New Species, Subgenus and Records of *Bactrocera* Macquart from the South Pacific (Diptera: Tephritidae: Dacinae)

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ABSTRACT *Bactrocera (Bulladacus)* subgen.nov. is described to include nine species of Asian and Pacific Dacinae. *B. (Afrodacus) grandistylus* sp.nov., *B. (Bulladacus) gnetum* sp.nov. and *B. (Notodacus) paraxanthodes* sp.nov. are described and illustrated, the latter being closely related to *B. xanthodes* (Broun), an economic species with which it has been confused. *B. (Bactrocera) passiflorae* (Froggatt) and *B. (Bulladacus) aenigmatica* (Malloch) are revised and a new colour form of the former illustrated, while the male of the latter is described and illustrated for the first time.

Introduction

The Dacinae of the tropical and subtropical regions of the world attract considerable interest due to the economic importance of many species. Particular emphasis is placed on the taxonomy and biology of the subfamily. Since the review of Dacinae of the Australasian and Oceanian regions by Drew (1989), extensive survey work has been carried out in the Cook Islands, Fiji, New Caledonia, Tonga and Western Samoa using male lure traps and host fruit collecting.

The species treated in this paper have been collected during these surveys and represent valuable additional data on the Dacinae. In particular, *B. aenigmatica* has been known only from the type female collected in 1924. Now that males are known, the subgeneric position of this species can be defined. *B. passiflorae*, a major pest species in Fiji, Niue and the northern Tongan islands (Niua's), shows considerable variation in colour patterns and this needs to be understood in order to identify some specimens.

Bristle terminology follows Drew (1989). Specimen depositories are abbreviated as follows: ANIC, Australian National Insect Collection, Canberra; NHM, Natural History Museum, London; QDPI Queensland Department of Primary Industries, Brisbane; QM, Queensland Museum, Brisbane.

Bactrocera (Afrodacus) Bezzi
Bactrocera (Afrodacus) grandistylus sp.nov.
(Fig. 1)

Types. New Caledonia: holotype ♂, Maré Island, 6.ix.1993, J. M. Lemontey, bred ex *Diospyros fasciculosa* (in QM, Reg. No. T.13050); paratypes: 5 ♀♀, 2 ♂♂, same data as holotype (1 ♀, 1 ♂ in QM, Reg. No. T13051 & 13052; 1 ♀ in ANIC; 1 ♀ in NHM; 2 ♀♀, 1 ♂ in QDPI).

Description. Male. *Head*: Vertical length 1.4 mm. Frons—length 1.88 times breadth; orange-brown without dark markings; anteromedial hump with a few short dark hairs; orbital setae black: 1 *s.or.*, 2 *i.or.*; lunule orange-brown. Ocellar triangle black. Vertex orange-brown. Face fulvous without dark spots; length 0.44 mm. Genae fulvous, pale fuscous subocular spot; pale weak seta present. Occiput orange-brown, with small fuscous to black spots dorsally; occipital row with 4-7 black setae. Antennae with segments 1 and 2 fulvous, segment 3 fulvous with dark fuscous on apex and outer surface; black dorsal seta on segment 2; arista black (fulvous basally); length of segments: 0.12 mm; 0.2 mm; 0.68 mm.

