

The Palaearctic species of the genus *Diachasmimorpha* Viereck (Hymenoptera: Braconidae: Opiinae)

C. van Achterberg

Achterberg, C. van. The Palaearctic species of the genus *Diachasmimorpha* Viereck (Hymenoptera: Braconidae: Opiinae).

Zool. Med. Leiden 73 (1), 30.iv.1999: 1-10, figs 1-8.— ISSN 0024-0672.

C. van Achterberg, Afdeling Entomologie (Hymenoptera), Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands (e-mail: achterberg@naturalis.nnm.nl).

Key words: Hymenoptera; Braconidae; Opiinae; *Diachasmimorpha*; Palaearctic; Bhutan; Russia; key; Diptera; *Citrus reticulata*; *Bactrocera minax*; Tephritidae.

Two new species of the genus *Diachasmimorpha* Viereck, 1913 (Braconidae: Opiinae) are described: *D. feijeni* spec. nov. from Bhutan (reared from *Bactrocera minax* (Enderlein) (Diptera: Tephritidae) in fruits of *Citrus reticulata* Blanco (mandarin)) and *D. budrysi* spec. nov. from Far East Russia. A key to the Palaearctic species is added, including two similar species (*Fopius alternatae* (Tobias, 1977), and *F. myolejae* (Tobias, 1977)).

Introduction

The genus *Diachasmimorpha* Viereck, 1913 (Braconidae: Opiinae) is a relatively small genus, which is mainly restricted to the Palaeotropics, East Palaearctic and Nearctic regions. Mr Feijen (Thimphu, Bhutan) kindly handed over to me two specimens reared from a pest (the Chinese citrus fly: *Bactrocera minax* (Enderlein, 1920); Tephritidae) in mandarins (*Citrus reticulata* Blanco). It proved to be an undescribed species, which is described below; another new species was found among a series of *D. longicauda* (Shestakov, 1940) from Far East Russia collected by Dr E. Budrys (Vilnius, Lithuania). *Diachasmimorpha* species are koinobiont endoparasitoids of larvae in fruits and flower buds, and of gallmaking larvae of Tephritidae (Wharton, 1997). They have a high potential value for biological control of tephritid pests.

The Chinese citrus fly (*Bactrocera minax* (Enderlein)) has been reported from Bhutan (White & Elson-Harris, 1992), West Bengal (Nath, 1973) and South-China (Yang, 1988; IIE, 1991). Enderlein (1920) described it (as *Polistomimetes minax*) from North India (Sikkim). The fly is known to attack a variety of *Citrus* species (White & Wang, 1992). Due to its economic importance the fly has been intensively studied in Bhutan since 1990 (F.H.J. van Schoubroeck, in prep.). In the lower hills of Bhutan, mandarin is the main cash crop and *B. minax* has been identified as a main pest. Larvae induce premature fruit dropping in a late stage. Orchards with drop percentages of 50-75% are not uncommon, though orchards with much lower percentages are also found. Mandarin is grown between 300 and 1600 m altitude. The fly is especially a problem in the more shady orchards at higher altitude. Unlike most fruit flies, *B. minax* is univoltine. From mid April to mid May adults emerge from pupae in the soil. Females start laying eggs in May. However, larvae do not develop much till late summer (van Schoubroeck, in prep.). In September the speed of development of the larvae increases and the larvae become easily visible in attacked fruits. Mandarins start dropping from October onwards. Larvae emerge from dropped fruits and pupate in the soil. In Bhutan, control methods of the fly concentrate on baiting

with protein hydrolysate and destruction of the dropped fruits. In China sterile male release has been tried (Wang et al., 1995). So far, no parasitoids have been recorded from *B. minax*, although thousands of pupae were collected and reared in Bhutan. In the Punakha sample of 155 pupae, two *Diachasmimorpha* specimens emerged from two slightly misformed pupae. In two pupae that did not hatch, rotting wasp remains were found. As studies in Bhutan concentrate on the mandarin orchards at higher altitudes, it is possible that the new parasitoid is of more importance in the orchards at lower altitudes.

