, 0.7–0.8:1; $S_3:S_2$, 1.1–1.2:1. Tegula with two bristles.

Abdomen. Tergites 2–4 entirely brown pollinose in dorsal view, with silver posterolateral patches. Tergite 5 brown pollinose with silver posterolateral patches expanded onto dorsum to form large posterolateral spots; asymmetrical, $T5R:T5L$, 1.2–1.8:1. Tergite 6 narrow dorsally, wider laterally, fused with right lateral plate; swollen medially (Fig. 28B). Sternites 2–5 rectangular, with scattered bristles (Fig. 28B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 slightly enlarged and swollen internally; right side developed into long, posteriorly projecting, finger-like protuberance (Fig. 28B). Syntergosternite 8 dark brown, sparsely brown pollinose; swollen, $WS8:LT35$, 1.1–1.2:1, $WT5:WS8$, 1.1:1.

Genitalia. Epandrium shining yellow, reddish towards the edges; wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 2.5–2.6:1. Cerci bright yellow. Surstyli yellow; symmetrical; short, almost as deep as long; densely covered with short hairs over entire medial surface (Fig. 28C,E). Subepandrial sclerite moderately wide, asymmetrical, offset to the right; $WSES:WEP$, 0.3:1 (Fig. 28C). Hypandrium strongly deflected left (Fig. 28C). Phallic guide straight, with small distal hook; asymmetrical with right edge somewhat swollen, covered with small hairs; group of long hairs laterally just proximal to hook (Fig. 28A,C). Phallus trifid, projecting less than half way to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts cut on angle like needle (Fig. 28C–D). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 28C). Ejaculatory apodeme narrow, three-sided; one side very short so that appears almost flat in lateral view; with basal rosette (Fig. 28C).

Female

Unknown.

Distribution

Known only from western Tasmania and south-east Queensland (Fig. 23A).

Remarks

The Tasmanian specimens are from a hilltop in an area dominated by open, moist heath (buttongrass plains). The slopes of the hill contain pockets of wet and dry sclerophyll vegetation, dense shrubs, sedges, and heath. Temperate

rainforest exists several kilometres away along the Franklin River. The Queensland specimens are from a hilltop in dry, open, sandy heath. The lowlands around the hill are dominated by wallum heath. Despite the apparent differences in habitat and the remarkable disjunct distribution of these populations, no differences could be found amongst the specimens that would suggest that there are two species. The apparently disjunct distribution could be an artefact of collecting. More effort should be made to survey pipunculids in acidic coastal heath habitats in New South Wales and Victoria. If this species is a heath specialist I would expect it to be found in habitats from Cooloola National Park in south-east Queensland, south to Tasmania.

Etymology

Proposed in honour of Michael Mathieson, who was involved with the collection of several specimens of this species.

Clistoabdominalis monas (Perkins)

(Figs 23C, 29A–F)

Pipunculus monas Perkins, 1905: 145. – T.l.: Australia, Queensland, Bundaberg. – T.d.: BPBM (Nr 4212).

Pipunculus (Eudorylas) monas Perkins, 1905. – Hardy, 1964, 1989. *Eudorylas monas* (Perkins, 1905). – Kapoor *et al.*, 1987; De Meyer, 1996.

Clistoabdominalis monas (Perkins, 1905). – Skevington & Yeates, 2001.

Material examined

Lectotype. Australia, Queensland, [Bundaberg, 24°52' S, 152°21' E, excellent condition; pin corroding], 2333, ♂, #9336 (BPBM nr 4212).

Other material examined. **Australia: Queensland:** Lake Placid, near Cairns, 1 ♂, #618 (AMS); Brisbane, 1 ♂, #459 (UQ); Gatton, 1 ♂, #413 (CNC); Moggill, 1 ♂, #417 (UQ).

Description and measurements based on all specimens.

Diagnosis

Male

Autapomorphies. Sternite 6 extended dorsally on right side; with three protuberances, a small ventral finger hidden under left side of tergite 5, a stubby dorsal fin projecting anteriorly, and a long, thin, annulated, dorsolateral finger projecting anteriorly (Fig. 29E). Epandrium swollen, rounded ventrally and on right side with distal end projecting over base of right surstylus (Fig. 29C–D). Surstyli slightly asymmetrical; curled up on outer edges with distinctive row of hairs on outer surface; with distal, medial corners pointed and projecting sharply inward; base of surstyli upturned medially; cluster of 6–7 hairs on dorsomedial surface (Fig. 29B–D). Phallic guide with wide, flap-like, lateral

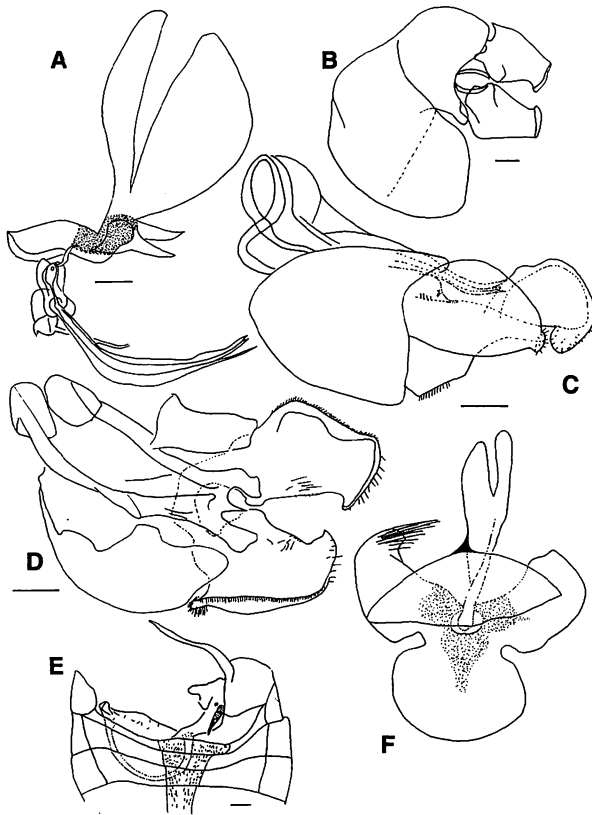


Fig. 29. Male *Clistoabdominalis monas* (#417 and 618). *A*, lateral of phallus, sperm pump, and ejaculatory apodeme; *B*, ventral of distal end of abdomen; *C*, right lateral of terminalia; *D*, dorsal of terminalia, phallus removed; *E*, ventral of abdomen with terminalia removed; *F*, dorsal of ejaculatory apodeme. Scale bars = 0.1 mm.

protuberances extending further distally than hook (Fig. 29*D*). Phallus darkly pigmented; ducts clearly separated well back from tips; tips of ducts pointed (Fig. 29*A,C*). Hypandrial apodeme reduced, very narrow, with weakly sclerotised ring clasping base of sperm pump. Sperm pump translucent, globular, separate from base of ejaculatory apodeme (Fig. 29*A*). Ejaculatory apodeme three-sided; with distinctive three-lobed base darkened medially (Fig. 29*A,F*).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3.5:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.6–2.0:1. Tergites 2–5 mostly brown pollinose dorsally, with silver posterolateral patches extending as narrow bands onto posterior edges of dorsum. Tergite 6 very narrow, fused to wider right lateral plate (Fig. 29*E*). Sternite 6 enlarged, swollen internally, with distinctive, thickened edge; extended dorsally on right side (Fig. 29*E*). Syntergosternite 8 swollen, WT5:WS8, 1.0–1.1:1.

Description

Male

Body length, 3.0–3.4 mm.

Head. Postpedicel acuminate; yellowish brown. Pedicel brown with 2–4 dorsal bristles and 1–3 ventral bristles; PW:DBL, 3.8–5.0:1, PW:VBL, 3.8–5.0:1. Scape with one dorsal bristle. Labellum brown.

Thorax. Postpronotal lobe dull yellow. Prescutum and scutum brown pollinose dorsally, sparsely silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 10–16 hairs. Halter brown.

Legs. Trochanters brown; with scattered hairs. Femora brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 5–8 black spines on apical half, posteroventrally with row of 8–12 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.7–4.2 mm; $C_4:C_3$, 0.6–0.8:1; $S_3:S_2$, 1.6–2.0:1. Tegula with two bristles.

Abdomen. Tergites 2–5 mostly brown pollinose dorsally, with silver posterolateral patches extending as narrow bands onto posterior edges of dorsum. Tergite 5 asymmetrical, T5R:T5L, 1.5–1.8:1. Tergite 6 very narrow, fused to wider right lateral plate (Fig. 29*E*). Sternites 2–5 rectangular, densely covered with bristles (Fig. 29*E*). Sternites 6 and 7 not visible from above. Sternite 7 very large. Sternite 6 enlarged, swollen internally, with distinctive, thickened edge; extended dorsally on right side; with three protuberances, a small ventral finger hidden under left side of tergite 5, a stubby dorsal fin projecting anteriorly, and a long, thin, annulated, dorsolateral finger projecting anteriorly (Fig. 29*E*). Syntergosternite 8 brown; swollen, WS8:LT35, 1.2–1.6:1, WT5:WS8, 1.0–1.1:1.

Genitalia. Epandrium not visible in dorsal view; asymmetrical, ER:EL, 1.8–2.0:1; swollen and rounded ventrally and on right side with distal end projecting over base of right surstylus (Fig. 29*C–D*). Surstyli slightly asymmetrical; curled up on outer edges with distinctive row of hairs on outer surface; with distal, medial corners pointed and projecting sharply inward; base of surstyli upturned medially; cluster of 6–7 hairs on dorsomedial surface (Fig. 29*B–D*). Subepandrial sclerite moderately wide, symmetrical; WSES:WEP, 0.3:1 (Fig. 29*D*). Hypandrium strongly deflected left (Fig. 29*D*). Phallic guide straight, wide, with small distal hook; wide, flap-like, lateral protuberances extend further distally than hook; with row of short hairs laterally just proximal to hook and a few hairs lateral to these (Fig. 29*C–D*). Phallus trifid, projecting half way to tips of surstyli; darkly pigmented; ducts clearly separated well back from tips and distinctly separate distal to base of tube formed by hypandrial apodeme; tips of ducts pointed (Fig. 29*A,C*). Hypandrial apodeme reduced, very narrow, with weakly sclerotised ring clasping base of sperm

pump. Sperm pump translucent, globular, separate from base of ejaculatory apodeme (Fig. 29A). Ejaculatory apodeme three-sided; with distinctive three-lobed base darkened medially (Fig. 29A,F).

Female

Unknown.

Distribution

Scattered records in eastern Queensland from Cairns to Brisbane (Fig. 23C).

Remarks

Despite considerable recent efforts to collect pipunculids in the Brisbane area no specimens of this species have been collected since 1967. It is apparently rare and likely does not form hilltop aggregations. Known specimens were collected between early March and late June. Hardy (1964) designated the lectotype (referred to as 'type' in his paper) for *C. monas*.

Clistoabdominalis nutatus, sp. nov.

(Figs 16A, 30A–E)

Material examined

Holotype. Australia, Northern Territory, Darwin, Ben's Hill, 4.2 km S of Stuart Highway on Berrimah Road, 12°28'26" S, 130°55'22" E, [hilltop], 0715–0800 hours, ♂, 22.ix.1998, JAS, #4063 (ANIC).

Paratypes. **Australia: Northern Territory:** same data as holotype, 1♂, 22.ix.1998, #4070 (ISNB), 1♂, 22.ix.1998, #4071 (CNC). **Queensland:** East Claudie R., [12°44' S, 143°18' E], mercury vapour light, 1♂, 1.vii.1982, MS, GD, #403 (UQ); Undara Volcanic NP, The Bluff, [18°19' S, 144°44' E, 770 m], hilltop, 5♂, 19.vii.1998, JRS, #3968, 70, 5 (UQ), #3977, 81 (CNC).

Other material examined. **Australia: South Australia:** Flinders Ranges NP, Brachina Gorge, Heysen Hilltop, 1♂, #1129 (UQ).

Description and measurements based on #403, 1129, 4063, 4070, and 4071.

Diagnosis

Male

Autapomorphies. Right surstylus greatly enlarged, with distal medial and lateral upturned projections; left surstylus small, simple, rectangular (Fig. 30A,C–D).

Characters shared with a few species. Pedicel with long bristles ventrally, PW:VBL, <2.8:1. No ventral spines on fore and hind femora. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.3–1.6:1. Tergite 2 silver pollinose on anterior two thirds, brown pollinose along posterior edge. Tergite 6 widest dorsally, with wide tongue projecting ventrally, forked into Y-shape laterally (Fig. 30B). Sternites 2–5 with scattered bristles longest in posterolateral corners (Fig. 30B). Sternite 6 narrow (Fig. 30B). Syntergosternite 8 small, WT5:WS8,

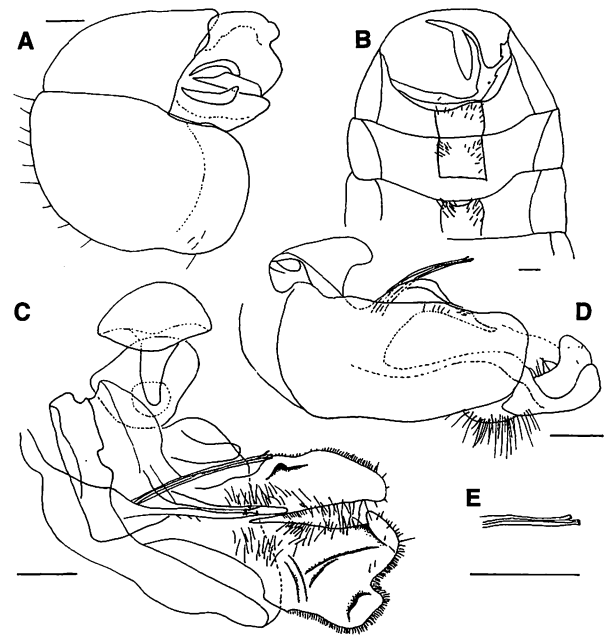


Fig. 30. Male *Clistoabdominalis nutatus* (#403 and 4071). A, ventral of distal end of abdomen; B, ventral of abdomen with terminalia removed; C, dorsal of terminalia; D, right lateral of terminalia; E, dorsal of tip of phallus. Scale bars = 0.1 mm.