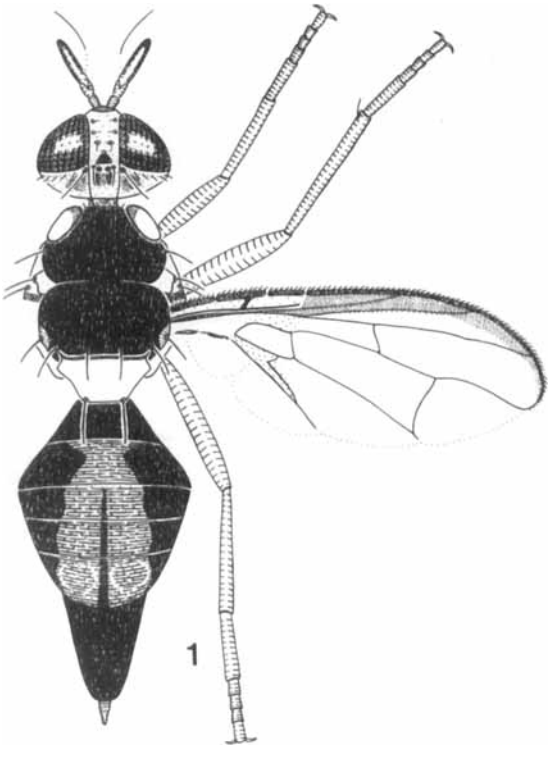

Fig. 1. *Bactrocera (Afrodacus) grandistylus* sp.nov., female.

Thorax: Scutum black except red-brown along mesonotal suture and on lateral margins posterior to suture. Pleural areas shining black except red-brown below humeral calli. Yellow markings as follows: postpronotal lobes (except inner anterior corners pale fuscous), notopleura; broad mesopleural stripe reaching to postpronotal lobe

dorsally, continuing to katepisternum as a large transverse spot, anterior margin strongly convex; anatergite (posterior apex black), anterior ¾ katatergite (remainder black). Postnotum black. Scutellum yellow except for narrow, black, basal band. Setae: *sc.* 2, *prsc.* 2, *ia.* 1, *p.sa.* 1; *a.sa.* 1, *mpl.* 1 (generally pale), *npl.* 2, *scp.* 4. Legs—entirely fulvous; mid tibiae each with a small, apical, black spur. Wings—length 4.9 mm; cells bc and c with a pale fuscous tint; microtrichia in outer corner of cell c only; remainder of wings with a pale fuscous tint except fuscous cell sc, narrow fuscous costal band slightly overlapping R_{2+3} of uniform width and ending between extremities of R_{4+5} and M. Anal streak reduced to a pale fuscous tint within cell cup. Dense aggregation of microtrichia around A_1 + CuA_2; supernumerary lobe of medium development.

Abdomen: Oval; terga free; pecten present on tergum III. Tergum I and sterna I and II wider than long. Tergum I black with a medial longitudinal orange-brown band; terga II-V orange-brown with broad lateral longitudinal black bands over all four terga and narrow medial longitudinal black band over terga III-V. A pair of oval orange-brown shining spots on tergum V. Posterior lobe of surstylus short, sternum V with a deep concavity on posterior lobe.

Female. As for male except without dense aggregation of microtrichia around A_1 + CuA_2; supernumerary lobe weak; abdominal tergum III without pecten. Ovipositor: basal segment extremely large and shining black; dorsoventrally compressed and tapering posteriorly in dorsal view; ratio of length of oviscape to length of tergum V, 3.1:1. Aculeus needle shaped at apex.

Attractant. No known record.

Distribution. New Caledonia.

Host. *Diospyros fasciculosa* (Ebenaceae).

Comments. *B. grandistylus* is similar to *B. allwoodi* in possessing a black scutum without postsutural vittae, yellow postpronotal lobes and notopleura, a yellow scutellum and clear wings except for the narrow costal band and anal streak. It differs from *B. allwoodi* and the South Pacific species of subgenus *Afrodacus* in having an extremely large oviscape and a combination of absence of facial spots, anterodorsal corners of postpronotal lobes fuscous, broad mesopleural stripe reaching postpronotal lobes dorsally and a markedly reduced anal streak in the wing.

Bactrocera (Bactrocera) Macquart
Bactrocera (Bactrocera) passiflorae (Froggatt) (Fig. 2)

Dacus passiflorae Froggatt, 1910: 870.
Dacus (Strumeta) passiflorae: Drew, 1974a: 71.
Bactrocera (Bactrocera) passiflorae: Drew, 1989: 150.