For the recognition of the subfamily Opiinae, see van Achterberg, 1990, 1993, 1997, for a key to the genera, see Wharton (1997), and for the terminology used in this paper, see van Achterberg, 1988.

Descriptions

Subfamily Opiinae Foerster, 1862

Genus *Diachasmimorpha* Viereck, 1913

Key to Palaearctic species of the genus *Diachasmimorpha* Viereck
(including the two similar Palaearctic species of the genus *Fopius* Wharton)

- 1. Second metasomal tergite coarsely striate or costate medially; pronope absent or nearly so; notauli complete; vein m-cu of fore wing just antefurcal, or postfurcal; antenna with 29-67 segments 2
- Second tergite completely smooth; pronope deep (but shallow and indistinct in *D. tryoni*); notauli reduced posteriorly (but complete in *D. tryoni*); vein m-cu of fore wing just postfurcal or subinterstitial (fig. 5); antenna with 41-53 segments; subgenus *Parasteres* Fischer, 1967 5
- 2. Ovipositor sheath somewhat longer than body; antenna with 47-67 segments; vein m-cu of fore wing just postfurcal (fig. 1); hind leg black; postpectal carina and oblique carina of propleuron absent; subgenus *Diachasmimorpha* Viereck, 1913 ... 3
- Ovipositor sheath much shorter than body, at most somewhat longer than metasoma; antenna with 29-39 segments; vein m-cu of fore wing narrowly antefurcal; hind leg yellowish-brown; postpectal carina and oblique carina of propleuron present; genus *Fopius* Wharton, 1987 4
- 3. Middle tibia and tarsus black; tegulae yellowish-brown; antenna with 47-48 segments; mesoscutum punctulate; metapleuron rugulose; first subdiscal cell of fore wing comparatively robust apicad (fig. 102 in Fischer, 1986) *D. paeoniae* (Tobias)
- Middle tibia and tarsus (except its segments apically) yellowish-orange; tegulae black; antenna with 63-67 segments; mesoscutum smooth; metapleuron largely smooth; first subdiscal cell of fore wing more elongate and parallel-sided apicad (fig. 1) *D. feijeni* spec. nov.
- 4. Third antennal segments of ♀ about 3.5 times as long as its width; propodeum finely rugose; pleural sulcus crenulate; metapleuron largely rugose; hind femur about 4 times as long as wide; metasoma mainly black(ish) dorsally; antenna with 29-36 segments; scutellum black [*E. myolejae* (Tobias)]
- Third antennal segments of ♀ about 2.5 times as long as its width; propodeum

- coarsely reticulate; pleural sulcus smooth; metapleuron largely smooth; hind femur about 3 times as long as wide; metasoma (except first tergite) brownish-yellow dorsally; antenna with 35-39 segments; scutellum yellowish [*D. alternatae* (Tobias)]
- 5. Notauli complete; occipital carina largely or completely absent; pronope shallow and indistinct; metasoma and hind femur predominantly dark brown or blackish; length of ovipositor sheath about twice as long as metasoma *D. tryoni* (Cameron)
- Notauli reduced posteriorly; occipital carina present up to middle level of eye; pronope deep and medium-sized; colour of metasoma and hind femur variable, if brownish or yellowish then ovipositor sheath somewhat longer than metasoma .. 6
- 6. Metasoma and fore femur yellowish; hind femur about 3 times as long as wide *D. aino* (Watanabe)
- Metasoma and fore femur black; hind femur about 4 times as long as wide 7
- 7. Length of ovipositor sheath 0.5-0.6 times fore wing, 1.2-1.3 times metasoma; humeral plate pale yellowish; mesosoma bright orange-brown; length of mesosoma 1.2-1.3 times its height *D. longicauda* (Shestakov)
- Length of ovipositor sheath about 1.1 times fore wing and 2.5 times metasoma; humeral plate dark brown; mesosoma largely more or less dark brown; length of mesosoma about 1.1 times its height *D. budrysi* spec. nov.