1.6:1, LT3–5:LS8 7.7–8.2:1. Epandrium black, sparsely silver pollinose. Surstyli heavily sclerotised medially adjacent to subepandrial sclerite, densely covered with bristles in this region (Fig. 30A,C–D). Subepandrial sclerite moderately wide; darkly sclerotised; covered with bristles near junction with surstyli; symmetrical; WSES:WEP, 0.3–0.4:1 (Fig. 30C). Hypandrium short and wide, deflected left at 90° to phallic guide (Fig. 30C). Phallus extremely narrow; tips of ducts slightly flared (Fig. 30C–E). Hypandrial apodeme positioned ventral to hypandrium; forming a circular sheath around the base of the phallus; with narrow dorsal extension projecting posteriorly (cf. Fig. 38F–G). Ejaculatory apodeme small funnel (Fig. 30C).

Description

Male

Body length, 4.2–4.6 mm.

Head. Postpedicel short acuminate; usually brown, rarely yellow. Pedicel brown with 2–3 dorsal bristles and two ventral bristles; PW:DBL, 1.9–3.3:1, PW:VBL, 1.7–2.7:1. Scape with one dorsal bristle. Labellum dark brown.

Thorax. Postpronotal lobe bright yellow to dull yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose on posterior one half, densely silver pollinose along anterior edge; with fringe of 8–12 hairs. Halter yellow to brown.

Legs. Trochanters brown; hind trochanter with scattered hairs. Femora dark brown with narrow yellow apices; no

ventral spines on fore and hind femora; mid-femur anteroventrally with row of 4–9 black spines on apical half, posteroventrally with row of 13–19 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 4.6–4.8 mm; $C_4:C_3$, 0.8–0.9:1; $S_3:S_2$, 1.3–1.6:1. Tegula with two bristles.

Abdomen. Tergite 2 silver pollinose on anterior two thirds, brown pollinose along posterior edge. Tergites 3–4 densely brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 with large silver pollinose patches posterolaterally, brown pollinose medially and along anterior edge; slightly asymmetrical, $T5R:T5L$, 1.1–1.2:1. Tergite 6 widest dorsally, with wide tongue projecting ventrally, forked into Y-shape laterally (Fig. 30B). Sternites 2–5 rectangular, with scattered bristles; bristles longest in posterolateral corners (Fig. 30B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 narrow (Fig. 30B). Syntergosternite 8 black, sparsely silver pollinose; small, $WS8:LT35$, 0.4–0.5:1, $WT5:WS8$, 1.6:1, $LT3-5:LS8$ 7.7–8.2:1.

Genitalia. Epandrium black, sparsely silver pollinose, wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 5.9–10.4:1. Cerci yellow; large (Fig. 30A). Surstyli yellow; asymmetrical; right surstylus greatly enlarged, with distal medial and lateral upturned projections; left surstylus small, simple, rectangular; surstyli heavily sclerotised medially adjacent to subepandrial sclerite, densely covered with bristles in this region (Fig. 30A,C–D). Subepandrial sclerite moderately wide; darkly sclerotised; covered with bristles near junction with surstyli; symmetrical; $WSES:WEP$, 0.3–0.4:1 (Fig. 30C). Hypandrium short and wide, deflected left at 90° to phallic guide (Fig. 30C). Phallic guide long and narrow, deflected ventrally at 45°; symmetrical; with a few hairs along lateral edges and just proximal to hook (Fig. 30C–D). Phallus trifid, projecting nearly to tips of surstyli; extremely narrow; ducts closely associated almost to tips although distinctly separate distal to base of tube formed by hypandrial apodeme; tips of ducts slightly flared (Fig. 30C–E). Hypandrial apodeme positioned ventral to hypandrium; forming a circular sheath around the base of the phallus; with narrow dorsal extension projecting posteriorly (cf. Fig. 38F–G). Sperm pump closely associated with basal rosette of ejaculatory apodeme, difficult to discern (Fig. 30C). Ejaculatory apodeme small funnel with basal rosette (Fig. 30C).

Female

Unknown.

Distribution

North Queensland, the Northern Territory near Darwin, and an unexpected outlier from the Flinder's Ranges of South Australia (Fig. 16A).

Remarks

Very similar to *C. yeatesi*. The only consistent difference between these two species is in the shape of the surstyli. Despite the apparently disjunct range presented by the South Australian specimen, I have little doubt that it belongs to this species. However, without more material for comparison this specimen has been excluded from the type series.

Four of the five specimens were collected on hilltops in dry sclerophyll forest. The fifth specimen was collected at a mercury vapour light. Pipunculids occasionally visit lights but there is no pattern of visitation. Forty-six specimens of Australian Pipunculidae representing 10 genera and 14 species have been collected at lights. Of these, only one species has been collected exclusively at light (*Dasydorylas* sp. 45). As there are only two specimens of *D.* sp. 45 known and they were collected together, this is almost certainly an artefact. It appears that specimens come to lights only because of local disturbances to roost sites, not because any species are nocturnal.

Etymology

Derived from the Latin *nutatus*, 'nod' or 'droop'; in reference to the deflexed phallic guide in this species. Masculine.

Clistoabdominalis octiparvus, sp. nov.

(Figs 23D, 31A–F)

Material examined

Holotype. Australia, Queensland, Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, ♂, 29.xi.1997, JS, CL, #1450 (QM T99021).

Paratypes. **Australia: Queensland:** same data as holotype, 1 ♂, 20.i.1998, JAS, SW, #2890 (UQ); Isla Gorge NP, 25°11' S, 149°58' E, 1 ♂, 3.iii.1991, GD, #4018 (GDCB); **Victoria:** Gladysdale, [37°50' S, 145°39' E], 1 ♂, 27.x.1961, DC, #255 (ANIC). **Western Australia:** 8 km E Gingin, [31°21' S, 115°48' E], 6482, 1 ♂, 27.ix.1964, G.L. Bush, #583 (AMS); 3 km S of Dawesville, Tim's Thicket Road, [32°38' S, 115°38' E], 1 ♂, 27.x.1987, MI, ES, #3695 (CAS).

Description and measurements based on all specimens.

Diagnosis

Male

Autapomorphies. Right surstylus greatly enlarged, with distal lateral upturned projection and long medial finger; left surstylus small, simple, rectangular (Fig. 31A,D,F). Hypandrial apodeme positioned dorsal to hypandrium; with narrow dorsal extension projecting laterally (Fig. 31C–D).

Characters shared with a few species. Pedicel with long bristles, $PW:VBL$, <2.8:1. No ventral spines on fore and hind femora. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.5–1.6:1. Tergite 2 silver pollinose on anterior two thirds, brown

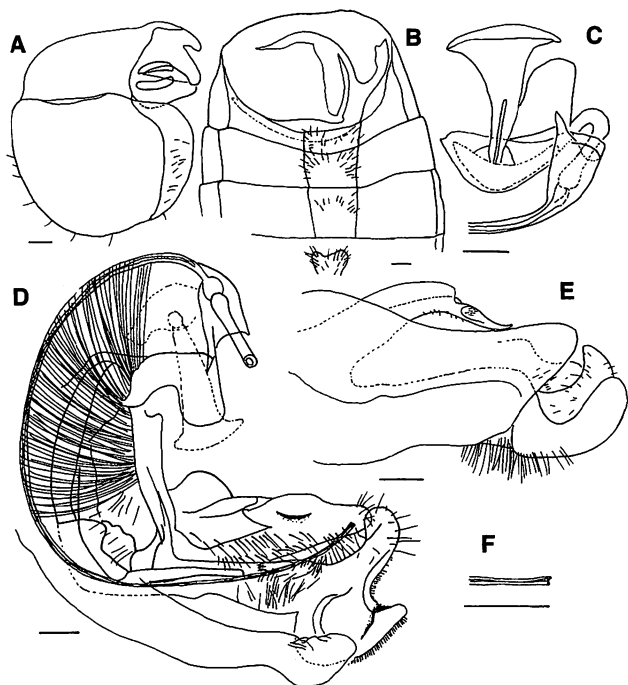


Fig. 31. Male *Clistoabdominalis octiparvus* (#255 and 2890). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme; *D*, dorsal of terminalia; *E*, right lateral of terminalia; *F*, dorsal of tip of phallus. Scale bars = 0.1 mm.

pollinose along posterior edge; may also be entirely brown pollinose dorsally. Tergite 6 widest dorsally, with wide tongue projecting ventrally, forked into Y-shape laterally (Fig. 31*B*). Sternites 2–5 with scattered bristles longest in posterolateral corners (Fig. 31*B*). Sternite 6 narrow (Fig. 31*B*). Synergosternite 8 small. Epandrium black, sparsely silver pollinose. Surstyli heavily sclerotised medially adjacent to subepandrial sclerite, densely covered with bristles in this region (Fig. 31*A,D,F*). Subepandrial sclerite moderately wide; darkly sclerotised; covered with bristles near junction with surstyli; symmetrical; WSES:WEP, 0.4:1 (Fig. 31*D*). Hypandrium short and wide, deflected left at 90° to phallic guide (Fig. 31*D*). Phallus extremely narrow; tips of ducts slightly flared (Fig. 31*D,F*). Phallus supported medially by darkly pigmented membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 31*D*). Hypandrial apodeme forming a circular sheath around the base of the phallus (Fig. 31*C*). Ejaculatory apodeme small funnel (Fig. 31*C*).

Description

Male

Body length, 4.0–4.7 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 2–4 dorsal bristles and 2–4 ventral bristles; PW:DBL, 2.2–2.5:1, PW:VBL, 1.6–2.1:1. Scape with one dorsal bristle. Labellum brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose on posterior one half, densely silver pollinose along anterior edge; with fringe of 8–10 hairs. Halter yellow to brown.

Legs. Trochanters brown; hind trochanter with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 5–8 black spines on apical half, posteroventrally with row of 11–16 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 4.8–5.4 mm; C₄:C₃, 0.9–1.0:1; S₃:S₂, 1.5–1.6:1. Tegula with two bristles.

Abdomen. Tergite 2 silver pollinose on anterior two thirds, brown pollinose along posterior edge; may also be entirely brown pollinose dorsally. Tergites 3–4 densely brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 with large silver pollinose patches posterolaterally, brown pollinose medially and along anterior edge; asymmetrical, T5R:T5L, 1.1–1.3:1. Tergite 6 widest dorsally, with wide tongue projecting ventrally, forked into Y-shape laterally (Fig. 31*B*). Sternites 2–5 rectangular, with scattered bristles; bristles longest in posterolateral corners (Fig. 31*B*). Sternites 6 and 7 not visible from above. Sternite 6 narrow (Fig. 31*B*). Synergosternite 8 black, sparsely silver pollinose; small.

Genitalia. Epandrium black, sparsely silver pollinose, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 18.2:1; expanded distally into flap covering base of right surstylus (Fig. 31*D–E*). Cerci yellow; large (Fig. 31*A*). Surstyli yellowish brown; asymmetrical; right surstylus greatly enlarged, with distal lateral upturned projection and long medial finger; left surstylus small, simple, rectangular; surstyli heavily sclerotised medially adjacent to subepandrial sclerite, densely covered with bristles in this region (Fig. 31*A,D–E*). Subepandrial sclerite moderately wide; darkly sclerotised; covered with bristles near junction with surstyli; symmetrical; WSES:WEP, 0.4:1 (Fig. 31*D*). Hypandrium short and wide, deflected left at 90° to phallic guide (Fig. 31*D*). Phallic guide long and narrow, deflected ventrally at 45°; symmetrical; with a few hairs along lateral edges and just proximal to hook (Fig. 31*D–E*). Phallus trifid, projecting nearly to tips of surstyli; extremely narrow; ducts closely associated almost to tips although distinctly separate distal to base of tube formed by hypandrial apodeme; tips of ducts slightly flared (Fig. 31*D, F*). Phallus supported medially by darkly pigmented membranous hypandrial curtain extending from the dorsomedial distal part of the hypandrium (Fig. 31*D*).

Hyandrial apodeme positioned dorsal to hypandrium; forming a circular sheath around the base of the phallus; with narrow dorsal extension projecting laterally (Fig. 31C–D). Sperm pump closely associated with basal rosette of ejaculatory apodeme, difficult to discern (Fig. 31C). Ejaculatory apodeme small funnel with basal rosette (Fig. 31C).

Female

Unknown.

Distribution

Specimens have been collected in three broadly different areas: south-central Queensland, south-central Victoria and south-west Western Australia (Fig. 23D).

