

**A REVIEW OF THE INDO-AUSTRALIAN SUBGENERA
HEMINOTODACUS DREW, PARADACUS PERKINS AND
PERKINSIDACUS SUBGEN. N. OF BACTROCERA MACQUART
(DIPTERA: TEPHRITIDAE: DACINAE)**

D.L. HANCOCK¹ and R.A.I. DREW²

¹8/3 McPherson Close, Edge Hill, Cairns, Qld 4870

²International Centre for the Management of Pest Fruit Flies, Griffith University, Qld 4111

Abstract

The Indo-Australian subgenera *Heminotodacus* Drew (1 species) and *Paradacus* Perkins (7 species) of *Bactrocera* Macquart are reviewed and a new subgenus, *Perkinsidacus* **subgen. n.**, is proposed for two Australasian species: *Bactrocera banneri* White from Morotai, northern Moluccas and *B. coracinus* (Drew) [type species] from Papua New Guinea. These three subgenera belong in the *Zeugodacus* group of subgenera and are distinguished by the presence of 2 pairs of scutellar setae and no medial yellow vitta on the scutum. A key to the ten species placed in these three subgenera is included.

Introduction

This is the seventh in a series of papers reviewing the subgenera of the economically important fruit fly genus *Bactrocera* Macquart, made possible by the revisions of Australasian and Southeast Asian species by Drew (1989) and Drew and Romig (2013) respectively. This paper deals with subgenera *Heminotodacus* Drew and *Paradacus* Perkins, which were considered by Hancock and Drew (2015) to contain one and six described species respectively, distributed primarily in Wallacea and New Guinea but with an outlying species in India and Sri Lanka; an additional species from Papua Province, Indonesia (White and Evenhuis 1999) was overlooked. Two additional species from eastern Indonesia (Maluku) and Papua New Guinea, included by Drew (1989) or Drew and Romig (2013, 2016) in subgenus *Paratridacus* Shiraki, are transferred here to the new subgenus *Perkinsidacus* **subgen. n.** All three subgenera belong in the *Zeugodacus* group of subgenera as defined by Drew (1989) and are united by the presence of 2 pairs of scutellar setae plus lack of a medial yellow vitta on the scutum. No host plants are known for any of the ten included species and only two have been recorded at a male attractant (cue lure).

Genus *Bactrocera* Macquart

Subgenus *Heminotodacus* Drew

Heminotodacus Drew, 1989: 15. Type species *Bactrocera dissidens* Drew, 1989, by original designation.

Definition. Abdominal sternite V of male with a shallow posterior emargination; posterior lobe of male surstylus long and narrow; pecten of cilia present on abdominal tergite III of male; postpronotal seta present; supra-alar setae absent; prescutellar acrostichal setae present; two pairs of scutellar setae; scutum with medial postsutural yellow vitta absent.

Response to male lures. None known (Drew 1989).

Comments. *Heminotodacus* differs from other *Zeugodacus* group subgenera in the combination of postpronotal seta present, medial yellow vitta on the scutum absent, 2 pairs of scutellar setae and male pecten present. The postpronotal seta is placed centrally, differing from the posterolateral placement seen in subgenus *Notodacus* Perkins (*Melanodacus* group of subgenera: see Hancock and Drew 2017) and this character is thus regarded as homoplasious.

B. (Heminotodacus) dissidens Drew

Bactrocera (Heminotodacus) dissidens Drew, 1989: 187. Type locality Bulolo, Papua New Guinea.

Distribution. Papua New Guinea (known only from the Bulolo district, Morobe Province).

Comments. This species was distinguished by Drew (1989) by the presence of a postpronotal seta, face fulvous without dark spots, scutum with a lateral yellow vitta joining the postpronotal and notopleural lobes and a broad but incomplete transverse fuscous band across the wing. For a detailed description and illustration see Drew (1989).

Subgenus *Paradacus* Perkins

Paradacus Perkins, 1938: 143. Type species *Paradacus fulvipes* Perkins, 1938, by original designation.