Diachasmimorpha (*Parasteres*) *budrysi* spec. nov.
(figs 5-8)

Material.— Holotype, ♀ (RMNH), "Russia: Primorski, "Kedrovaya Pad" Pres[erve], 30 km W Vladivostok, 26.vii.1988, swept, E. Budrys, RMNH'95".

Holotype, ♀, length of body 4.5 mm, of fore wing 5.0 mm.

Head.— Antenna 1.3 times length of fore wing, with 46 segments, length of third segment 1.1 times fourth segment, length of third, fourth and penultimate segments 2.4, 2.1 and 1.8 times their width, respectively (figs 5, 6); apex of antenna acute, without spine; scapus rather compressed, outer side largely smooth, remainder distinctly punctate; length of maxillary palp 1.2 times height of head, segments narrow; OOL: diameter of posterior ocellus:POL = 16:5:5; frons flat, slightly concave and smooth medially, setose and punctulate laterally; length of eye in dorsal view 1.5 times temple; vertex flattened, smooth; temple punctulate; temples subparallel-sided behind eyes; occipital carina present up to middle level of eyes, absent dorsally. ventrally remaining far removed from hypostomal carina; face densely and finely punctate; anterior tentorial pits rather small, distinct; clypeus largely smooth, with some punctures, convex ventrally and rather flat, in lateral view distinctly removed from mandibles (but in frontal view without hypoclypeal depression); length of malar space 1.2 times basal width of mandible; mandible robust, not twisted and basally punctate, with rather long ventral carina.

Mesosoma.— Length of mesosoma 1.1 times its height; pronope present, deep, medium-sized; propleuron flattened and with small posterior flange; side of pronotum smooth (except a few short crenulae), flange-like protruding postero-ventrally;

precoxal sulcus deep and wide, smooth except for some crenulae, not reaching base of middle coxa, area above middle coxa not distinctly tuberculate; remainder of mesopleuron punctulate, with some crenulae dorso-anteriorly, and smooth above precoxal sulcus; only ventral 0.7 of pleural sulcus distinctly crenulate; no postpectal carina; metapleuron rather sparsely long greyish setose, punctate, ventrally with coarse rugae, weakly depressed postero-ventrally; mesosternal sulcus deep, distinctly crenulate; notauli wide, smooth, only anteriorly impressed, medially absent and with deep (isolated) medio-posterior pit; mesoscutum punctulate, but lateral lobes only so near notaulic area, middle mesoscutal lobe moderately protruding, largely setose; scutellar sulcus deep, wide and with three long carinae; scutellum rather convex and sparsely punctulate, largely smooth; surface of propodeum (except narrowly medio-anteriorly and posteriorly) largely very coarsely reticulate-vermiculate and rather sparsely long greyish setose, with short and strong median carina, and with large incomplete trigonal areola; propodeal spiracle round, medium-sized and medially situated.

Wings.— Fore wing: 1-M straight, hardly curved posteriorly; r:3-SR:SR1 = 4:9:43; 1-SR+M distinctly sinuate; anterior quarter of basal cell and basally of first subdiscal cell glabrous, remaining part setose; SR1 nearly straight and ending close to apex of wing (fig. 7); cu-a subvertical, straight; 1-CU1:2-CU1 = 4:15; 2-SR:3-SR:r-m = 13:9:9; first subdiscal cell rather robust and widened apically (fig. 7); CU1b medium-sized; m-cu just postfurcal (fig. 5), and distinctly converging to 1-M posteriorly. Hind wing: SR largely absent, only as an unpigmented fold; m-cu long and straight; 1-M as long as 1r-m; M+CU:1-M = 17:13; cu-a straight and vertical; subbasal cell largely glabrous, with a few setae.

Legs.— Hind coxa punctulate, long greyish setose (as trochanter, trochantellus and femur basally); tarsal claws rather robust, without lobe and only bristly setose; length of femur, tibia and basitarsus of hind leg 4.2, 9.2, and 5.6 times their width, respectively; length of hind tibial spurs 0.25 and 0.30 times hind basitarsus.