Remarks

Two of the specimens were captured on hilltops in dry sclerophyll forest (of six). Given that no specimens have been captured in the wetter forests east of the coastal mountain ranges it appears that *C. octiparvus* prefers drier habitats west of these mountains in the southern half of the continent.

Etymology

Derived from the Latin *octo*, 'eight', and *parvus*, 'little'; in reference to the diminutive size of sytergosternite 8 in this species. Masculine.

Clistoabdominalis scalenus, sp. nov.

(Figs 16A, 32A–F)

Material examined

Holotype. Australia, Tasmania, Franklin-Gordon Wild R. NP, Donaghy's Hill, 42°11'52" S, 145°55'55" E, [hilltop], ♂, 7.i.1999, JAS, MM, #4652 (ANIC).

Paratypes. **Australia: Tasmania:** same data as holotype, 2♂, #4650, 7 (CNC), 4♂; #4651, 3–4, 6 (UQ), 1♂, #4655 (ISNB).

Description and measurements based on all specimens.

Diagnosis

Male

Autapomorphies. Tergite 6 reduced laterally so that only separate right lateral plate present (Fig. 32C). Sternite 6 glabrous, shining orange; considerably modified on right side; large rectangular protuberance just posterior to right side of sternite 5; very wide dorsal to this with medial protuberance and a long, curving dorsal finger (Fig. 32C). Sternite 7 orange, pruinose. Sytergosternite 8 mostly black, orange adjacent to sternite 7. Cerci almost perpendicular to sytergosternite 8 (Fig. 32A). Right surstylus huge, flattened laterally into large curving, blade;

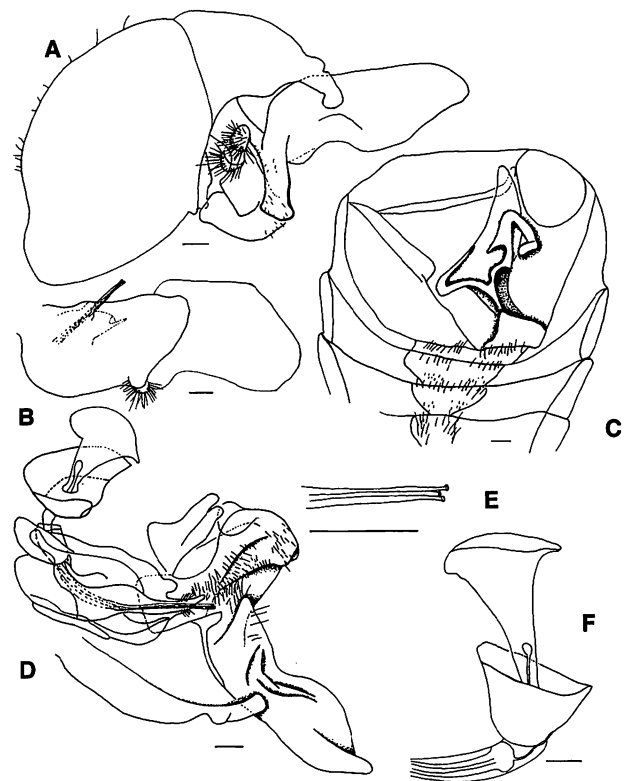


Fig. 32. Male *Clistoabdominalis scalenus* (#4654). A, ventral of distal end of abdomen; B, right lateral of terminalia; C, ventral of abdomen with terminalia removed; D, dorsal of terminalia; E, dorsal of tip of phallus; F, lateral of sperm pump and ejaculatory apodeme. Scale bars = 0.1 mm.

right surstylus with boot-shaped medial protuberance; left surstylus small, simple, hollowed out medially (Fig. 32A,D). Subepandrial sclerite narrow, asymmetrical, offset to the left; WSES:WEP, 0.2:1 (Fig. 32D).

Characters shared with a few species. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Wing with r-m crossvein located submedially in discal cell; $S_3:S_2$, 1.4–1.5:1. Epandrium shining yellowish orange. Left gonopod with round distal protuberance (Fig. 32D). Tips of phallic ducts slightly swollen (Fig. 32E). Ejaculatory apodeme small funnel (Fig. 32F).

Description

Male

Body length, 4.4–4.7 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 2.8–3.6:1, PW:VBL, 2.4–6.0:1. Scape with 1–2 dorsal bristles. Labellum yellow to brownish yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 10–14 hairs. Halter dark brown.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 8–9 black spines on apical half, posteroventrally with row of 13–17 black spines. Tibiae yellow; apical spines absent.

Wings. Length: 4.9–5.3 mm; $C_4:C_3$, 0.9–1.0:1; $S_3:S_2$, 1.4–1.5:1. Tegula with two bristles.

Abdomen. Tergites 2–5 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; silver most extensive dorsally on tergite 5. Tergite 5 asymmetrical, $T5R:T5L$, 1.0–1.2:1. Tergite 6 narrow dorsally, reduced laterally so that only separate right lateral plate present (Fig. 32C). Sternites 2–5 rectangular, with scattered bristles (Fig. 32C). Sternite 6 glabrous, shining orange, not visible from above. Sternite 7 orange, pruinose; syntergosternite 8 mostly black, orange adjacent to sternite 7. Sternite 6 enlarged, swollen somewhat internally; considerably modified on right side; large rectangular protuberance just posterior to right side of sternite 5; very wide dorsal to this with medial protuberance and a long, curving dorsal finger (Fig. 32C). Syntergosternite 8 sparsely silver pollinose, only slightly swollen, $WS8:LT35$, 0.8–1.1:1, $WT5:WS8$, 1.1–1.4:1.

Genitalia. Epandrium shining yellowish orange, wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 3.9:1. Cerci yellow; almost perpendicular to syntergosternite 8 (Fig. 32A). Surstyli orangish yellow; asymmetrical; right surstylus huge, flattened laterally into large curving blade; right surstylus with boot-shaped medial protuberance; left surstylus small, simple, hollowed out medially; hairs clustered at distal end of subepandrial sclerite and on adjacent surstyli (Fig. 32A–B,D). Subepandrial sclerite narrow, asymmetrical, offset to the left; $WSES:WEP$, 0.2:1 (Fig. 32D). Hypandrium strongly deflected left (Fig. 32D). Phallic guide straight, with small distal hook; slightly asymmetrical; dorsal hypandrial extension onto phallic guide more prominent on right side; with row of short hairs laterally just proximal to hook (Fig. 32B,D). Left gonopod with round distal protuberance (Fig. 32D). Phallus trifold, projecting less than half way to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts slightly swollen (Fig. 32D–E). Hypandrial apodeme wide. Sperm pump round, fused with basal rosette of ejaculatory apodeme (Fig. 32F). Ejaculatory apodeme small funnel with basal rosette (Fig. 32D,F).

Female

Unknown.

Distribution

All known specimens are from Franklin-Gordon Wild River National Park in western Tasmania (Fig. 16A).

Remarks

All specimens were captured hilltopping on Donaghy's Hill. The area is dominated by open, moist heath (buttongrass plains). The slopes of the hill contain pockets of wet and dry sclerophyll vegetation, dense shrubs, sedges, and heath.

Etymology

Derived from the Latin *scalenus*, 'uneven', 'unequal'; in reference to the remarkably asymmetrical surstyli of this species. Masculine.

Clistoabdominalis scintillatus, sp. nov.

(Figs 9D, 33A–E)

Material examined

Holotype. Australia, Queensland, Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, hilltop, ♂, 22.i.1998, JAS, SW, #2459 (QM T99022).

Paratypes. **Australia: Northern Territory:** Kakadu NP, Mirrai Lookout, 12°52'01" S, 132°42'12" E, hilltop, 15♂, 27.ix.1998, JAS, #4089, 4104, 8, 13, 9, 22, 32, 5, 7–9, 41, 3, 5–6 (UQ). **Queensland:** Carnarvon NP, Mt Moffatt Section Headquarters, 25°01'19" S, 147°57'16" E, 740 m amsl, 1♂, 21.xi.1995, MI, SG, #3923 (INHS); same data as holotype, 2♂, 2.xii.1997, JS, CL, #2011, 45 (ANIC), 9♂, 20.i.1998, JAS, SW, #2756, 62, 72, 95, 2940, 4, 6, 76, 3004 (UQ), 3♂, 22.i.1998, JAS, SW, #2398, 2453, 2545 (CNC); Carnarvon NP, Hilltop N of Tombs, 25°04'53" S, 147°52'10" E, hilltop, 1♂, 26.xi.1997, JS, CL, #2190 (UQ); Cooloolo NP, East Mullen hilltop, 26°00' S, 152°59" E, 129 m, [dry sclerophyll], 1♂, 11.iv.1998, JAS, #3900 (UQ); Brisbane, Mt Coot-tha, 27°29'16" S, 152°57'02" E, 170 m, hilltop, 1♂, 25.viii.1997, JAS, #826 (CNC), 3♂, 26.x.1997, JS, #1170–2, 1♂, 8.xi.1997, JAS, #1006 (UQ), 2♂, 19.iv.1998, JS, #3867, 86 (ISNB).

Description based primarily on #826, 2190, 2459, 2545, 2944, 2946, and 4146; measurements based on #1172, 2940, 3886, and 4139.

Diagnosis

Male

Autapomorphies. Thorax and abdomen entirely densely silver pruinose.

Characters shared with a few species. Pedicel with short bristles, $PW:BL$, >3:1. First segment of hind trochanter with row of long spines. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.7–1.9:1. Tergite 6 swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 33B). Sternites 2–5 with scattered peg-like bristles (Fig. 33B). Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 33B). Syntergosternite 8 somewhat swollen, $WT5:WS8$, 1.0–1.2:1. Epandrium glabrous, shining black. Surstyli symmetrical; with somewhat elongate, pale tips; 6–8 long dorsomedial bristles (Fig. 33A, D). Subepandrial sclerite narrow, asymmetrical,

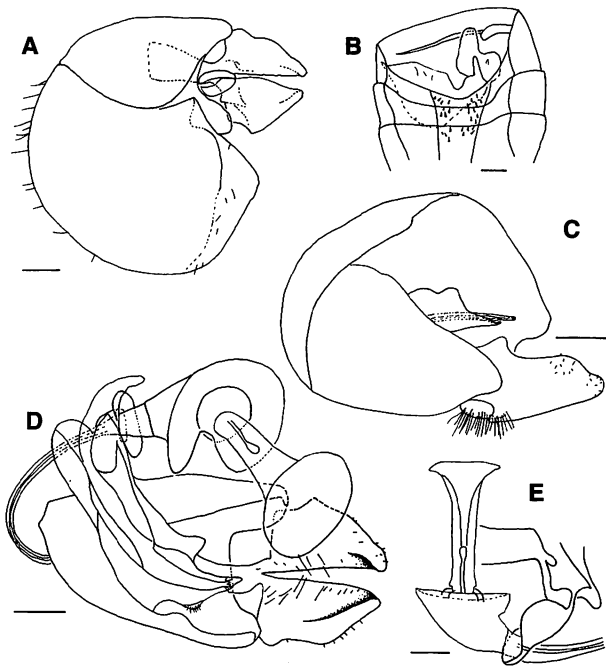


Fig. 33. Male *Clistoabdominalis scintillatus* (#1172, 2453, and 4141). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, right lateral of terminalia; *D*, dorsal of terminalia, phallus displaced ventrally; *E*, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme. Scale bars = 0.1 mm.

offset to the right; WSES:WEP, 0.2:1 (Fig. 33D). Phallic guide with small, hairy protuberance on the right side (Fig. 33D). Ejaculatory apodeme large funnel (Fig. 33E).

Description

Male

Body length, 2.7–3.1 mm.

Head. Postpedicel short acuminate; brown to dull yellow. Pedicel brown with 3–4 dorsal bristles and 2–3 ventral bristles; PW:DBL, 3.3–4.2:1, PW:VBL, 4.0–5.0:1. Scape with one dorsal bristle. Labellum dark brown to yellow.

Thorax. Postpronotal lobe yellow. Prescutum, scutum and pleuron densely silver pruinescent. Scutellum densely silver pruinescent; with fringe of 10 hairs. Halter yellow.

Legs. Trochanters brown; first segment of hind trochanter with row of long spines. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 1–3 black spines on apical half, posteroventrally with row of 10–11 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 3.0–3.5 mm; $C_4:C_3$, 0.9–1.2:1; $S_3:S_2$, 1.7–1.9:1. Tegula with two bristles.

Abdomen. Tergites 2–5 densely silver pruinescent. Tergite 5 asymmetrical, T5R:T5L, 1.3–1.4:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 33B). Sternites 2–5 rectangular, with scattered peg-like bristles (Fig. 33B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 33B). Syntergosternite 8 black, sparsely silver pollinose, somewhat swollen, WS8:LT35, 0.9–1.1:1, WT5:WS8, 1.0–1.2:1.

Genitalia. Epandrium glabrous, shining black, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 3.8:1. Cerci yellow. Surstyli brownish yellow; symmetrical; short, longer than deep; with somewhat elongate, pale tips; with 6–8 long dorsomedial bristles (Fig. 33A,C–D). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.2:1 (Fig. 33D). Hypandrium strongly deflected left (Fig. 33D). Phallic guide straight, with small distal hook; slightly asymmetrical with small protuberance on the right side; with row of short hairs laterally just proximal to hook (Fig. 33C–D). Phallus trifold, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 33C). Hypandrial apodeme wide (Fig. 33E). Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 33D–E). Ejaculatory apodeme large funnel with basal rosette (Fig. 33D–E).