Material examined. Fiji: 6 ♀, Nailiko Road Bridge, Malevu, 3.x.1991, G. Walker *et al.*, bred from *Ochrosia oppositifolia* Schum.; 6 ♂♂, 2 ♀♀, Nailiko Bridge, 100km W. of Suva, Maleva, 24.iv.1991, E. Hamacek and G. Walker, bred from *Ochrosia oppositifolia*; 5 ♀♀, Nailiko Road bridge, Maleva, 26.xi.1991, G. Walker *et al.*, bred from *Ochrosia oppositifolia*. **Tonga**: 1 ♀, Mu'a, Niuafoau, 16.vi.1992, Pulotu, bred ex *Citrus sinensis* Osbeck. (orange); 8 ♀♀, Petoni, Niufo'ou, 16.vi.1992, Pulotu, bred ex *Citrus sinensis* (orange). (All in QDPI.)

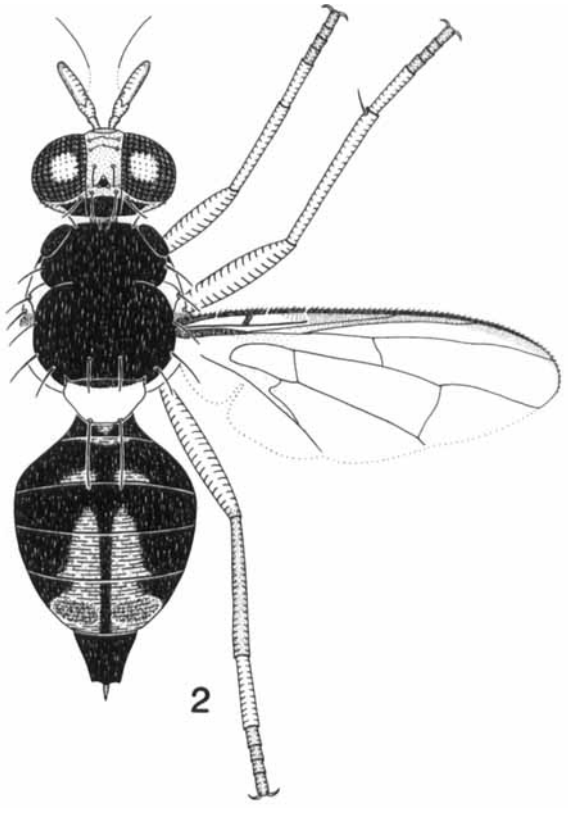

Fig. 2. *Bactrocera (Bactrocera) passiflorae* (Froggatt), pale form, female.

Description. *B. passiflorae* has been revised by Drew (1974a, 1989) and described as having abdominal terga I-V mostly glossy black. However, recent extensive host rearing has produced specimens of this species with markedly different abdominal colour patterns. These patterns occur mostly in female specimens and are as follows: terga III-V orange-brown with a moderately broad medial and 2 broad, lateral longitudinal, black bands which join along anterior margin of tergum III. This colour form has been reared from *Ochrosia oppositifolia* (Apocynaceae) in Viti Levu, Fiji, and from *Citrus sinensis* (Rutaceae) in the Niua group of northern Tongan islands. All other characters are described by Drew (1974a, 1989).

Distribution. *B. passiflorae* is known from Fiji, Niue Island and the northern Tongan islands (Niua group).

Comments. *B. passiflorae* is a species of major economic importance in Fiji, Niue and the northern Tongan islands (Nuia's) through direct crop losses and restrictions to trade. Consequently accurate identification is important. This colour form is similar to *B. kirki* (Froggatt) in abdominal colour pattern, but differs in having black postpronotal lobes, entirely pale legs and scutellum.

Bactrocera (Bulladacus) subgen.nov.