Metasoma.— Length of first tergite about equal to its apical width, its surface smooth laterally, very strongly costate medially and concave basally, its dorsal carinae strong (flange-like basally), reaching apex of tergite; spiracle of first tergite small, laterally situated; laterope large and deep; dorsope absent (but because of strong surrounding carinae giving impression of presence); second tergite entirely smooth, its spiracle just in notum; setae of second and following tergites forming a submedial row; ovipositor straight, apically specialized, slightly sinuate, without distinct ventral teeth and a minute dorsal protuberance, not ribbon-shaped apically; length of ovipositor sheath 1.12 times fore wing and 2.5 times metasoma, flattened (ribbon-shaped), long setose and without apical spine; hypopygium large (but not surpassing apex of metasoma) and apically acute.

Colour.— Blackish; head (but dorsally brownish), palpi, pronotum anteriorly, mesoscutum partly, brownish-yellow; remainder of mesosoma and legs more or less dark brown; wing membrane subhyaline, with dark patch near vein CU1b; pterostigma and veins dark brown.

Distribution.— Far East Russia.

Biology.— Unknown.

Notes.— Very similar to *D. longicauda* (Shestakov), but it differs by its colour and by the length of the ovipositor.

It is a pleasure to name this species after its collector, Dr E. Budrys (Vilnius, Lithuania) for his contribution to the knowledge of spheciform Hymenoptera.

Diachasmimorpha (*D.*) *fejjeni* spec. nov.
(figs 1-4)

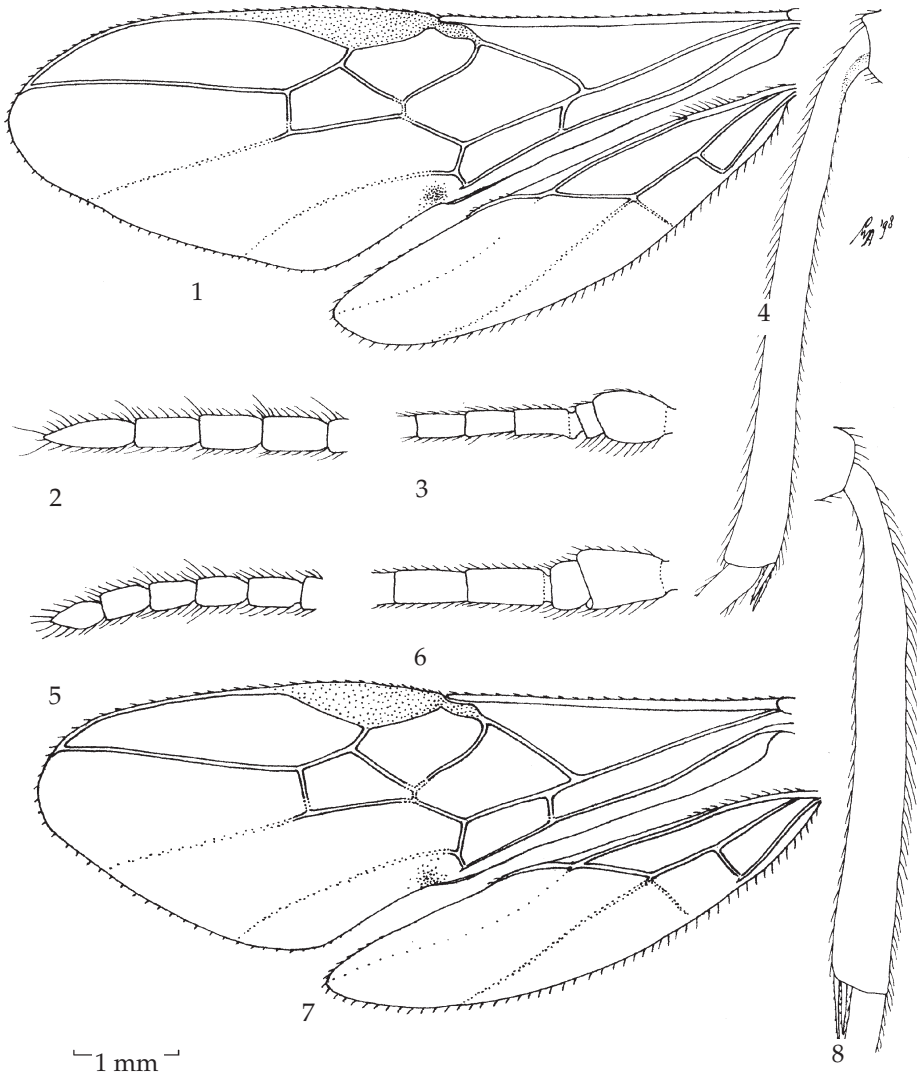
Material.— Holotype, ♀ (RMNH), "Bhutan, Punakha, 1200 m, ex *Bactrocera minax* (End.) (Tephrit.) in *Citrus* [*reticulata*]-fruit, coll. xi.1997, em. iv.1998, H.R. Feijen, RMNH'98". Paratype: 1 ♀ (RMNH), same label data.