Female

Unknown.

Distribution

Known from south-east Queensland and north of 13° S in the Northern Territory (Fig. 9D).

Remarks

All but one of the specimens of this spectacular species have been captured on hilltops in dry sclerophyll forest (39 of 40 specimens). Specimens are unmistakable in the field with their glittering silver pruinescence; however, other than this characteristic, *C. scintillatus* is identical to *C. trochanteratus*. The *C. helluo*-group as a whole have only very minor differences in genitalic structure, suggesting that reproductive isolation between species may be gained using either external features (as with *C. scintillatus*) or chemical cues. Given this, future work on this species-group should focus on the utility of cuticular hydrocarbons or molecular techniques for species determination. This type of character data may help to overcome the taxonomic impediment posed to non-specialists by most species in this group.

Etymology

Derived from the Latin *scintillatus*, 'sparkle' or 'glitter'; in reference to the spectacular silver appearance of this species. Masculine.

Clistoabdominalis tasmanicus, sp. nov.

(Figs 5H, 9D, 34A–E)

Material examined

Holotype. Australia, Tasmania, Cradle Mt NP, 41°37'38" S, 145°56'45" E, in flowering heath, Malaise trap, ♂, 22.xii.1998–8.i.1999, JAS, #4703 (ANIC).

Allotype. Australia, Tasmania, ♀, same data as holotype, #4701 (UQ).

Paratypes. **Australia: Tasmania:** same data as holotype, 4♀, #4696–7, 4702, 22 (UQ), 1♀, #4786 (CNC).

Description and measurements based on all specimens.

Diagnosis

Male

Autapomorphies. Sternites 2–5 triangular; darkly sclerotised; densely covered with bristles (Fig. 34B). Sternite 6 very slightly enlarged and swollen internally; with medial boot-shaped protuberance and longer right lateral finger

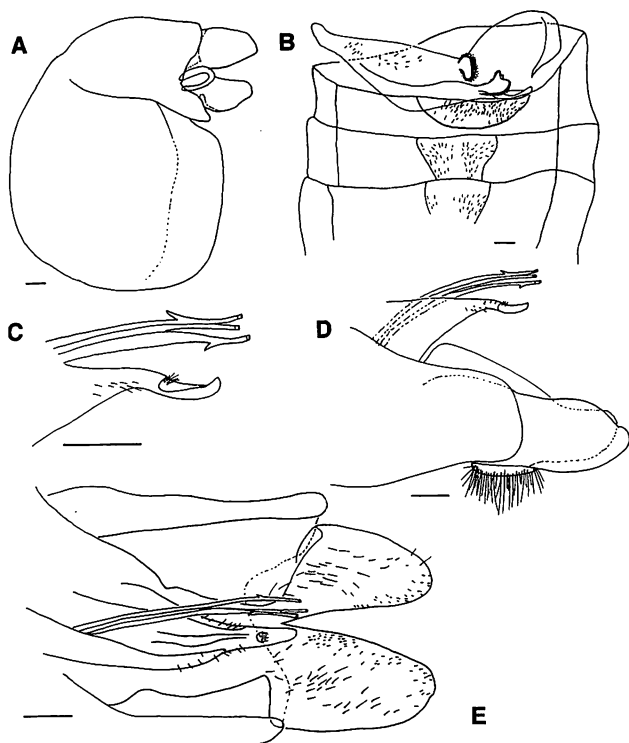


Fig. 34. Male *Clistoabdominalis tasmanicus* (#4703). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, lateral of phallus and phallic guide; *D*, right lateral of terminalia; *E*, dorsal of terminalia. Scale bars = 0.1 mm.

(Fig. 34B). Each phallic duct with a single backwards pointing protuberance just proximal to tip (Fig. 34C–E).

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3.0:1. Ventral spines on fore and hind femora absent. Apical spines on tibiae absent. Wing with r-m crossvein located submedially in discal cell; $S_3:S_2$, 1.4:1. Tegula with 12 bristles. Syntergosternite 8 swollen, WT5:WS8, 1.0:1. Surstyli almost symmetrical, left surstylus somewhat shorter; short, stubby, with scattered short hairs (Fig. 34E). Subepandrial sclerite wide, asymmetrical, offset to the right; WSES:WEP, 0.4:1 (Fig. 34E). Ejaculatory apodeme three-sided (cf. Fig. 35C–D).

Female

Characters shared with a few species. Ovipositor piercer slightly upcurved, base cylindrical (Fig. 5H).

Description

Male

Body length, 4.7 mm.

Head. Postpedicel short acuminate; brown. Pedicel brown with two dorsal bristles and two ventral bristles; PW:DBL, 3.4:1, PW:VBL, 3.4:1. Scape with one dorsal bristle. Labellum yellow.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 16 hairs. Halter brown.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 10 black spines on apical half, posteroventrally with row of 13 black spines. Tibiae yellow with narrow brown medial bands; apical spines absent.

Wings. Length: 6.2 mm; $C_4:C_3$, 0.6:1; $S_3:S_2$, 1.4:1. Tegula with 12 bristles.

Abdomen. Vestiture of tergites 2–5 of male not seen, specimen dissected. Tergite 5 asymmetrical, T5R:T5L, 1.4:1. Tergite 6 very narrow, poorly sclerotised, apparently fused with right lateral plate (Fig. 34B). Sternites 2–5 triangular; darkly sclerotised; densely covered with bristles (Fig. 34B). Sternites 6 and 7 not visible from above. Sternite 6 very slightly enlarged and swollen internally; with medial boot-shaped protuberance and longer right lateral finger (Fig. 34B). Syntergosternite 8 swollen, WS8:LT35, 0.9:1, WT5:WS8 1.0:1.

Genitalia. Epandrium wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 2.7:1. Surstyli almost symmetrical, left surstylus somewhat shorter; short, stubby, with scattered short hairs (Fig. 34A, D–E). Subepandrial sclerite wide, asymmetrical, offset to the right; WSES:WEP, 0.4:1 (Fig. 34E). Hypandrium strongly deflected left (Fig. 34E). Phallic guide straight, with small

distal hook; symmetrical; with row of short hairs laterally just proximal to hook and scattered hairs along margins (Fig. 34C–E). Phallus trifid, projecting just beyond base of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple; each duct with a single backwards pointing protuberance just proximal to tip (Fig. 34C–E). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (cf. Fig. 35C–D). Ejaculatory apodeme three-sided, with U-shaped basal rosette (cf. Fig. 35C–D).

Female

As male except: body length, 4.1–4.5 mm. Eyes dichoptic; FR, 0.9–1.1:1. FFE, 0.2–0.3:1. Tergites 2–6 mostly brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; silver most extensive dorsally on tergite 6.

Ovipositor. Ovipositor piercer slightly upcurved, base cylindrical (Fig. 5H). OL, 0.8 mm; OL:PL, 1.5–1.6:1; BL:OL, 0.4–0.5:1; B:PL, 5.4–5.5:1.

Distribution

Known only from Cradle Mountain National Park in Tasmania (Fig. 9D).

Remarks

All specimens were captured in Malaise traps in pocket of wet alpine heath surrounded by clumps of trees dominated by *Nothofagus*.

Etymology

Named after the Australian state where all known specimens have been collected (Tasmania). Masculine.

Clistoabdominalis tharra, sp. nov.

(Figs 35A–G, 36B)

Material examined

Holotype. Australia, Queensland, Mt Etna, summit, 23°09'35" S, 150°27'06" E, 284 m, ♂, 19.ix.1999, JAS, #7002 (QM T99023).

Paratypes. **Australia: Queensland:** same data as holotype, 1 ♂, 19.ix.1999, JAS, #7003 (UQ); Carnarvon NP, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, 1 ♂, 27.xi.1997, JS, CL, #1762 (ISNB); Carnarvon NP, Mt Moffatt Section, Mt Moffatt Summit, 25°03'35" S, 148°02'38" E, 1097 m, 1 ♂, 22.i.1998, JAS, SW, #2598 (UQ); Moreton Island, Mt Tempest, 27°09' S, 153°24' E, 285 m, hilltop, 1 ♂, 20.ix.1997, JAS, #1079 (CNC).

Description and measurements based on all specimens.

Diagnosis

Male

Autapomorphies. Tergite 2 brown pollinose dorsally, with silver posterolateral patches extending onto posterior

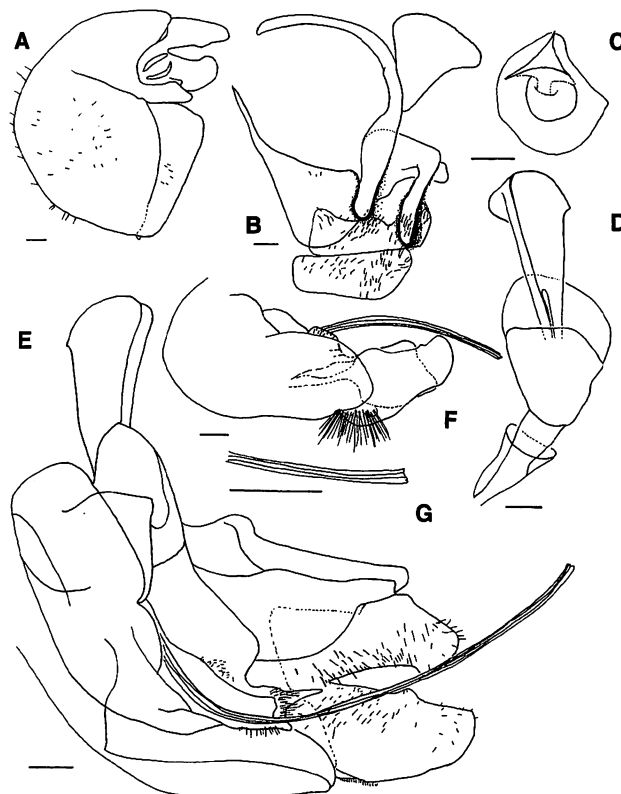


Fig. 35. Male *Clistoabdominalis tharra* (#1079 and 1762). A, ventral of distal end of abdomen; B, ventral of abdomen with terminalia and lateral parts of abdomen removed; C, dorsal of ejaculatory apodeme; D, lateral of sperm pump and ejaculatory apodeme; E, dorsal of terminalia; F, right lateral of terminalia; G, dorsal of tip of phallus. Scale bars = 0.1 mm.

corners of dorsum; also a narrow silver pollinose band along anterior edge. Tergites 3–4 brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; on tergite 3 silver extends in very narrow band along rear of segment leaving less than one third of posteromedial edge brown; tergite 4 with posterior band of silver twice as wide and almost joining in middle. Tergite 6 with ventral half of tergite swollen into thin, darkly sclerotised structure with wide protuberance projecting anteriorly, easily visible in ventral view without dissection (Fig. 35B). Sternite 6 with right side developed into long, anteriorly projecting, finger-like protuberance, easily visible in ventral view without dissection (Fig. 35B). Right surstylus larger than left, with small medial swelling along inner edge; left surstylus with triangular swelling along inner edge near apice; densely covered with short hairs over entire medial surface (Fig. 35A,E). Tips of phallic ducts with small medial indentations (Fig. 35G).

Characters shared with a few species. Body length, 5.7–6.4 mm. Pedicel with long bristles, PW:BL, <3.0:1. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally, along posterior edge, and in two

dorsocentral stripes. Scutellum brown pollinose medially, silver-grey pollinose around edges. Fore-femur anteroventrally with row of 6–11 black spines on apical half, posteroventrally with 0–2 black spines and a few stout hairs; hind-femur anteroventrally with 1–5 black spines and a few stiff hairs, no spines posteroventrally. Fore and mid tibiae with apical spines. Wing with r-m crossvein located medially in discal cell; $S_3:S_2$, 1.0–1.2:1. Tergite 6 with right lateral plate fused basally with rest of tergite (Fig. 35B). Sternites 2–5 darkly sclerotised. Sternite 6 enlarged, swollen internally (Fig. 35B). Syntergosternite 8 small, $WT5:WS8$, 1.3–1.4:1, $LT3-5:LS8$ 3.8–6.5:1. Epandrium reddish brown; pruinose. Cerci angled at 45° to surstyli (Fig. 35A). Subepandrial sclerite moderately wide, asymmetrical, offset to the right; $WSES:WEP$, 0.3:1 (Fig. 35E). Phallic guide with right edge elevated and covered with small hairs; row of long hairs laterally just proximal to hook (Fig. 35E). Ejaculatory apodeme narrow, three-sided; one side very short so that appears almost flat in lateral view; basal rosette somewhat elongate (Fig. 35C–D).

Description

Male

Body length, 5.7–6.4 mm.

Head. Postpedicel obtuse; brown. Pedicel brown with 4–5 dorsal bristles and 2–4 ventral bristles; $PW:DBL$, 1.8–3.0:1, $PW:VBL$, 1.8–2.2:1. Scape with 1–2 dorsal bristles. Labellum yellowish brown.

Thorax. Postpronotal lobe yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally, along posterior edge, and in two dorsocentral stripes. Scutellum brown pollinose medially, silver-grey pollinose around edges; with fringe of 12–16 hairs. Halter brown.