Type species *Bactrocera gnetum* sp.nov.
This subgenus is erected to take species of *Bactrocera* which possess a bulla on the wing of the male. It is similar to subgenus *Bactrocera* in possessing a short surstylus, a deep concavity on the posterior margin of sternum V of the male and a pecten of cilia on abdominal tergum III of the male. It differs from *Bactrocera* in having a bulla on the wing of the male and no shining spots on abdominal tergum V. Included species show no response to known synthetic male attractants. The subgenus occurs from southern Thailand and the Philippines to Australia and the South Pacific.

Definition. *Bactrocera* with posterior lobe of surstylus of male short; abdominal sternum V of male deeply concave on posterior margin; pecten of cilia present on abdominal tergum III of male; 1 pair of *sc.* bristles present; *prsc.* bristles present; *a.sa.* bristles present or absent; bulla present on extension of cell cup of wing of male; abdomen without oval shining spots on tergum V.

Species included: *B. aenigmatica* (Malloch), *B. bullata* Drew, *B. bullifera* (Hardy), *B. eximia* Drew, *B. gnetum* sp.nov., *B. mcgregori* (Bezzi), *B. penefurva* Drew, *B. peterseni* (Hardy), *B. tigrina* (May).

Bactrocera (Bulladacus) aenigmatica (Malloch) (Fig.3)

Dacus aenigmaticus Malloch, 1931: 261.
Dacus (Afrodacus) aenigmaticus: Hardy, 1955: 6; Drew, 1974a: 2.
Bactrocera (Afrodacus) aenigmatica: Drew, 1989: 19.

Material examined. Western Samoa: 3 ♂♂, 3 ♀♀, Paupua, Savaii, 23.v.1991, A. Peters *et al.*, bred from *Aglaia samoensis* Gray. (In QDPI).

Description. *B. aenigmatica* was revised by Drew (1974a, 1989) from a study of the unique type female. Now that males are available for study, the subgeneric position of this species can be determined. The following characters of the male are important: bulla present near anal cell extension; dense aggregation of microtrichia around $A_1 + CuA_2$; supernumerary lobe of medium development; pecten present on abdominal tergum III; posterior lobe of surstylus short; abdomen with very narrow medial longitudinal black band over all terga; narrow lateral black margins on terga III and IV only. The specimens are teneral and characters of sternum V are not discernible.

Attractant. No known record.

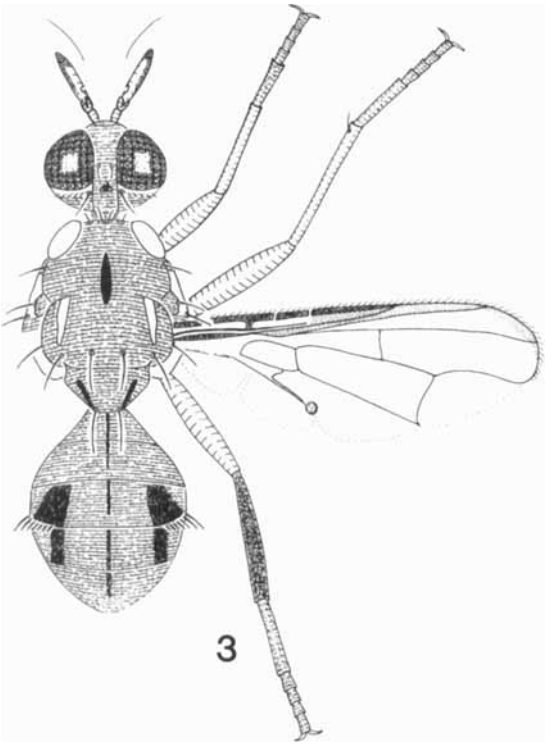

Fig. 3. *Bactrocera (Bulladacus) aenigmatica* (Malloch), male.

Distribution. *B. aenigmatica* is known only from Western Samoa (Upolu and Savaii).

Host. *Aglaia samoensis* Gray (Meliaceae).