Holotype, ♀, length of body 7.8 mm, of fore wing 7.4 mm.

Head.— Antenna 1.5 times length of fore wing, with 67 segments, length of third segment 1.2 times fourth segment, length of third, fourth and penultimate segments 2.8, 2.4 and 2.0 times their width, respectively (figs 2, 3); apex of antenna without spine; scapus compressed, outer side smooth, ventrally distinctly punctate; length of maxillary palp 0.8 times height of head, segments narrow; OOL:diameter of posterior ocellus:POL = 26:6:11; frons flat and smooth medially, setose and punctulate laterally; length of eye in dorsal view 1.5 times temple; vertex flattened, smooth; temple smooth; temples subparallel-sided behind eyes; occipital carina present up to middle level of eyes, absent dorsally, ventrally remaining far removed from hypostomal carina; face densely and finely punctate; anterior tentorial pits rather small, distinct; clypeus largely smooth, with some punctures, convex ventrally and rather flat, in lateral view distinctly removed from mandibles (but in frontal view without hypoclypeal depression); length of malar space 1.3 times basal width of mandible; mandible robust, not twisted and basally punctate, with long ventral carina.

Mesosoma.— Length of mesosoma 1.3 times its height; pronope absent (except for a faint impression); propleuron flattened and with small posterior flange; side of pronotum smooth, flange-like protruding postero-ventrally; precoxal sulcus deep and wide, smooth except for one distinct crenula, not reaching base of middle coxa, area above middle coxa rather tuberculate; remainder of mesopleuron largely smooth, with some punctulation postero-ventrally and medially; only ventral half of pleural sulcus finely crenulate; no postpectal carina; metapleuron long greyish setose, largely smooth, depressed postero-ventrally; mesosternal sulcus smooth; notauli narrow, smooth, complete, and ending in short and deep medio-posterior pit; middle mesoscutal lobe smooth and strongly protruding, largely setose; scutellar sulcus deep wide and with one long carina; scutellum flat and smooth; surface of propodeum (except narrowly medio-anteriorly and widely posteriorly) largely coarsely reticulate and long greyish setose, with rather short and strong median carina, and with large incomplete pentagonal areola; propodeal spiracle round, small and situated just behind middle of propodeum.

Wings.— Fore wing: 1-M straight, but curved posteriorly; r:3-SR:SR1 = 4:12:54; 1-SR+M distinctly sinuate; anterior half of basal and basally of first subdiscal cell glabrous, remaining part setose; SR1 straight and ending close to apex of wing (fig. 1); cu-a oblique, straight; 1-CU1:2-CU1 = 3:22; 2-SR:3-SR:r-m = 15:12:8; first subdiscal cell elongate and parallel-sided apically (fig. 1); CU1b medium-sized; m-cu just postfurcal (fig. 1), and weakly converging to 1-M posteriorly. Hind wing: SR largely absent, only



