First record of the subfamily Dirrhopinae (Hymenoptera: Braconidae) from the Australian region, with a discussion of relationships and biology

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Abstract The subfamily Dirrhopinae (Hymenoptera: Braconidae) is recorded for the first time from the Australian region on the basis of Dirrhope minor Belokobylskij collected at light from several sites in northern Queensland. The species is redescribed and a discussion of relationships, distribution and biology of the subfamily is presented. 

Key words Braconidae, Dirrhope, Dirrhopinae, Hymenoptera.

INTRODUCTION 

The Braconidae is one of the largest families of parasitic Hymenoptera worldwide. To date, 580 species have been described from Australia, including 52 introduced species (Stevens et al. 2001), but this may represent less than 20% of the true size of the fauna. Biologically, the vast majority of braconids are endo- or ectoparasitoids of insect larvae, particularly of Lepidoptera, Coleoptera, Diptera, and, more rarely, of several other insect orders (Shaw & Huddleston 1991; Wharton 1993; Wharton et al. 1997). Thirty-four subfamilies usually are recognised of which 29 occur in Australia, the Miracinae only by undescribed species (Austin unpubl. data 2001). During a recent study of Australian dorctine braconids (Belokobylskij et al. in press), we discovered specimens in the accessions at the Australian National Insect Collection, Canberra that belong to the Dirrhopinae, a subfamily previously not recorded from the Australian region.

The Dirrhopinae contains only a single rare genus, Dirrhope Foerster, known from four species believed to be restricted to the Holarctic region. The genus was described first from Europe in the mid-19th century for the species D. rufa Foerster (Foerster 1851). A second species, D. americana Muesebeck, was reared from a leaf-mining lepidopteran host, Ectoedemia phloeophaga Busck (Nepticulidae) in North America and this has provided the only host record for the group (Muesebeck 1935). Two species, D. eoa Belokobylskij and D. minor Belokobylskij, were described recently from the eastern Palaearctic (Belokobylskij 1989), with D. minor being recorded subsequently from Vietnam (Belokobylskij 1993). Although the subfamily has been stated to have a Northern Hemisphere distribution (e.g., Whitfield 1997), the record of Dirrhope from South Africa (Nixon 1965) appears to have been overlooked by recent authors.

Here, we report the occurrence of Dirrhopinae from Australia for the first time on the basis of D. minor collected at light in northern Queensland. We redescribe the species to facilitate its identification, provide the first record of a male D. minor, and discuss the relationships, distribution and biology of the subfamily.

METHODS AND TERMINOLOGY 

Terms for morphology used here follow Belokobylskij & Tobias (1998) and Sharkey & Wharton (1997). The following abbreviations are used: OD, maximum diameter of lateral ocellus; OOL, ocular-ocellar line; POL, postocellar line; ANIC, Australian National Insect Collection, Canberra; ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

Specimens for SEM were examined uncoated under a Phillips XL30 field emission scanning electron microscope (FESEM, Phillips, Eindhoven, The Netherlands) using secondary electron imaging at 1 kV and a spot size of two. Images were saved directly as TIFF files on the FESEM computer and later edited and arranged into plates using Adobe Photoshop (Adobe Systems Inc., San Jose, USA).

SYSTEMATICS 

Dirrhope minor Belokobylskij (Figs 1–4, 5–12, 13) 


Material examined. Russia. Holotype female, Primorski Territory, 15 km NW Partizans, forest, 13.vii.1979, S. Belokobylskij. Australia, Queensland. 1 female, 11.45S 142.35E, Heathlands, 15–26.i.1992, I. Naumann, T. Weir, at light (ANIC); 1 female, 12.43S 143.18E, 11 km

Description. Female. Body length 1.2–1.5 mm; fore wing length 1.1–1.3 mm. Coloration. Head and mesosoma brown-yellow; first tergite yellow, rest of metasoma yellow-white, faintly darkened medially; antennae yellow in basal half, light brown or yellow-brown to brown in apical half; palps pale yellow; legs yellow, tarsi white-yellow; fore wing hyaline with rather wide transverse infuscate stripe under pterostigma; pterostigma brown, paler apically. Head. Width almost twice its median length, 1.6 times maximum length; occiput strongly concave; head behind eyes distinctly roundly narrowed; length of temple 0.5–0.6 times transverse diameter of eye; ocelli in an equilateral triangle; POL 0.8–1.2 times OD, 0.4 times OOL; OOL 0.2–0.33 times OD; frons very weakly concave, with distinct median carina; eye glabrous, 1.35–1.4 times as high as broad; face without vertical carina; width of face 0.8–0.9 times height of eye and 1.3–1.4 times height of face; malar space height 0.15–0.20 times height of eye, 0.5–0.8 times basal width of mandible; clypeal suture deep and complete; clypeus convex, roundly convex on lower margin; width of clypeus about twice its height; maxillary palps 0.75–0.9 times height of head, third segment short and wide; antennae rather thick and almost filiform, wider medially, 17–18-segmented; scape 2.2 times as long as wide; all flagellar segments longitudinal, first segment 2–2.3 times as long as its apical width, 1–1.1 times as long as segment 2, second segment 1.8–2.2 times as long as wide, segments 8–16 on ventral side with elongate rather wide areas covered with very dense short hairs, penultimate segment elongate, 1.5–1.7 times as long as wide, 0.8 times as long as first segment, 0.7–0.75 times as long as apical