Legs. Trochanters brown; with scattered hairs. Femora dark brown with narrow yellow apices; fore-femur anteroventrally with row of 6–11 black spines on apical half, posteroventrally with 0–2 black spines and a few stout hairs; mid-femur anteroventrally with row of 8–12 black spines on apical half, posteroventrally with row of 11–17 black spines; hind-femur anteroventrally with 1–5 black spines and a few stiff hairs, no spines posteroventrally. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 6.7–7.0 mm; $C_4:C_3$, 0.8–1.2:1; $S_3:S_2$, 1.0–1.2:1. M_2 usually absent, present in #1079. Tegula with two bristles.

Abdomen. Tergite 2 brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; also a narrow silver pollinose band along anterior edge. Tergites 3–4 brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum; on tergite 3 silver extends in very narrow band along rear of segment leaving less than one third of posteromedial

edge brown; tergite 4 with posterior band of silver twice as wide and almost joining in middle. Tergite 5 with posterior two thirds silver pollinose, anterior one third brown pollinose; asymmetrical, $T5R:T5L$, 1.2:1. Tergite 6 narrow dorsally, wider laterally, right lateral plate fused basally with rest of tergite; ventral half of tergite swollen into thin, darkly sclerotised structure with wide protuberance projecting anteriorly, easily visible in ventral view without dissection (Fig. 35B). Sternites 2–5 rectangular, darkly sclerotised, with scattered bristles (Fig. 35B). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; right side developed into long, anteriorly projecting, finger-like protuberance, easily visible in ventral view without dissection (Fig. 35B). Syntergosternite 8 brown, densely silver pollinose, small, $WS8:LT35$, 0.7–0.8:1, $WT5:WS8$ 1.3–1.4:1, $LT3-5:LS8$ 3.8–6.5:1.

Genitalia. Epandrium reddish brown; pruinose; wrapping around dorsally so that visible in dorsal view; asymmetrical, $ER:EL$, 2.2–2.4:1. Cerci yellow, angled at 45° to surstyli (Fig. 35A). Surstyli brown to yellowish brown; asymmetrical; right surstylus larger, with small medial swelling along inner edge; left surstylus with triangular swelling along inner edge near apice; short, almost as deep as long, densely covered with short hairs over entire medial surface (Fig. 35A, E–F). Subepandrial sclerite moderately wide, asymmetrical, offset to the right; $WSES:WEP$, 0.3:1 (Fig. 35E). Hypandrium strongly deflected left (Fig. 35E). Phallic guide straight, with small distal hook; asymmetrical with right edge elevated and covered with small hairs; row of long hairs laterally just proximal to hook (Fig. 35E–F). Phallus trifid, projecting well beyond tips of surstyli so that visible ventrally without dissection; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts with small medial indentations (Fig. 35E–G). Hypandrial apodeme wide but short. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 35D). Ejaculatory apodeme narrow, three-sided; one side very short so that appears almost flat in lateral view; basal rosette somewhat elongate (Fig. 35C–D).

Female

Unknown.

Distribution

Restricted to south-east Queensland (Fig. 36B).

Remarks

The five specimens were captured hilltopping in dry sclerophyll forests and coastal heath.

The presence of M_2 veins on the wings of one specimen is interesting. This character has traditionally been used as a generic feature for many pipunculid taxa. The character has little phylogenetic utility and appears in many unrelated

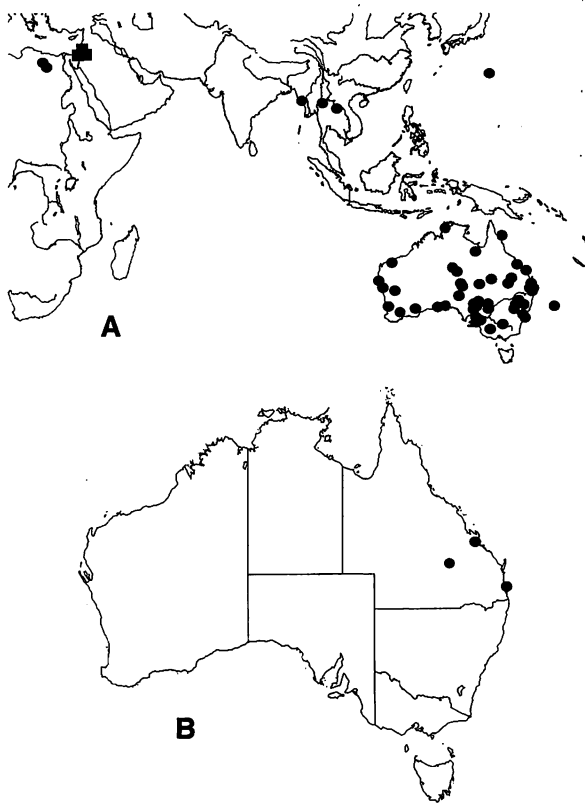


Fig. 36. Distributions of *Clistoabdominalis* species. A, *C. trochanteratus*: ■ records from De Meyer (1995), ● specimens examined by author; B, *C. tharra*.

lineages, particularly in larger species like this. It likely performs an important structural function in these large-winged species, adding extra support to the distal part of the wings. Although it is usually present in all members of a species, there are numerous examples of species in which it is present in only some of the specimens (for example *Pipunculus tibialis* (Hardy) and *Pipunculus torus* Skevington (Skevington & Marshall 1998)).

Etymology

Derived from the Yindjibarndi Aboriginal term for 'hook'; in reference to the prominent hooks on tergite 6. Feminine.

Clistoabdominalis trochanteratus (Becker)

(Figs 5I, 36A, 37A–D)

Pipunculus trochanteratus Becker, 1900: 221; Kertész, 1901. – T.I.: Egypt, 'Assiut, Luxor, Ob. Aegypten'. – T.d.: ZMHB (1 syntype, Nr. 44461, from 'Assiut' and labelled 'Typus'. Location of other syntypes unknown).

Dorylas trochanteratus (Becker, 1900). – Sack, 1935.

Dorilas (Eudorylas) trochanteratus (Becker, 1900). – Hardy, 1949.

Eudorylas trochanteratus (Becker, 1900). – Tanasijtshuk, 1988; De Meyer, 1996.

Pipunculus picrodes Perkins, 1905: 145. **syn. nov.**

Pipunculus (Eudorylas) picrodes Perkins, 1905. – Hardy, 1964, 1989.

Eudorylas picrodes (Perkins, 1905). – De Meyer, 1996.

Clistoabdominalis trochanteratus (Becker, 1900). – Skevington & Yeates, 2001.

Material examined

Lectotype. *Pipunculus picrodes*: Australia, New South Wales, Sydney, [33°53' S, 151°13' E], 2351, [paripariation on] 10.ii.1905, from jassid on *Leptospermum laevigatum*; ♀, 1.iii.1905, [poor condition, wings and legs damaged, head missing, dissected, puparium preserved on same pin as adult], #9342 (BPBM Nr 4214).

Other material examined. **Egypt:** Baharein, 1♂, #4454 (BMNH); Khamissa, 1♀, #4455 (BMNH). **Japan:** Ogasawara Arch, Haha-jima, S ridge, Chibusu Yama, 2♂, #9355–6 (BPBM). **Thailand:** Pangmakampon (Pankampawng) nr. Fang, 1♀, #6732 (BPBM); NW Chiangmai Prov., [Ban] Chiang Dao, 1♂, #6730 (BPBM). **Laos:** Phoukouv-Kuei, 1♀, #6733 (BPBM); Vientiane, 1♂, #6731 (BPBM). **Australia:** 1♂, #9641 (SAM); **Northern Territory:** Darwin, 1♂, #2384 (BPBM); 33.6 km SSW Napperby homestead, NW Alice Springs, 3♂, 5♀, #158–65 (ANIC); Alice Springs, 1♂, #2378 (BPBM). **Queensland:** Lizard I., 1♂, 2♀, #490–2 (QDPC); Ridgepole Waterhole, 24 km ESE of Musselbrook Resource Centre, Lawn Hill NP, 1♂, #102 (UQ); Carmila Beach, 1♂, 1♀, #3935–6 (INHS); North-west I. near Yeppoon, 1♀, #547 (UQ); Carnarvon NP, Mt Moffatt Section, Mt Moffatt Summit, 6♂, #2916, 32, 56, 86, 95, 99 (CNC); Murkin W[ater]hole, 1♂, #7755 (UQ); Noosa Heads, 1♀, #305–7 (ANIC); Angellala Ck, 23 km W of Morven, 1♂, #550 (UQ); Moreton I., Mt Tempest, 1♂, #1082 (UQ), 14♂, #1088, 95–9, 1101–8 (ISNB), 21♂, #3730–50 (CNC), 32♂, #3751–82 (UQ); Scrub Road, Brisbane Forest Park, 1♂, #3373 (UQ); Broadbeach, 1♂, 2♀, #275–7 (ANIC). **New South Wales:** Narrabri, 1♂, #4192 (BMNH); Fowlers Gap Res[earch] St[atio]n, 1♂, #9300 (ANIC); 23 km s.e. Tamworth, 1♂, #9293 (ANIC); Warrumbungle NP, 1♂, #1196 (UQ); Lord Howe I., Old Settlement, 1♀, 1♂, #250–1 (ANIC); 27 km N Dubbo, 1♂, #365 (ANIC); Menindee-Wilcannia road, 57 km from Menindee, 1♂, #1159 (UQ); Putty Road, 115 km S Singleton, 1♂, #629 (AMS); Dee Why, 2♂, 3♀, #270–3, 371 (ANIC), 1♂, 2♀, #588, 605, 11 (AMS); Dee Why Lagoon, 1♂, #587 (AMS); Sydney, 1♂, #4191 (BMNH); Jerilderie, 4♀, 2♂, #1204–5, 9–12 (ASCU). **Victoria:** 20 km NNE Horsham, 1♂, #5125 (MVMA). **South Australia:** 23 km S Hamilton Downs H[ome]S[tead], 1♂, #5047 (MVMA); Antikootirrimna W/H., 36 km S Abminga, 1♂, #175 (ANIC); Koonchera Dune near Koonchera Waterhole, 1♂, #905 (UQ); Mabel Ck Station, 1♂, #909 (SAM); Gammon Ranges NP, S end of Weetootla Gorge, 2♂, #1112, 4 (UQ); Flinders Ranges NP, Brachina Gorge, Heysen Hilltop, 4♂, #1128, 34, 43, 51 (UQ); 24 km W Nullarbor homestead, 1♂, #295 (ANIC); Flinders Ranges NP, 4 km S of Wilpeena Pound, 1♂, #1155 (UQ); Dutchman's Stern Conservation Park, 1♂, #1161 (UQ); 2 km W of Hamley Bridge, 1♂, #7893 (UQ); Swan Reach Conservation Park, 1♂, 8♀, #3137, 39, 42–8 (UQ); Sandy Ck Conservation Park, 8 km NE of Gawler, 2♀, #1166–7 (UQ); Mitcham, 2♂, #913–4 (SAM). **Western Australia:** Millstream, 1♂, 1♀, #9297–8 (ANIC); ~3 km N of Denham, 4♂, #7413–6 (UQ); 105.6 km N of Northampton, 3♂, #7418–20 (UQ), 2♂, #7424–5 (CNC); Mt Magnet, Mt Waramboo, 5♂, #7431, 8, 42, 5 (UQ), #7443 (WAM); 45 mi[les] NW Cue, 1♂, #3722 (CAS); Walyunga NP, 1♀, #7663 (UQ); 19.2 km WSW Eucla Motel, 1♂, #131 (ANIC); Newmanns Rocks, 50 km W of Balladonia Motel, 1♂, #4040 (GDCB); New Degate, 1♂, #241 (ANIC).

Material examined by Marc De Meyer (De Meyer, 1995). **Israel:** Bet She'an Valley; Be'er Sheva; Ze'elim; Shivta, Sedom; N. Bsoor.

Description based primarily on #162, 272–3, 276, 1128, 1166, 1196, 2999, 3746, 3769, 4454, and 9342; measurements based on #131,

159, 241, 251, 271–2, 909, 1099, 1101, 1128, 1151, 1155, 1159, 1196, 1212, 2384, 2999, 3137, 3146, 3722, 4040, 4454, 5125, 6730–2, 6734, 7414, 7442–3, 7445, 7755, and 7893.

Diagnosis

Male

Characters shared with a few species. Pedicel with short bristles, PW:BL, >3:1. First segment of hind trochanter with row of small spines (*cf.* Fig. 1G). Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.7–2.1:1. Tergite 6 swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 37D). Sternites 2–5 with scattered peg-like bristles (Fig. 37D). Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 37D). Synergosternite 8 somewhat swollen, WT5:WS8, 1.0–1.1:1. Epandrium glabrous, shining black. Surstyli symmetrical; with somewhat elongate, pale tips; 6–8 long dorsomedial bristles (Fig. 37A,C). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.1–0.2:1 (Fig. 37C). Phallic guide with small, hairy protuberance on the right side (Fig. 37C). Ejaculatory apodeme large funnel (Fig. 37C).

Female

Characters shared with a few species. Ovipositor piercer slightly upcurved, base cylindrical (Fig. 5I).