Comments. *B. aenigmatica* is a species of no economic importance, having been reared from only one wild forest fruit, *Aglaia samoensis*. It is readily distinguishable from other species of *Bulladacus* by the presence of a narrow, medial, longitudinal, black vitta on the scutum and black, lateral stripes on the scutellum.

Bactrocera (Bulladacus) gnetum sp.nov. (Fig. 4)

Types. Fiji: holotype ♀, Saivou, Vanua Levu, 29.i.1991, G. Walker and Sada Nand Lal, bred ex *Gnetum gnemon* (Bele Sikau) (in QM, Reg. No. T.12941); paratypes: 15 ♀♀, 14 ♂♂, same data as holotype (2 ♀♀, 2 ♂♂ in QM, Reg. No. T.12942-12945; 4 ♀♀, 4 ♂♂ in ANIC; 4 ♀♀, 4 ♂♂ in NHM; 5 ♀♀, 4 ♂♂ in QDPI).

Description. Male. *Head*: Vertical length 1.1 mm. Frons—length 1.7 times breadth; red-brown without dark markings; anteromedial hump with few short dark hairs; orbital setae black: 1 *s. or.*, 2 *i. or.*; lunule red-brown. Ocellar triangle black.

Vertex fuscous. Face fulvous without dark spots; length 0.4 mm. Genae fulvous, without dark subocular spot; black seta present. Occiput fulvous, black centrally, fulvous along eye margins; occipital row with 3-4 black setae. Antennae with segments 1 and 2 fulvous, segment 3 dark fuscous; dark dorsal seta on segment 2; arista black (fulvous basally); length of segments: 0.06 mm, 0.14 mm, 0.45 mm.

Thorax: Scutum black without pale markings. Pleural areas black without pale markings. Yellow markings as follows: postpronotal lobes, broad mesopleural stripe reaching to postpronotal lobe dorsally, continuing to katepisternum as small transverse spot, anterior margin straight; anatergite (posterior apex black); anterior $^{5}/_{8}$ katatergite (remainder black); 2 lateral postsutural vittae beginning anterior to mesonotal suture and tapering posteriorly to end before *ia.* setae. Notopleura dark fuscous. Postnotum black. Scutellum yellow except for narrow, black, basal band. Setae: *sc.* 2, *prsc.* 2; *ia.* 1, *p.sa.* 1; *a.sa.* 1, *mpl.* 1, *npl.* 2, *scp.* 4. Legs—all segments fulvous except hind tibiae very pale fuscous; mid tibiae each with small, apical, black spur. Wings—length 3.7 mm; cells bc and c pale fuscous (cell c paler); microtrichia covering all of cell c and most of cell bc; remainder of wings with pale fuscous tint except dark fuscous cell sc, narrow fuscous costal band confluent with R_{2+3} and ending between extremities of R_{4+5} and M. Anal streak absent. Bulla present on anal cell extension. Dense aggregation of microtrichia around $A_1 + CuA_2$; supernumerary lobe of medium development.

Abdomen: Oval; terga free; pecten present on tergum III. Tergum I and sterna I and II wider than long. Terga I and II orange-brown; terga III-V orange-brown except for broad, black, lateral, longitudinal margins which just meet at midline of anterior margin of tergum III (sometimes a fine orange-brown line separates these dark markings at midline of tergum III), broad, medial, longitudinal, black band which begins at posterior margin of tergum III and widens markedly to end at posterior margin of tergum V. Oval, shining spots absent. Posterior lobe of surstylus short, sternum V with deep concavity on posterior margin.

Female. As for male except without bulla or dense aggregation of microtrichia around $A_1 + CuA_2$; supernumerary lobe weak; abdominal tergum III without pecten. Ovipositor: basal segment black on apical 0.6-0.7 (orange-brown basally); dorsoventrally compressed and tapering posteriorly in dorsal view; ratio of length of oviscape to length of tergum V, 1.67:1. Aculeus needle shaped at apex.

Attractant. No known record.

Distribution. Fiji.

Host. *Gnetum gnemon* (Gnetaceae).