Definition. Abdominal sternite V of male with a shallow posterior emargination; posterior lobe of male surstylus long and narrow; pecten of cilia present on abdominal tergite III of male; postpronotal seta absent; supralar setae present; prescutellar acrostichal setae present or absent; two pairs of scutellar setae; scutum with medial postsutural yellow vitta absent.

Response to male lures. Cue lure (2 species) or no response known (5 species) (Drew and Romig 2013, White and Evenhuis 1999).

Included species. *Bactrocera (P.) angustifinis* (Hardy), *B. (P.) areolata* (Walker), *B. (P.) duplicata* (Bezzi), *B. (P.) fulvipes* (Perkins), *B. (P.) hancocki* Drew & Romig, *B. (P.) magnicauda* White & Evenhuis and *B. (P.) urens* White.

Comments. *Paradacus* is distinguished from other *Zeugodacus* group subgenera by the combination of postpronotal seta absent, medial yellow vitta on the scutum absent, 2 pairs of scutellar setae and male pecten present. The lateral postsutural vittae, when present, extend anterior to the suture as small spots; when absent a triangular extension from the notopleural lobe is present. Known females (except *B. duplicata*) have an exceptionally long and narrow oviscape. Hancock and Drew (2015) transferred *B. terminifer* (Walker) to subgenus *Parazeugodacus* Shiraki and the three Papua New

Guinean species included by Drew (1989) to subgenus *Zeugodacus* Hendel; the fourth species included by Drew (1989), the Moluccan *B. perplexa* (Walker), was transferred to subgenus *Zeugodacus* by Drew and Romig (2013). For detailed morphological descriptions and illustrations of the Southeast Asian and Wallacean species see Drew and Romig (2013) and for an illustrated key see Drew and Romig (2016). The remaining species, *B. magnicauda*, was described and illustrated by White and Evenhuis (1999).

B. (Paradacus) angustifinis (Hardy)

Dacus (Paradacus) angustifinis Hardy, 1982: 197. Type locality Lindu Valley, central Sulawesi, Indonesia.

Bactrocera (Paradacus) angustifinis (Hardy): Norrbom *et al.* 1999: 99; Drew and Romig 2013: 219.

Distribution. Indonesia (Sulawesi).

Male lure. Cue lure.

Comments. This species is known only from males. The scutellum has a broad black basal band.

B. (Paradacus) areolata (Walker)

Dacus areolatus Walker, 1861: 295. Type locality Batchian, northern Moluccas, Indonesia.

Dacus (Paradacus) areolatus Walker: Hardy 1959: 163.

Bactrocera (Paradacus) areolata (Walker): Norrbom *et al.* 1999: 99; Drew and Romig 2013: 220.

Distribution. Indonesia (Bacan and Seram Islands, northern and southern Maluku: White and Evenhuis 1999).

Comments. This species is known from two females and differs from the others in the subgenus by its fulvous scutum and extensive wing pattern. The oviscape is at least as long as the abdomen.

B. (Paradacus) duplicata (Bezzi)

Chaetodacus duplicatus Bezzi, 1916: 107. Type locality Pachmarhi, central India.

Dacus (Zeugodacus) duplicatus Bezzi: Hardy 1977: 57.

Bactrocera (Zeugodacus) duplicata (Bezzi): Norrbom *et al.* 1999:102.

Bactrocera (Paradacus) duplicata (Bezzi): Drew and Romig 2013: 238.

Distribution. India (Madhya Pradesh and Karnataka) and Sri Lanka.

Comments. This species is known from both sexes. The female has a short oviscape.

B. (Paradacus) fulvipes (Perkins)

Paradacus fulvipes Perkins, 1938: 143. Type locality Bettotan, nr Sandakan, Sabah, Malaysia.

Dacus (Paradacus) fulvipes (Perkins): Hardy and Adachi 1954: 155; Hardy 1974: 20.
Bactrocera (Paradacus) fulvipes (Perkins): Norrbom *et al.* 1999: 99; Drew and Romig 2013: 221.

Distribution. East Malaysia (Sabah) and Indonesia (northern Sulawesi). Hardy (1974) recorded a female from Batangas, Luzon, Philippines that appears to belong here.

Comments. This species is known from both sexes; Drew and Romig (2013) recorded the male holotype from Sabah and a female from Sulawesi. The female ovipositor is at least as long as the abdomen.