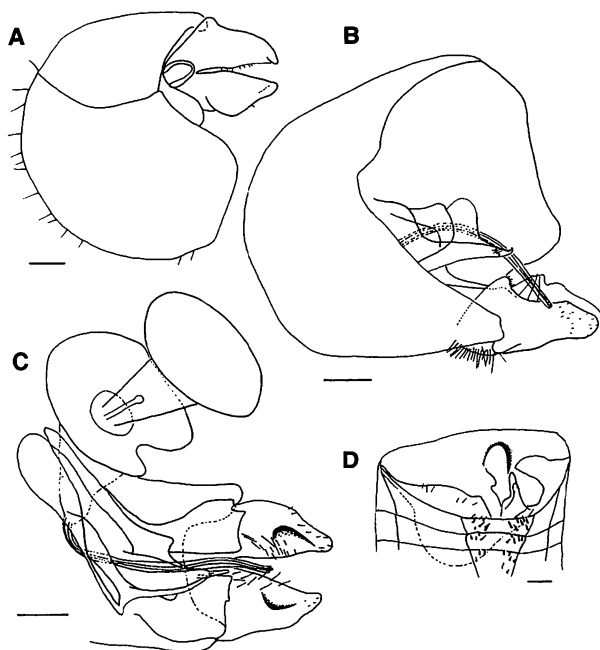


Fig. 37. Male *Clistoabdominalis trochanteratus* (#307, 1196, and 3777). A, ventral of distal end of abdomen; B, right lateral of terminalia; C, dorsal of terminalia; D, ventral of abdomen with terminalia removed. Scale bars = 0.1 mm.

Description

Male

Body length, 2.2–3.4 mm.

Head. Postpedicel short acuminate; brown to pale yellowish brown. Pedicel brown with three dorsal bristles and two ventral bristles; PW:DBL, 4.0–5.6:1, PW:VBL, 3.5–6.0:1. Scape with one dorsal bristle. Labellum brown to yellow.

Thorax. Postpronotal lobe yellow to dark brown. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose; with fringe of 8–12 hairs. Halter yellow to pale brown.

Legs. Trochanters brown; first segment of hind trochanter with row of small spines (*cf.* Fig. 1G). Femora dark brown; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 2–4 black spines on apical half, posteroventrally with row of 7–8 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 2.8–3.7 mm; $C_4:C_3$, 0.9–1.2:1; $S_3:S_2$, 1.7–2.1:1. Tegula with two bristles.

Abdomen. Tergites 2–5 brown pollinose dorsally; with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 asymmetrical, T5R:T5L, 1.4–1.7:1. Tergite 6 narrow dorsally, wider laterally and with separate right lateral plate; swollen medially; with paired ventral protuberances, right protuberance much smaller than left one (Fig. 37D). Sternites 2–5 rectangular, with scattered peg-like bristles (Fig. 37D). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 enlarged, swollen internally; with bowl-like depression on right side near point of fusion with tergite 6 (Fig. 37D). Synergosternite 8 black, sparsely brown pollinose, only slightly swollen, WS8:LT35, 1.1–1.5:1, WT5:WS8, 1.0–1.1:1.

Genitalia. Epandrium glabrous, shining black, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 3.4:1. Cerci yellow. Surstyli brownish yellow; symmetrical; short, longer than deep; with somewhat elongate, pale tips; with 6–8 long dorsomedial bristles (Fig. 37A–C). Subepandrial sclerite narrow, asymmetrical, offset to the right; WSES:WEP, 0.1–0.2:1 (Fig. 37C). Hypandrium strongly deflected left (Fig. 37C). Phallic guide straight, with small distal hook; slightly asymmetrical with small protuberance on the right side; with row of short hairs laterally just proximal to hook (Fig. 37B–C). Phallus trifid, projecting nearly to tips of surstyli; ducts closely associated almost to tips although distinctly separate distal to sperm pump; tips of ducts simple (Fig. 37B–C). Hypandrial apodeme wide. Sperm pump slightly elongate, fused with basal rosette of ejaculatory apodeme (Fig. 37C). Ejaculatory apodeme large funnel with basal rosette (Fig. 37C).

Female

As male except: postpedicel acuminate; yellow. Eyes dichoptic; FR, 0.9–1.1:1. FFE, 0.5:1. Tergite 6 mostly silver pollinose, black along dorsomedial edge.

Ovipositor. Ovipositor piercer slightly upcurved, base cylindrical (Fig. 5J). OL, 0.5–0.6 mm; OL:PL, 1.7–1.9:1; BL:OL, 0.5:1; B:PL, 5.1–6.0:1.

Distribution

This is the most widespread species of *Clistoabdominalis* and is common throughout Australia (including on Lord Howe Island). I have examined relatively little material from outside of Australia and only have specimens from Japan, Egypt, Laos and Thailand (Fig. 36A). Published records also indicate that it is found in Israel (De Meyer 1995).

Remarks

Despite the huge range of this species it seems to have some degree of specificity to its habitat requirements. All of the specimens from Australia, Japan and the Middle East come from arid to semi-arid habitats (coastal and inland sand dunes, mallee scrub, dry heath, dry sclerophyll, *Banksia* scrub, *Acacia*). No habitat data are available for the specimens from Thailand and Laos. *Clistoabdominalis trochanteratus* is a common hilltopping species within these habitats (92 of 178 specimens captured hilltopping).

Host records for this species include *Tartessus* sp. (Cicadellidae, Tartessinae) (Perkins 1905, 1906b; Hardy 1964) and *Nephotettix* sp. (Cicadellidae, Athysanini) (Hardy 1972a, b; Lin 1974; Yano 1979; Chandra 1980) (Appendix 1). Only the legs of one unidentified hopper are associated directly with any of Perkins' specimens (#9342). Rearing data is available for this specimen. Pupariation was on 20.ii.1905 and emergence was on 1.iii.1905 (20 days).

The types involved with this species and its synonyms posed a number of problems. There may only be one existing syntype of *Pipunculus trochanteratus*. Sergey Kuznetsov (St Petersburg, Russia) obtained this specimen and all of the other Becker types about 12 years ago and has never returned them to their home institutions. They are thus unavailable to me. Fortunately, there seems to be only one *Clistoabdominalis* species from the *helluo*-group in the Middle East so it is quite certain that the type is the same as other identified material that I have seen from that region.

Identified material of *C. roralis* includes both *C. roralis* sensu Hardy (1968) and Kapoor *et al.* (1987) and *C. trochanteratus*. The type for *Dorylas roralis* is lost and likely destroyed. Most of the pipunculid types from Budapest were destroyed in World War II (for details see account of *Pipunculus horvathi* Kertész in Skevington and Marshall (1998)). The original description is not detailed enough to distinguish between *C. roralis* and *C. trochanteratus*, so I recommend following Hardy's (1968), Lin's (1974), and Kapoor *et al.*'s (1987) concept of *C. roralis*. The species that

they illustrated as *C. roralis* (Hardy, fig. 29a–e; Lin, fig. 5H; Kapoor *et al.* fig. 64A–H) is very similar to *C. trochanteratus* but has a small basal flap protruding from the base of the left surstylus. I have seen material of this species from the Philippines and Hong Kong. Given the known range of *C. trochanteratus* it is almost certain that Kapoor *et al.* (1987) confounded these two species in their monograph and some of the 55 Indian specimens treated as *C. roralis* include *C. trochanteratus*. This will be best sorted out when the Oriental species of *Clistoabdominalis* are revised. At that time it will become apparent whether or not it is necessary to designate a neotype for *C. roralis*.

I am quite confident in synonymising *Pipunculus picrodes* with *C. trochanteratus*. The type is in poor condition but the ovipositor shape and measurements conform to other known specimens of *C. trochanteratus*. Hardy (1964) designated the lectotype (referred to as 'type' in his paper) for *C. picrodes*.

Clistoabdominalis yeatesi, sp. nov.

(Figs 5J, 16B, 38A–G)

Material examined

Holotype. Australia, Queensland, Mt Tinbeerwah E of Cooroy, 26°24' S, 152°59' E, hilltop, ♂, 7.xi.1998, JAS, #4377 (QM T99024).

Allotype. Australia, Queensland, Moreton Island, Mt Tempest, 27°09' S, 153°24' E, 285 m, hilltop, ♀, 20.ix.1997, JAS, #1085 (UQ).

Paratypes. **Australia: Queensland:** Cooloolo NP, Mt Elliot, summit, under fire tower, 26°01' S, 152°54' E, 163 m, 4♂, 11.iv.1998, 2♂, 12.iv.1998, JAS, #3894–7, 3901–2 (UQ); Ballon SF, Turkey Mt, summit, 26°20'49" S, 150°52'08" E, 1♂, 16.i.1998, CL, #3111 (UQ); Barakula SF No. 302, Summit Round Mt, 26°22'13" S, 150°58'09" E, [hilltop], 15♂, 8.i.2000, JAS, MM, #7492–7506 (UQ); Mt Tinbeerwah near Noosa, 26°23' S, 152°58' E, [hilltop], 3♂, 3.iii.1999, JAS, SM, DY, #5788–90 (UQ); same data as holotype, 9♂, 7.xi.1998, JAS, #4364, 6, 9 (UQ) #4371, 8–9 (CNC), #4383–5 (ISNB); Mt Beerburum Summit, 26°58' S, 152°58' E, 1♂, 31.xii.1996, CL, #104 (UQ); same data as allotype, 7♂, 20.ix.1997, 3♂, 21.ix.1997, #1071, 3–5, 7, 84, 7, 9, 93, 1100 (UQ); Brisbane, Mt Coot-tha, 27°29'16" S, 152°57'02" E, 170 m, hilltop, 1♂, 13.iv.1997, JS, #452, 3♂, 20.iv.1997, JS, #832, 5–6, 1♂, 16.viii.1997, JAS, CL, #754, 2♂, 25.viii.1997, JAS, #824–5, 2♂, 1.xi.1997, CL, #1065, 9, 2♂, 8.xi.1997, JAS, #948, 56, 9♂, 27.i.1998, JAS, #3029–30, 3, 6, 41–3, 7, 79 (UQ), 6♂, 7.iii.1998, JAS, #3616–7, 19–21, 4 (CNC), 2♂, 1.iv.1998, JS, #3825–6, 5♂, 18.iv.1999, JAS, #5797–5801, 3♂, 15.v.1999, JAS, #5738–40 (UQ), 3♂, 17.vii.1999, JAS, #6456–8 (ISNB); Mt Greville near Boonah, 28°05' S, 152°30' E, hilltop, 2♂, 4.xii.1996, CL, SE, CB, SW, #57–8 (CNC), 2♂, 6.iv.1997, JS, #801, 5 (UQ); Mt Walsh summit, 25°35' S, 152°03' E, 640 m, open forest and rock slabs, 50071, 1♂, 2–3.xii.1998, CB, SE, #6508 (QM T99025). **New South Wales:** Broken Bay, [33°34' S, 151°19' E], 1♂, 31.xii.1923, Mackerras, #248 (ANIC); Kurnell, [34°01'00" S, 151°12'00" E], by sweeping coastal bush, B.M. 1960–619, 1♂, 19.x.1958, M. Nikitin, #4196 (BMNH).

Description based primarily on #1085, 3033, 3897, 4371, and 4377; measurements based on #104, 1085, 3029, 4385, 5790, 6458, and 7503.

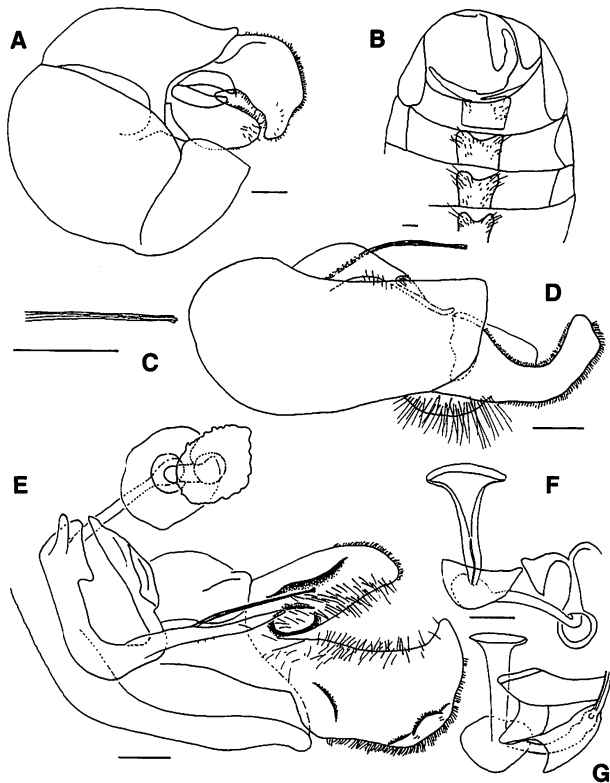


Fig. 38. Male *Clistoabdominalis yeatesi* (#452, 754, and 5790). *A*, ventral of distal end of abdomen; *B*, ventral of abdomen with terminalia removed; *C*, dorsal of tip of phallus; *D*, right lateral of terminalia; *E*, dorsal of terminalia; *F*, posterolateral view of sperm pump, ejaculatory apodeme, and hypandrial apodeme; *G*, lateral of sperm pump, ejaculatory apodeme, and hypandrial apodeme. Scale bars = 0.1 mm.

Diagnosis

Male

Autapomorphies. Right surstylus greatly enlarged, upturned on right distal edge, tip twisted medially; left surstylus small, simple, rectangular (Fig. 38*A,E*).