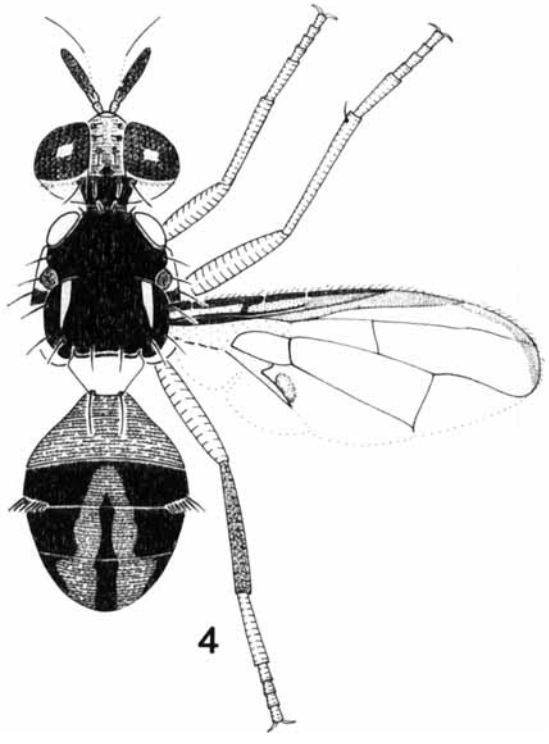

Fig. 4. *Bactrocera (Bulladacus) gnetum* sp.nov., male.

Comments. *B. gnetum* is similar to *B. eximia* Drew, *B. penefurva* Drew, *B. peterseni* (Hardy) and *B. tigrina* (May) in possessing a black scutum in addition to the subgeneric characters. It differs from *B. eximia*, *B. penefurva* and *B. tigrina* in lacking a medial, yellow vitta on the scutum and from *B. peterseni* in having a narrow costal band that is not expanded into a spot at the wing apex, dark colour patterns on abdominal terga III-V not in the form of a "T" shape, and femora entirely fulvous without dark markings.

Bactrocera (Notodacus) paraxanthodes sp.nov. (Fig. 5)

Types. New Caledonia: holotype ♀, Mavé, 13.v.91, C. Pinson (in QM, Reg. No. T.12946); paratypes: 1 ♂, same data as holotype (in QDPI); 2 ♀♀, 2 ♂♂, Farino, May 1991, C. Pinson, bred from *Schefflera* sp. (1 ♂ in QM, Reg. No. T.12947; 2 ♀♀, 1 ♂ in QDPI); **Western Samoa:** 3 ♀♀, 7 ♂♂, Aopo, Savaii, 22.x.1991, B. Enosa *et al.*, bred from *Ficus* sp. (1 ♀, 2 ♂♂, in ANIC; 1 ♀, 2 ♂♂, in NHM; 1♀, 3 ♂♂ in QDPI).

Description. This species is very similar to *Bactrocera xanthodes* (Broun) (see Drew, 1974a, 1989) except as follows: medial, postsutural, yellow vitta on scutum not reaching posterior margin and extending anteriorly to line of posterior margins of postpronotal lobes; scutellum without lateral yellow margins; 2 black, lateral bands running from bases of apical bristles towards but not reaching base of scutellum; wing with overall pale fulvous tint, costal band broad,

reaching vein R_{4+5} and expanding across wing apex.

Attractant. No known record.