B. (Paradacus) hancocki Drew & Romig

Bactrocera (Paradacus) hancocki Drew and Romig, 2013: 223.

Distribution. Indonesia (southern Sulawesi).

Male lure. Cue lure.

Comments. This species is known only from males. The scutum lacks postsutural lateral yellow vittae but a triangular presutural vitta is present from the notopleural lobe. The scutellum has a large black subapical patch.

B. (Paradacus) magnicauda White & Evenhuis

Bactrocera (Paradacus) magnicauda White and Evenhuis, 1999: 517. Type locality Nabire, [Papua Province], Indonesia.

Distribution. Indonesia (Papua Province).

Comments. This species is known from a single female, which has the ovipositor about as long as the abdomen.

B. (Paradacus) urens White

Bactrocera (Paradacus) urens White, in White and Evenhuis 1999: 518. Type locality Buru, Moluccas, Indonesia.

Distribution. Indonesia (Buru Island, southern Maluku).

Comments. This species is known from a single female, which has the ovipositor at least as long as the abdomen.

Subgenus *Perkinsidacus* subgen. n.

Type species: *Dacus coracinus* Drew, 1971, by present designation.

Definition. Abdominal sternite V of male with a shallow posterior emargination; posterior lobe of male surstylus long and narrow; pecten of cilia absent on abdominal tergite III of male; postpronotal seta absent; supralar setae present; prescutellar acrostichal setae present; two pairs of scutellar setae; scutum with medial postsutural yellow vitta absent.

Response to male lures. None known (Drew 1989, Drew and Romig 2013).

Etymology. Named after Frederick Athol Perkins (1897-1976), a pioneer in the study of Australasian Dacinae and describer of six currently accepted subgenera of *Bactrocera*.

Included species. *Bactrocera* (*P.*) *banneri* White and *B.* (*P.*) *coracinus* (Drew), both transferred from subgenus *Paratridacus* Shiraki.

Comments. *Perkinsidacus* is distinguished from other *Zeugodacus* group subgenera by the combination of postpronotal seta absent, medial yellow vitta on the scutum absent, 2 pairs of scutellar setae and male pecten absent. The Philippine subgenus *Nesodacus* Perkins also lacks the male pecten and medial vitta but it has only 1 pair of scutellar setae and also lacks prescutellar acrostichal setae. The lateral postsutural vittae do not extend anterior to the suture as small spots or vittae, further distinguishing this subgenus from the otherwise similar *Heminotodacus* and *Paradacus* (and also from *Nesodacus*).



Fig. 1. *Bactrocera* (*Perkinsidacus*) *coracinus* (Drew), dorsal view of holotype male. Photo by Geoff Thompson © Queensland Museum, Brisbane.

B. (Perkinsidacus) banneri White

Bactrocera (Paratridacus) banneri White, in White and Evenhuis 1999: 520. Type locality Morotai I., Moluccas, Indonesia.

Distribution. Eastern Indonesia (Morotai Island, northern Maluku).

Host plant. Unknown.

Comments. For a detailed description and illustration see Drew and Romig (2013).

B. (Perkinsidacus) coracinus (Drew) (Fig. 1)

Dacus (Paratridacus) coracinus Drew, 1971: 46. Type locality Bainiyik, Sepik district, Papua New Guinea.

Bactrocera (Paratridacus) coracinus (Drew): Drew 1989: 198.

Distribution. Papua New Guinea (East and West Sepik Provinces).

Host plant. Unknown.

Comments. Drew (1972) noted that the male posterior surstylus lobes were produced but shorter than in *Zeugodacus* group subgenera such as *Austrodacus* Perkins and placed this species in the same subgenus as *B. (Paratridacus) expandens* (Walker). However, the lobes are long, narrow and directed posteroventrally, as in all other *Zeugodacus* group subgenera, rather than the broad, posteriorly directed lobes seen in typical *Paratridacus* Shiraki (see Fig. 1 in Hancock and Drew 2016). About as long as the width of the surstylus, the posterior lobes closely resemble those of *Parasinodacus* Drew & Romig [*cf.* Fig. 12f in Hardy (1973) of *B. (P.) cilifera* (Hendel)]. The holotype of *B. coracinus* (Fig. 1) is in the Queensland Museum, Brisbane and has been examined for this study; the surstylus lobes are clearly visible. For a detailed description and illustration see Drew (1971, 1989).