Characters shared with a few species. Pedicel with long bristles at least ventrally, PW:VBL, <2.8:1. Ventral spines on fore and hind femora absent. Fore and mid tibiae with apical spines. Wing with r-m crossvein located basally in discal cell; $S_3:S_2$, 1.5–1.7:1. Tergite 2 usually silver pollinose on anterior two thirds, brown pollinose along posterior edge; occasionally entirely brown pollinose dorsally. Tergite 6 widest dorsally, with wide tongue projecting ventrally, forked into Y-shape laterally (Fig. 38*B*). Sternites 2–5 with scattered bristles longest in posterolateral corners (Fig. 38*B*). Sternite 6 narrow (Fig. 38*B*). Syntergosternite 8 small, WT5:WS8, 1.3–1.6:1, LT3–5:LS8 5.0–6.6:1. Epandrium black, silver pollinose. Surstyli heavily sclerotised medially adjacent to subepandrial sclerite, densely covered with bristles in this region (Fig. 38*E*). Subepandrial sclerite moderately wide;

darkly sclerotised; covered with bristles near junction with surstyli; symmetrical; WSES:WEP, 0.4:1 (Fig. 38*E*). Hypandrium short and wide, deflected left at 90° to phallic guide (Fig. 38*E*). Phallic guide long and narrow, deflected ventrally at 45°; symmetrical (Fig. 38*D–E*). Phallus extremely narrow; tips of ducts slightly flared (Fig. 38*C–E*). Hypandrial apodeme positioned ventral to hypandrium; forming a circular sheath around the base of the phallus; with narrow dorsal extension projecting posteriorly (Fig. 38*F–G*). Ejaculatory apodeme small funnel (Fig. 38*E–F*).

Female

Autapomorphies. Ovipositor piercer slightly upcurved, base cylindrical with small tubercle on dorsum above cerci (Fig. 5*J*).

Description

Male

Body length, 4.2–4.7 mm.

Head. Postpedicel short acuminate; yellow. Pedicel brown with 2–3 dorsal bristles and 2–3 ventral bristles; PW:DBL, 2.8–4.3:1, PW:VBL, 1.9–2.6:1. Scape with one dorsal bristle. Labellum dark brown to yellow.

Thorax. Postpronotal lobe bright to dull yellow. Prescutum and scutum brown pollinose dorsally, silver-grey pollinose anterolaterally. Scutellum brown pollinose on posterior one half, densely silver pollinose along anterior edge; with fringe of 12–18 hairs. Halter yellow.

Legs. Trochanters brown; hind trochanter with scattered hairs. Femora dark brown with narrow yellow apices; no ventral spines on fore and hind femora; mid-femur anteroventrally with row of 5–9 black spines on apical half, posteroventrally with row of 10–16 black spines. Tibiae brown with yellow apices; fore and mid tibiae with apical spines.

Wings. Length: 5.1–5.3 mm; $C_4:C_3$, 0.6–0.9:1; $S_3:S_2$, 1.5–1.7:1. Tegula with 1–3 bristles.

Abdomen. Tergite 2 usually silver pollinose on anterior two thirds, brown pollinose along posterior edge; occasionally entirely brown pollinose dorsally. Tergites 3–4 densely brown pollinose dorsally, with silver posterolateral patches extending onto posterior corners of dorsum. Tergite 5 with large silver pollinose patches posterolaterally, brown pollinose medially and along anterior edge; slightly asymmetrical, T5R:T5L, 1.1:1. Tergite 6 widest dorsally, with wide tongue projecting ventrally, forked into Y-shape laterally (Fig. 38*B*). Sternites 2–5 rectangular, with scattered bristles; bristles longest in posterolateral corners (Fig. 38*B*). Sternites 6 and 7 sparsely silver pollinose, not visible from above. Sternite 6 narrow (Fig. 38*B*). Syntergosternite 8 black, brown pollinose to sparsely silver pollinose; small, WS8:LT35, 0.5:1, WT5:WS8, 1.3–1.6:1, LT3–5:LS8 5.0–6.6:1.

Genitalia. Epandrium black, silver pollinose, wrapping around dorsally so that visible in dorsal view; asymmetrical, ER:EL, 7.6:1. Cerci yellow; large (Fig. 38A). Surstyli yellow; asymmetrical; right surstylus greatly enlarged, upturned on right distal edge, tip twisted medially; left surstylus small, simple, rectangular; surstyli heavily sclerotised medially adjacent to subepandrial sclerite, densely covered with bristles in this region (Fig. 38A,D–E). Subepandrial sclerite moderately wide; darkly sclerotised; covered with bristles near junction with surstyli; symmetrical; WSES:WEP, 0.4:1 (Fig. 38E). Hypandrium short and wide, deflected left at 90° to phallic guide (Fig. 38E). Phallic guide long and narrow, deflected ventrally at 45°; symmetrical; with a few hairs along lateral edges and just proximal to hook (Fig. 38D–E). Phallus trifold, projecting nearly to tips of surstyli; extremely narrow; ducts closely associated almost to tips although distinctly separate distal to base of tube formed by hypandrial apodeme; tips of ducts slightly flared (Fig. 38C–E). Hypandrial apodeme positioned ventral to hypandrium; forming a circular sheath around the base of the phallus; with narrow dorsal extension projecting posteriorly (Fig. 38F–G). Sperm pump closely associated with basal rosette of ejaculatory apodeme, difficult to discern (Fig. 38F). Ejaculatory apodeme small funnel with basal rosette (Fig. 38E–F).

Female

As male except: eyes dichoptic; FR, 1.2:1. FFE, 0.3:1.

Ovipositor. Ovipositor piercer slightly upcurved, base cylindrical with small tubercle on dorsum above cerci (Fig. 5J). OL, 1.0 mm; OL:PL, 1.4:1; BL:OL, 0.4:1; B:PL, 4.4:1.

Distribution

South-east Queensland south to the Sydney area of New South Wales (Fig. 16B).

Remarks

Most specimens were captured on hilltops in dry sclerophyll forest (96 of 98). No habitat data are available for the other two specimens.

Etymology

Proposed in honour of David K. Yeates, in recognition of his input into my Ph.D. thesis.

Recommendations for further research

Weaknesses prevalent throughout the world of pipunculid systematics continue to pose problems and should be the focus of future work. The sexes of pipunculids are notoriously difficult to associate, and collection of large numbers of hilltopping males exacerbates the problem. Even when females can be associated with the more distinctive males, difficulties in identification continue. Additional research into this problem is badly needed. Molecular

methods will undoubtedly prove to be a useful tool for associating the sexes of pipunculids, but a less expensive tool is needed to streamline future research on these animals. Cuticular hydrocarbon analysis and spectroscopy should be explored as possibly quicker and cheaper methods for identifying female pipunculids. Females may have species-specific hydrocarbon profiles or reflect specific wavelengths of light. There is no doubt that if males can correctly detect females of their species from amongst many potential species on a hilltop there must be a way for us to more easily recognise these specimens.

An excellent taxonomic framework is now established for *Clistoabdominalis* in Australia; however, future work here should focus additional collecting efforts in rainforest areas and in south-eastern Australia. Ecological projects relating to the group can now be undertaken with the expectation that most Australian species are described and can be readily identified. More work on the life histories of Australian pipunculids is badly needed. The elucidation of host records will provide both the necessary information for applied projects in biological control and the necessary data to examine host–parasite evolution in light of the hypothesised phylogenies. Rearing will also enable associations to be made between the sexes in these flies.

Taxonomic progress made here will also facilitate the study of mating strategies in Australian Pipunculidae. From notes provided in the species remarks sections above, hilltopping is apparently an important mating strategy in *Clistoabdominalis*. With further work, valuable insights may be made into mating strategies of pipunculids and into the evolution of male aggregations in general.

Research on non-Australian species of *Clistoabdominalis* should now take precedence. Revision of the remaining species in the Australasian and Oriental *Clistoabdominalis* lineage will enable biogeographical analysis of the clade. However, more collecting is necessary before serious inroads can be made into such a revision.

In summary, research into many areas relating to these flies has great potential and should provide a rich store of information for both practical and theoretical work.

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Appendix 1. Documented host relationships for Australian Pipunculidae
The most conservative estimates of host relationships are presented in bold face

Parasitoid	Host given by Perkins (1905, 1906a, 1906b)	Host given by Hardy (1964)	Host on pin with pipunculid	Host data given by other authors
<i>Cephalops (Semicephalops) xanthocnemis</i> (Perkins)	<i>Liburnia</i> or allied form (Delphacidae, Delphacinae)	Delphacidae	None	
<i>Microcephalops anthracias</i> (Perkins)	<i>Thamnotettix</i> ? (Cicadellidae, Deltocephalinae, Athysanini)	<i>Balclutha</i> sp.? (Deltocephalinae, Balcluthini)	Perkins No. 2239	
<i>Claraeola erinys</i> (= <i>hylaeus</i>)	<i>Eurinoscopus</i> (synonym of <i>Batrachomorphus</i>) (Cicadellidae, Iassinae); reared from at least two species of Cicadellidae	<i>Batrachomorphus</i> sp.?	#4184, 4312; missing from #9343	
<i>Claraeola</i> sp.				<i>Eurymelops bicolor</i> (Burmeister) (Cicadellidae, Eurymelinae, Eurymelini). Unpublished label data: NSW: Pymble, [33°45' S, 151°08' E], No. 244, from <i>Eurymela bicolor</i> , [formed puparium on] 26.vii.1932, 1 ♀, hatched xi.1932, #1207 (ASCU).
<i>Clistoabdominalis beneficiens</i>	<i>Phrynophyes</i> ¹ (Deltocephalinae, Stenometopiini); <i>Deltocephalus</i> (Deltocephalinae, Deltocephalini); <i>Athysanus</i> ¹ (Deltocephalinae, Athysanini)		#4163	not associated with Nearctic leafhoppers as stated by Kapoor <i>et al.</i> (1987)
<i>C. helluo</i>	<i>Colgar peracutum</i> (Walker) (Flatidae, Flatinae); <i>Gaetulia chrysopoides</i> (Walker) (Issidae, Nogodininae); <i>Siphanta</i> (Flatinae)	Unknown genus Deltocephalini (Deltocephalindae); unknown fulgoroid genus	#3548	
<i>C. koebelei</i>	<i>Thaumatoscopus</i> (Cicadellidae, Penthimiinae); <i>Vulturinus</i> (Penthimiinae)	<i>Neodartus</i> sp.? (Penthimiinae) or <i>Vulturinus</i> sp.?	None	Not <i>Nesophrosyne</i> sp. (a Nearctic deltocephaline) as stated by Kapoor <i>et al.</i> (1987)
<i>C. monas</i>	<i>Deltocephalus</i>		None	Not 'jassid, name not given' as stated by Kapoor <i>et al.</i> (1987)
<i>C. trochanteratus</i> (= <i>picrodes</i>)	<i>Tartessus</i> (collected from <i>Leptospermum laevigatum</i>) (Cicadellidae, Tartessinae)	<i>Tartessus</i> sp?	Only legs remaining on pin with pipunculid #9342	None ² .
<i>Dasydorylas eucalypti</i>	<i>Rhotidus</i> (Cicadellidae, Ledrinae, Thymbrini)	<i>Ledropsis crocina</i> Distant ³ (Ledrinae, Ledrini (Fletcher 2000) or Petalocephalini (Oman <i>et al.</i> 1990))	None	Not <i>Ledropsin crocina</i> Dist. as stated by Kapoor <i>et al.</i> (1987)
<i>D. lamellifer</i> (= <i>comitans</i>)	<i>Athysanus</i> ¹ (Athysanini)	<i>Stirellus fatigandus</i> (Kirkaldy) (Deltocephalini) (as <i>Campbellinella fatigandus</i>)	#4313	Not <i>Campbellinella fatigandus</i> (Kirk.) as stated by Kapoor <i>et al.</i> (1987)
<i>Eudorylas cinerascens</i>	Puparia collected off leaves of <i>Melaleuca</i> on which <i>Privesa</i> (Ricaniiidae) were feeding (not reared from larvae)			Not associated with Nearctic leafhoppers on <i>Melaleuca</i> as stated by Kapoor <i>et al.</i> (1987)

Appendix 1. (Continued)

Parasitoid	Host given by Perkins (1905, 1906a, 1906b)	Host given by Hardy (1964)	Host on pin with pipunculid	Host data given by other authors
<i>E. mutillatus</i>	<i>Hecalus immaculatus</i> Kirkaldy (Cicadellidae, Deltocephalinae, Hecalini); <i>Tartessus</i>	<i>Hecalus pallescens</i> Stål (Cicadellidae, Deltocephalinae, Hecalini)	#3530, 4204, 4309	<i>Nephotettix cincticeps</i> Uhler ⁴ (Asai and Yano 1988; Koizumi 1959; Lin 1974; Morakote <i>et al.</i> 1990a; Morakote and Yano 1988; Yano <i>et al.</i> 1984); <i>N. virescens</i> (Distant) ⁴ and/or <i>N. nigropictus</i> (Stål) ⁴ (Chandra 1980) (Athysanini)
<i>Pipunculus</i> sp. ⁵				<i>Sextius virescens</i> (Fairmaire) (Membracidae) (Cookson and New, 1980)
<i>Tomosvaryella epichalca</i> (Perkins)				<i>N. cincticeps</i> (Chu & Hirashima 1981; Morakote <i>et al.</i> 1990b; Yano <i>et al.</i> 1984); <i>Nilaparvata lugens</i> (Stål) (Chu and Hirashima 1981; Lin 1974) (Delphacidae)
<i>T. pseudophanes</i> (Perkins)	<i>Hecalus immaculatus</i> (noted as being 'bred from the same Jassid as <i>P. cruciator</i> ', so it is almost certainly <i>Hecalus pallescens</i>)		None	
<i>T. synadelpha</i> (Perkins)	<i>Deltocephalus</i>	<i>Recilia hospes</i> (Kirkaldy) (Deltocephalini) (as <i>Divitiacus hospes</i>)	None	

¹ These genera are not currently recognised as occurring in Australia (Fletcher 2000). It is unclear what Perkins (1905) meant with respect to these taxa.