Figs 1-4, *Diachasmimorpha feijeni* spec. nov., ♀, holotype; figs 5-8, *Diachasmimorpha budrysi* spec. nov., ♀, holotype. 1, 7, wings; 2, 5, apex of antenna; 3, 6, base of antenna; 4, 8, hind tibia, lateral aspect. 1: 1.0 × scale-line; 2: 4.5 ×; 3, 4: 2.0 ×; 5: 4.0 ×; 6: 3.4 ×; 7: 1.3 ×; 8: 2.9 ×.

as an unpigmented fold medially and apically; m-cu long and straight; 1-M as long as 1r-m; M+CU:1-M = 18:16; cu-a straight and vertical; subbasal cell glabrous.

Legs.— Hind coxa punctulate, long greyish setose; tarsal claws rather robust, without lobe and with several spiny setae; length of femur, tibia and basitarsus of hind leg 4.5, 12.2, and 5.9 times their width, respectively; length of hind tibial spurs 0.22 and 0.25 times hind basitarsus.

Metasoma.— Length of first tergite 1.2 times its apical width, its surface smooth

laterally, with some strong costae medially and concave basally, its dorsal carinae strong (flange-like basally), reaching apex of tergite; spiracle of first tergite small, dorsally situated and in small depression; laterope very large and deep; dorsope absent; second tergite costate medially, smooth laterally, its spiracle in notum; setae of second tergite medially forming a subapical band, of third and following tergites a subapical row; ovipositor straight, apically specialized, slightly sinuate, with minute ventral teeth and a large dorsal protuberance, not ribbon-shaped apically; length of ovipositor sheath 1.28 times fore wing and 2.3 times metasoma, flattened (ribbon-shaped), long setose and without apical spine; hypopygium large and apically truncate.

Colour.— Black; head, pronotum, fore leg (but telotarsus infusate), middle tibia and tarsus (but tarsal segments infusate apically) yellowish-orange; ventral half of metasoma pale yellowish; wing membrane subhyaline, with dark patch near vein CU1b; pterostigma and veins blackish.

Variation.— Length of fore wing 6.9-7.4 mm, and of body 6.8-7.8 mm; antenna of ♀ with 63-67 segments; length of ovipositor sheath 1.28-1.29 times fore wing.

Distribution.— Bhutan.

Biology.— Solitary endoparasitoid of *Bactrocera minax* (Enderlein, 1920) (Diptera: Tephritidae) in mandarins.

Notes.— Similar to *D. paeoniae* (Tobias), but differs by the colour of the middle leg, the sculpture of the mesoscutum and of the metapleuron, the number of antennal segments and the shape of the first subdiscal cell of fore wing.

It is a pleasure to name this beautiful species after the family Feijen for their contribution to the knowledge of parasitoid Hymenoptera from Bhutan and eastern Africa.

Diachasmimorpha (Parasteres) longicauda (Shestakov, 1940)

Material.— 3 ♀ + 8 ♂ (RMNH), "Russia: Primorski, "Kedrovaya Pad" Pres[erve], 30 km W Vladivostok, 26.vii.1988, swept, E. Budrys, RMNH'95".

Variation.— Length of fore wing 3.0-4.9 mm, of body 2.6-4.7 mm, antennal segments of ♀ 45(1), of ♂ 45(1), 46(10), 47(10), 48(1), 52(1), or 53(1); vein m-cu of fore wing postfurcal or subinterstitial; length of ovipositor sheath 0.49-0.58 times fore wing, and 1.2-1.3 times metasoma.

Checklist of Palaearctic species of the genus *Diachasmimorpha* Viereck

Diachasmimorpha (Parasteres) aino (Watanabe, 1938)

Opius aino Watanabe, 1938: 35.

Biosteres (Chilotrichia) aino; Fischer, 1972: 488-490, figs 376-378.

Diachasmimorpha aino; van Achterberg & Maetô, 1990: 59, 63; Wharton, 1997: 14.