Key to species of *Heminotodacus*, *Paradacus* and *Perkinsidacus*

- 1 Scutum with postpronotal seta present and postpronotal and notopleural lobes connected by a lateral yellow vitta; wing with an incomplete transverse fuscous band (absent from costa to vein R₄₊₅) enclosing both R-M and DM-Cu crossveins; abdomen orange-brown with a fuscous medial vitta running its entire length [Papua New Guinea (Morobe Province)] subgenus *Heminotodacus* Drew ... *B. (H.) dissidens* Drew
- Scutum with postpronotal seta absent and postpronotal and notopleural lobes not connected by a lateral yellow vitta; wing not as above; abdomen without a fuscous medial vitta 2
- 2 Scutum with lateral postsutural vittae present but not extending anterior to suture as small spots; abdomen with pecten of cilia absent in males; abdominal tergites I+II entirely black; fore and mid femora entirely black subgenus *Perkinsidacus* **nov.** ... 3

- Scutum with either lateral postsutural vittae extending anterior to suture as small spots or with lateral postsutural vittae absent and a triangular vitta along suture from notopleural lobe; abdomen with pecten of cilia present in males; abdominal tergites I+II not entirely black, at least with posterior margin broadly fulvous; fore and mid femora usually not entirely black subgenus *Paradacus* Perkins ... 4
- 3 Wing with a broad costal band reaching vein R₄₊₅ and an oblique transverse band across R-M crossvein and apical part of cell dm to DM-Cu crossvein; anepisternal yellow stripe not reaching postpronotal lobe [Papua New Guinea (East and West Sepik Provinces)]
..... *B. (Pe.) coracinus* (Drew)
- Wing with costal band absent beyond apex of vein R₁ and without an oblique transverse band across R-M crossvein to DM-Cu crossvein; anepisternal yellow stripe reaching postpronotal lobe [eastern Indonesia (Morotai I., northern Maluku)] *B. (Pe.) banneri* White
- 4 Scutum with lateral postsutural vittae absent and a triangular vitta from notopleural lobe along suture present; scutellum with a black subapical patch; fore femora entirely and mid femora almost entirely fuscous [Indonesia (southern Sulawesi)] *B. (Pa.) hancocki* Drew & Romig
- Scutum with lateral postsutural vittae present and extending anterior to suture as small spots; scutellum without a black subapical patch; fore and mid femora broadly fulvous at least basally 5
- 5 Scutum fulvous; wing with an extensive fuscous pattern across entire disc [eastern Indonesia (Bacan and Seram Is, northern and southern Maluku)]
..... *B. (Pa.) areolata* (Walker)
- Scutum black; wing with fuscous pattern restricted to costal band and anal streak 6
- 6 Scutellum with a broad black basal band; fore and mid femora black on at least apical two-thirds, fulvous basally; abdomen mostly black [Indonesia (Sulawesi)] *B. (Pa.) angustifinis* (Hardy)
- Scutellum with a very narrow black basal band; fore and mid femora largely fulvous, at least on basal two-thirds; abdomen often largely fulvous 7
- 7 Abdomen largely black; anepisternal yellow stripe broad, reaching postpronotal lobe dorsally [India and Sri Lanka]
..... *B. (Pa.) duplicata* (Bezzi)
- Abdomen largely fulvous; anepisternal yellow stripe narrow, not reaching postpronotal lobe dorsally 8
- 8 Anepisternal yellow stripe reaching almost to anterior notopleural seta dorsally; wing with costal band very faint and not broadly expanded