² Identification of *C. trochanteratus* and *C. roralis* has been problematic. Host records exist for the latter but may be confounded with *C. trochanteratus* by identification errors. *Clistoabdominalis roralis* has been recorded on the following hosts: *Nephotettix cincticeps* Uhler (Chu and Hirashima 1981) and *Nephotettix nigropictus* (Stål) and/or *Nephotettix virescens* (Distant) (Chandra 1980).

³ This species is not currently recognised as occurring in Australia (Fletcher 2000). *Ledropsis froggatti* Distant is the only species of *Ledropsis* currently recognised from this continent.

⁴ Many species have been incorrectly listed as hosts for *E. mutillatus*. Most recently Kapoor *et al.* (1987) list the following as hosts: *Nephotettix cincticeps*, *N. virescens*, *N. nigropictus* (Stål), *N. malayanus* Ishihara and Kawase, and *N. parvus* Ishihara & Kawase. Of these, only *N. cincticeps* is definitely a host. The literature is full of such errors and misinterpretations. A few are illustrated below. Kathirithamby (1978) reared *E. mutillatus* from one or more species of *Nephotettix*. She lists the *Nephotettix* species present in her research area, but does not clarify which species her rearing records were obtained from. This has resulted in many incorrect citations of the following host records: *N. virescens*, *N. malayanus*, *N. nigropictus*, and *N. parvus*. Chandra (1980) lists several species of pipunculids including *E. mutillatus* as parasitoids of *Nephotettix virescens* and *N. nigropictus*, but he does not clarify which species use which hosts. Therefore *E. mutillatus* may use one or both of these hoppers as hosts. Both hosts are given in numerous latter citations of this work (for example Morakote *et al.* 1990a; Yano *et al.* 1984). One of the additional hurdles to overcome when verifying these host records is the common reference to rice leafhoppers and their hosts without providing the source for this data. The reader is left wondering if this data is the result of original research or of literature citation. For example, Chu and Hirashima (1981), Hardy (1971), Morakote *et al.* (1990a), and Yano (1979) list *N. cincticeps* as a host of *E. mutillatus* but are apparently referring to other work without citing it and are not basing this on original data.

⁵ This is certainly not a species of *Pipunculus* as indicated by Cookson and New (1980). Their identification was probably based on characters given by Colless and McAlpine (1970) which are now known to be inadequate. A photo provided to me by Cookson does not illustrate the characters necessary for generic identification; however, it appears to be a species of *Claraeola*, *Dasydorylas* or *Eudorylas*. The specimens were lodged in ANIC but are missing (personal communication L. Cookson, T. New).

Appendix 2. Character list for *Clistoabdominalis* phylogenetic analysis

The character matrix used to develop the *Clistoabdominalis* phylogenetic hypothesis is shown in Appendix 3. Character descriptions are included below.

General characters

1. *Body length*: (0) <4.3 mm; (1) >4.3 mm

Head

2. *Pedicel hairs*: (0) long (PW:DBL, <2.8); (1) short (PW:DBL, >3.0)

Thorax – general

3. *Postpronotal lobe*: (0) brown; (1) yellow
 4. *Thorax and abdomen*: (0) largely bare, with some short hairs; (1) entirely covered dorsally with long hairs (Fig. 19E).
 5. *Thorax and abdomen*: (0) with mixed brown and silver vestiture; (1) entirely snowy white
 6. *Scutum with dorsocentral silver stripes*: (0) absent; (1) present

Thorax – legs

7. *Hind coxa with aggregation of long anteroventral hairs*: (0) absent; (1) present (Fig. 17C)
 8. *Trochanters with aggregation of long ventral hairs*: (0) absent; (1) present (Fig. 17C)
 9. *First segment of hind trochanter with row of spines*: (0) absent; (1) present (Fig. 1G)
 10. *Fore and mid-femora with proximal cluster of long hairs*: (0) absent; (1) present (Fig. 17C)
 11. *Ventral spines on fore and hind femora*: (0) absent; (1) present (Fig. 1I)
 12. *Fore and mid-tibiae with apical spines*: (0) absent; (1) present (Fig. 1I)
 13. *Hind tibia with outstanding medial hairs*: (0) absent; (1) present (Fig. 1H)

Preabdomen

14. *Lateral fan of tergite 1*: (0) absent; (1) present
 15. *Sternite 4*: (0) similar in size to sternite 3; (1) greatly enlarged (Fig. 26D)
 16. *Sternite 5*: (0) entire (Fig. 1D); (1) divided (Fig. 26D)
 17. *Sternite 5*: (0) simple; (1) highly modified with huge lateral protuberance (Fig. 20A)
 18. *Sternites 2–5*: (0) with normal sclerotisation; (1) very darkly sclerotised
 19. *Sternites 2–5*: (0) not heart-shaped; (1) heart-shaped (Fig. 17A)
 20. *Sternites 2–5*: with long, bushy hairs (0) absent; (1) present (Fig. 17A)
 21. *Sternites 2–5*: with peg-like bristles (0) absent; (1) present (Fig. 24B)
 22. *Sternites 2–5*: (0) with posterolateral bristles undifferentiated; (1) covered with bristles, bristles longest in posterolateral corners (Fig. 38B)

Male postabdomen and genitalia

23. *Tergite 6 with ventral protuberance*: (0) absent; (1) present, round (Fig. 17A); (2) present as a raised ridge in middle of sclerite (Fig. 14B); (3) present, 1–3 raised fingers (Fig. 24B); (4) present, single, long, sinuous (Fig. 7B); (5) present, ventromedial edge of sclerite raised into ridge (Fig. 4A); (6) present, long finger projecting from ventral edge of sclerite (Fig. 14E); (7) present, ventrally swollen into wide, thin projection (Fig. 35B); (8) present, darkly sclerotised wide, medial fin (Fig. 20A); (9) present, as a long continuation of ventral end of sternite

24. *Tergite 6*: (0) flat; (1) swollen medially into lump (Fig. 24B)

25. *Tergite 6*: (0) present as one wide, fused sclerite (i.e. right lateral plate fused to remainder of sclerite); (1) divided into two parts, with a separate right lateral plate (Fig. 1D); (2) present as one sclerite, fused only ventrally and forked into Y-shape (Fig. 38B)

26. *Tergite 6*: (0) narrow, unmodified dorsally; (1) wider dorsally, with wide tongue projecting ventrally (Fig. 38B)

27. *Tergite 6*: (0) not visible in dorsal view; (1) visible in dorsal view

28. *Sternite 6*: (0) narrow; (1) enlarged, swollen internally (Fig. 8B)

29. *Sternite 6*: with ventral protuberance (0) absent; (1) present (Fig. 28B)

30. *Sternite 6*: (0) smooth; (1) with bowl-shaped depression on right side (Fig. 24B)

31. *Sternite 6*: (0) smooth; (1) raised into sharp anterior ridge medially and on left side (Fig. 19B)

32. *Sternite 6*: (0) not elongate laterally; (1) with right corner elongated into sinuous projection (Fig. 13A)

33. *Sternite 7*: (0) not visible from above; (1) visible from above

34. *Syntergosternite 8*: (0) average size; (1) very swollen; (2) very small

35. *Membranous area*: (0) present; (1) absent

36. *Epandrium*: (0) wrapping around so visible in dorsal view (Fig. 1E); (1) not visible dorsally

37. *Epandrium*: (0) pruinose; (1) glabrous, shining

38. *Epandrium*: (0) not unusually rounded; (1) swollen and rounded ventrally and on right lateral edge (Fig. 29C–D)

39. *Epandrium*: (0) moderately asymmetrical; ER:EL, <4:1; (1) very asymmetrical; ER:EL, >5:1

40. *Cerci*: (0) moderate size to large, not protruding ventrally; (1) small and bulbous (Fig. 4C)

41. *Cerci*: (0) parallel to syntergosternite 8; (1) projecting perpendicular to syntergosternite 8 (Fig. 32A)

42. *Surstyli*: (0) much longer than deep; (1) almost as deep as long

43. *Surstyli*: (0) with scattered hairs; (1) with dense hairs over entire medial surface (Fig. 17E) (2) 3–8 prominent medial hairs (Fig. 24C)

44. *Left surstylus*: (0) not expanded laterally; (1) expanded laterally (Fig. 8C)

45. *Tips of surstyli*: (0) not elongate; (1) somewhat elongate (Fig. 24C)

46. *Tips of surstyli*: (0) pigmented the same as the rest of the surstyli; (1) paler

47. *Right surstylus*: (0) not greatly enlarged; (1) greatly enlarged, shaped like a baseball glove (Fig. 38E)

48. *Right surstylus with lateral swelling near distal end*: (0) absent; (1) present (Fig. 30C)

49. *Surstyli*: (0) equally sclerotised; (1) more heavily sclerotised medially adjacent to subepandrial sclerite

50. *Surstyli with small basal protuberances*: (0) absent; (1) present (Fig. 26C)

51. *Large hook at base of right surstylus*: (0) absent; (1) present (Fig. 26A,C)

52. *Subepandrial sclerite*: (0) symmetrical; (1) asymmetrical, not twisted distally (Fig. 14C); (2) asymmetrical, twisted distally (Fig. 8C)

53. *Subepandrial sclerite*: (0) wide, WSES:WEP, > 2.5:1; (1) narrow, WSES:WEP, < 2.5:1.

54. *Subepandrial sclerite*: (0) same colour as surstyli; (1) more darkly sclerotised than surstyli

55. *Base of subepandrial sclerite*: (0) glabrous; (1) covered with bristles (Fig. 38E)

56. *Hypandrium*: (0) elongate (phallic guide much shorter than hypandrium; Fig. 8C); (1) short and wide (phallic guide as long as hypandrium; Fig. 38E)

57. *Hypandrium*: (0) symmetrical, not deflected to the side; (1) deflected left at about 45° to phallic guide (Fig. 8C); (2) deflected left at 90° to phallic guide (Fig. 38E)

58. *Base of right hypandrial lobe*: (0) unmodified; (1) with sclerotised flap projecting posteriorly (Fig. 20C)

59. *Gonopods*: (0) symmetrical or with left gonopod protruding; (1) asymmetrical, right gonopod protruding

60. *Phallic guide with protuberance bearing small setae on right side*: (0) absent; (1) present, thumb-like (Fig. 8C); (2) present, flap-like (Fig. 25B-C)

61. *Phallic guide with row of hairs laterally just proximal to distal hook*: (0) absent; (1) present

62. *Phallic guide with tongue-like projection on right side*: (0) absent; (1) present (Fig. 27G)

63. *Phallic guide*: (0) wide and short (Fig. 8C); (1) long and narrow (Fig. 38E)

64. *Phallic guide*: (0) in same plane as surstyli (Fig. 4C); (1) deflected ventrally at least 45° (Fig. 38D)

65. *Phallic guide with paired lateral projections*: (0) absent; (1) present (Fig. 29D)

66. *Phallus*: (0) same length or shorter than surstyli; (1) much longer than surstyli

67. *Phallic ducts*: (0) fusing into a single tube mid-way between sperm pump and tips; (1) separate distal to sperm pump (Fig. 17E)

68. *Phallus*: (0) with tips separate for longer than length of surstyli; (1) with tips separate for more than one half length of surstyli (Fig. 26C); (2) with tips separate for less than one half length of surstyli (Fig. 4B)

69. *Tips of phallic ducts*: (0) simple, round (Fig. 4B); (1) cut on angle like needles (Fig. 17F); (2) conical (Fig. 11D); (3) capped (Fig. 12E)

70. *Phallus*: (0) moderately wide (Fig. 8C); (1) extremely narrow (Fig. 38E)

71. *Hypandrial apodeme*: (0) absent, sperm pump not supported by any sclerotised structure; (1) forming a long, wide sheet which narrows to a thin loop which encircles the base of the phallus (Fig. 27H); (2) forming a short, wide sheet which broadly encloses the base of the phallus (Fig. 38F-G)

72. *Hypandrial apodeme*: (0) absent; (1) supporting sperm pump with distal extension (Fig. 27H); (2) with ring clasping base of sperm pump arising medially (Fig. 25E)

73. *Hypandrial apodeme*: (0) missing; (1) ventral to hypandrium; (2) dorsal to hypandrium (Fig. 31D)

74. *Sperm pump*: (0) elongate with two distal tails; (1) round to cylindrical (Fig. 1F); (2) funnel-shaped

75. *Sperm pump*: (0) translucent; (1) darkly pigmented

76. *Ejaculatory apodeme*: (0) fan-shaped; (1) 3-sided (Fig. 17E); (2) funnel-shaped (Fig. 1F); (3) umbrella-shaped

77. *Ejaculatory apodeme with basal rosette*: (0) absent; (1) present (Fig. 1F)