Biology.— *Euphranta* spec. (Tephritidae) in fruits of *Prunus cerasus* Linnaeus.

Distribution.— Japan.

Fopius alternatae (Tobias, 1977)

Opius (*Diachasma*) *alternatae* Tobias, 1977: 422, 426.

Biosteres (*Chilotrichia*) *alternatae*; Fischer, 1984:123-1260, figs 52, 53.

Diachasmimorpha aino; van Achterberg & Maetô, 1990: 59, 63.

Fopius alternatae; Wharton, 1997: 19.

Biology.— *Rhagoletis alternata* (Fallén, 1814) (Tephritidae) in fruits of *Rosa*.

Distribution.— Far East Russia.

Diachasmimorpha (*Parasteres*) *budrysi* spec. nov.

Biology.— Unknown.

Distribution.— Far East Russia.

Diachasmimorpha (*D.*) *fejjeni* spec. nov.

Biology.— *Bactrocera minax* (Enderlein, 1920) (Tephritidae) in *Citrus reticulata*-fruits.

Distribution.— Bhutan.

Diachasmimorpha (*Parasteres*) *longicauda* (Shestakov, 1940)

Diachasma longicauda Shestakov, 1940: 20.

Diachasmimorpha longicauda; Wharton, 1997: 14.

Biosteres (*Chilotrichia*) *shestakovi* Fischer, 1972: 511-513, fig. 391 (nom. nov.; not *Biosteres longicauda* (Thomson, 1895).

Biology.— Unknown.

Distribution.— Far East Russia.

Fopius myolejae (Tobias, 1977)

Opius (*Diachasma*) *myolejae* Tobias, 1977: 422, 425.

Biosteres (*Chilotrichia*) *myolejae*; Fischer, 1983: 31-34, figs 31-35.

Fopius myolejae; Wharton, 1997: 19.

Biology.— *Myoleja sinensis* (Zia, 1937) (Tephritidae) in fruits of *Lonicera maackii* Rupr.

Distribution.— Far East Russia.

Diachasmimorpha (*D.*) *paeoniae* (Tobias, 1980)

Opius (*Diachasma*) *paeoniae* Tobias in Ermolaev et al., 1980: 895, 901.

Biosteres (*Chilotrichia*) *paeoniae*; Fischer, 1986: 659-662, figs 99-104.

Diachasmimorpha aino; van Achterberg & Maetô, 1990: 59, 63; Wharton, 1997: 14.

Biology.— *Macrotrypeta ortalidina* Portschinsky, 1892 (Tephritidae) in *Paeonia*-flower buds.

Distribution.— Far East Russia.

Diachasmimorpha (Parasteres) tryoni (Cameron, 1911)

Opius tryoni Cameron, 1911: 343-344.

Biosteres tryoni; Wharton & Gilstrap, 1983: 728, 734.

Parasteres tryoni; Fischer, 1987: 692-694.

Diachasmimorpha tryoni; Wharton, 1987: 62; 1997: 14; van Achterberg & Maetò, 1990: 59, 63.

Biosteres acidusae Fischer, 1967: 3-5; Wharton & Gilstrap, 1983: 734.

Biology.— Wharton & Gilstrap (1983) and Fischer (1987) list several species, belonging to five genera of Tephritidae, among these the noxious pest *Ceratitis capitata* (Wiedemann, 1824).

Distribution.— Originally from eastern Australia; introduced in the Pacific, Nearctic and SW Palaearctic regions. In the Palaearctic region introduced in Algeria, Canary Islands, Egypt, Israel, Italy, and Spain, but probably not established.

Acknowledgements and abbreviations

I wish to express my gratitude to Cobi and Hans Feijen (Thimphu, Bhutan) for the gift of the reared specimens and information on the biology of *B. minax*, and Dr E. Budrys (Vilnius, Lithuania) for making his Braconidae available to me. RMNH stands for Nationaal Natuurhistorisch Museum/Naturalis, Leiden.

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Received: 28.ix.1998

Accepted: 29.ix.1998

Edited: M.J.P. van Oijen