- apically; face without a pair of black spots [eastern Indonesia (Buru I., southern Maluku)] *B. (Pa.) urens* White
- Anepisternal yellow stripe not or barely wider than notopleural lobe dorsally; wing with costal band distinct and broadly expanded apically; face with or without a pair of black spots 9
 - 9 Face with a pair of black spots; wing with apical expansion of costal band faint towards and across apex of vein M; abdomen with a black transverse band across base of tergite III [East Malaysia (Sabah), Indonesia (northern Sulawesi) and possibly Philippines (Luzon)]
..... *B. (Pa.) fulvipes* (Perkins)
 - Face without black spots; wing with apical expansion of costal band dark to and across vein M into cell m; abdomen without a black transverse band across base of tergite III [eastern Indonesia (northern Papua Province)] *B. (Pa.) magnicauda* White & Evenhuis

Discussion

Six of the ten species treated here occur in Wallacea (Zone C of Hancock and Drew 2015), five of them being endemic. Three of the remaining four species, *B. (Heminotodacus) dissidens*, *P. (Paradacus) magnicauda* and *B. (Perkinsidacus) coracinus*, are known only from the island of New Guinea (Zone D), while the latter's sister-species, *B. (Pe.) banneri*, is known only from northern Maluku (Moluccas). Only a single species has been recorded from South or Southeast Asia proper – *B. (Paradacus) duplicata* from India and Sri Lanka (Zone A).

Of the five Wallacean species of *Paradacus*, *B. (Pa.) angustifinis* and *B. (Pa.) hancocki* are endemic to Sulawesi, while *B. (Pa.) areolata* and *B. (Pa.) urens* are known only from Maluku. Only *B. (Pa.) fulvipes* has a wider distribution, being known from northern Sulawesi plus neighbouring Sabah on the island of Borneo and possibly Luzon in the Philippines. The latter record was collected in August 1945 and is possibly mislabelled, although the Sulawesi and Sabah records are from areas on the periphery of the Philippines and the Luzon record might well be correct.

The exceptionally long ov scape in *B. (Pa.) areolata*, *B. (Pa.) fulvipes*, *B. (Pa.) magnicauda* and *B. (Pa.) urens* indicates a close relationship, these four species occurring largely allopatrically in northern and southern Maluku, northern Sulawesi-Sabah-?Philippines, northern Papua Province and southern Maluku respectively; *B. (Pa.) areolata*, with its fulvous scutum and extensive wing pattern, appears to be the most apomorphic of the four. The southern Sulawesi *B. (Pa.) hancocki*, with its largely fulvous abdomen and extensive wing pattern, might also belong in this group but the shape of the ov scape is unknown. *Bactrocera (Pa.) angustifinis* and *B. (Pa.) duplicata* both have largely black abdomens but the distributional anomaly seen in the latter species suggests that it might not belong in *Paradacus* but be an aberrant

species belonging elsewhere. *Bactrocera* (*Pa.*) *angustifinis* is known from throughout Sulawesi and thus occurs sympatrically with both *B.* (*Pa.*) *hancocki* and *B.* (*Pa.*) *fulvipes*; the shape of its oviscapae is also unknown.

The scarcity of material and lack of any biological information on these species prohibits a fuller understanding of their relationships. No host plants are known but, as in the apparently related subgenera *Parasinodacus* Drew & Romig, *Nesodacus* Perkins and the Madagascan *Aglaodacus* Munro (all of which also lack the medial scutal vitta but have only 1 pair of scutellar setae), host plants are likely to be (at least primarily) non-cucurbitaceous.

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CORRECTION

In the review of subgenus *Bulladacus* Drew & Hancock by Drew and Hancock (2016), Table 1 incorrectly included Solomon Islands species in Zone F, rather than in Zone D as per the map of Hancock and Drew (2015). The corrected Table 1 is provided below. All 20 species are thus endemic to their particular biogeographic zones.

Table 1. Distribution of species in genus *Bactrocera* and subgenus *Bulladacus* in each biogeographic zone and percent endemism in *Bulladacus*. For a map of zones A-F see Hancock and Drew (2015).

Biogeographic Zone	No. species of <i>Bactrocera</i>	No. species of <i>Bulladacus</i>	% Endemic <i>Bulladacus</i>
(A) Indian subcontinent	75	0	–
(B) South-East Asia	225	5	100
(C) Wallacea	124	0	–
(D) New Guinea + Solomons	170	11	100
(E) Australia	76	2	100
(F) South Pacific	59	2	100

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