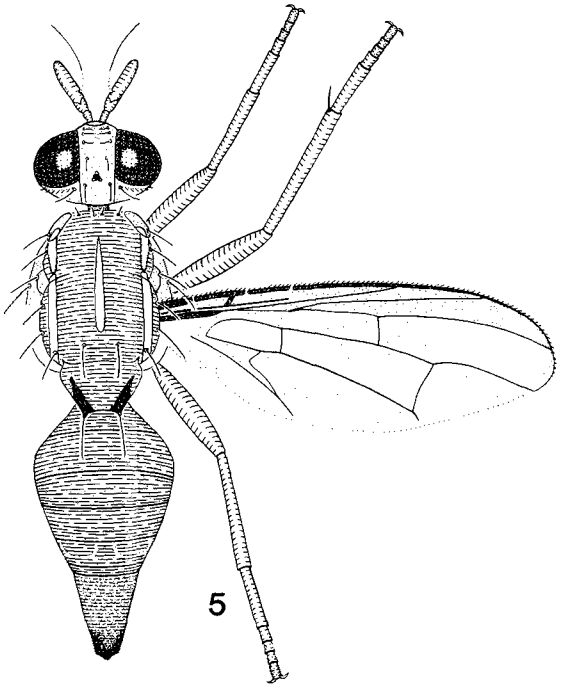

Fig. 5. *Bactrocera (Notodacus) paraxanthodes* sp.nov., female.

Distribution. New Caledonia, Vanuatu, Western Samoa.

Hosts. *Ficus* sp. (Moraceae), *Schefflera* sp. (Araliaceae), *Barringtonia edulis* (Lecythidaceae).

Comments. *B. paraxanthodes* differs from *B. xanthodes*, the only other species in the subgenus *Notodacus*, in the characters listed above in the description. Also, *B. xanthodes* infests a wide range of commercial fruits in the South Pacific region and is attracted to methyl eugenol, whereas *B. paraxanthodes* has only been reared from wild host fruits and is not attracted to methyl eugenol. Drew (1974b) noted that species of Dacinae were specific in their responses to male lures such as methyl eugenol. Because *B. xanthodes* is of major economic importance in the South Pacific region, while *B. paraxanthodes* is of no economic significance, survey work will need to be carried out to determine their distributions. It is possible that *B. paraxanthodes* is the only species occurring in Vanuatu, and if so, then no restrictions on international trade, based on *B. xanthodes*, should apply to that country. We have examined a series from Vanuatu (bred from *Barringtonia edulis*), collected for DNA analysis. The record in Drew (1989) of *B. xanthodes* bred from *B. edulis* in Vanuatu probably refers to *B. paraxanthodes*.

Acknowledgments

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concepts of sexual species. The concepts of "species isolation mechanism", "mate choice" and "species recognition" are used without distinction (p. 276), and with the last mentioned being a misleading corruption. Furthermore, in dealing with reinforcing selection, a cornerstone of the Isolation Concept of species, Godfray notes (p. 356) with apparent approbation, but without reference, that reinforcement is widely believed now not to be important in speciation. But on the following page he writes of the possible role for different strains of an "incompatibility microorganism" infecting two populations of one species and causing instantaneous genetic isolation and speciation. I think it is not unfair to expect anyone citing Futuyma's observation above to be aware that the criticisms that demolished ideas about the proposed role for reinforcement also hold for this hypothetical case of "instant speciation". Were these two "species", differing only in "incompatibility microorganisms", to become sympatric, they would still mate at random (since there has been no change to the Specific-Mate Recognition System), and the less abundant one would go extinct (Paterson 1978).

Despite my misgivings I am enthusiastic about this book and other reviewers have seen considerable merit in Godfray's approach (Charnov 1994; Rosenheim 1994). What I like particularly is the clear and consistent interpretation of parasitoid biology, despite it being from the optimisation perspective. One is thus in a good position to judge the merits of the theory and to use its logic. Opportunities for using parasitoids to test aspects or assumptions of the theory are therefore readily seen. Frequently I found myself sitting bolt upright with ideas for setting up an experiment to test a particular statement or interpretation. There is not much more that one could ask of a scientific book and there is no doubt it should be on all library shelves. I recommend wholeheartedly that it be consulted by all with an evolutionary interest or with a passion for parasitoids, whether as biological control agents or simply as wonderful organisms. However, you should remember that what is going to be critical to understanding parasitoids and their evolution is the way in which this book is read, absorbed and tested in future research programs.

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