Figs 5–12. Dirrhope minor Belokobylskij: (5) female, head, dorsal view; (6) female, head, dorso-lateral view; (7) female, apical segments of antenna; (8) male, mesosoma, lateral view; (9) female, mesosoma, dorso-lateral view; (10) female, mesosoma, dorsal view; (11) female, propodeum; (12) female, propodeum and first tergite. Scale bar = 200 µm for 5,6,8; 100 µm for 7,9–12.
segment, apical segment obtuse apically. **Mesosoma.** Length 1.5 times its height; lateral depression of pronotum narrow, deep and crenulate; notauli distinct on vertical surface of mesoscutum, almost absent on horizontal surface; prescutellar depression shallow and short, with median carina, densely rugulose-crenulate, about 0.2 times as long as scutellum; scutellum almost flat, without lateral carinae and without transverse posterior depression; prepectal carina distinct, shortly interrupted medioventrally; sternauli absent; mesopleura with rather long oblique smooth furrow in medio-posterior part or sometimes furrow entire; propodeum roundly narrowed posteriorly (lateral view); hind femur 3.6–3.9 times as long as wide; hind tibia strongly widened apically, its length 4.7–5.7 times maximum width, 1.1 times length of hind femur; maximum width of hind tibia 0.85–0.9 times width of hind femur; inner spur of hind tibia 0.75–0.8 times as long as basitarsus; hind tarsus almost as long as hind tibia; hind basitarsus with distinct wide ventral keel, 0.5–0.6 times as long as tarsal segments 2–5 combined; second tarsal tibia; hind basitarsus with distinct wide ventral keel, 0.5–0.6 times as long as basitarsus; hind tarsus almost as long as hind tibia; hind basitarsus with distinct wide ventral keel, 0.5–0.6 times as long as tarsal segments 2–5 combined; second tarsal segment 0.4 times as long as basitarsus, 0.85–1 times as long as fifth segment (without pretarsus). **Wings.** Length of fore wing 2.3–2.4 times its maximum width; pterostigma wide and short, 1.3–1.4 times as long as R; vein r arising almost from middle of pterostigma; sclerotised part of RS 2 times as long as r, 0.7–0.9 times 2RS (which is straight); vein r 0.45–0.5 times as long as maximum width of pterostigma; 1 m-cu 1.5–2 times as long as (RS + M)b, 0.3–0.4 times 2RS; 1st discal cell sessile, its width 1–1.2 times length; distance from 1 cu-a to 1M 0.75–1 times length of 1 cu-a; length of hind wing 3.8–4 times its width; C + Sc + R 0.35–0.5 times SC + R; M + CU 1.4–1.7 times 1M; hind wing with marginal cell in basal one-third weakly narrowed, with unsclerotised r. **Metasoma.** Almost as long as mesosoma; first tergite narrow, almost parallel-sided in apical half, with distinct spiracular tubercles slightly behind middle of tergite; length of first tergite 2.8 times its apical width, 2.5 times its width at level of spiracular tubercles; second tergite with 2 shallow strong oblique furrows; length of second tergite 0.5 times its basal width, 1.6 times length of third tergite; ovipositor sheath short, rounded apically, about 0.5 times as long as first tergite. **Sculpture.** Vertex with distinct transverse striae; frons with distinct dense semicircular striae, sometimes interrupted medially; face finely and entirely rugulose-striate; temple with fine longitudinal striae; mesoscutum densely granulate with long striations posteriorly; scutellum finely granulate or smooth for the most part, finely striate anteriorly; mesopleura smooth; propodeum finely coriaceous, with distinct marginate areas; areola rather narrow and pentagonal; median carina 1.5–1.6 times as long as fork; first tergite of metasoma mostly smooth, sometimes finely striate medially. **Male.** Differing from female as follows: body length 1.5 mm; fore wing length 1.4 mm; scape 2.5 times as long as wide; first flagellar segment 2.5 times as long as apical width, penultimate segment 2.7 times as long as wide; length of mesosoma 1.4 times its height; metasoma yellow, pale yellow medially, short, 0.8 times as long as mesosoma; length of first tergite 2.4 times its apical width, 2.2 times its width at level of spiracles; otherwise similar to female. **Remarks.** Similar to *D. eoa*, from the far-east of Russia (Belokobylskij 1989), based on the antenna being weakly narrowed towards the apex and having a short third segment, the mesopleura being mostly smooth, and the marginal cell of the hind wing possessing vein r. Distinguished from *D. eoa* by having a narrow areola with a single lateral carina, the segments in apical one-third of the antenna elongate, the temple finely striate, and the metasoma entirely light brown or yellow. In Australia, *D. minor* appears to be restricted to northern Queensland (Fig. 13).

**DISCUSSION**

*Dirrhope* has traditionally been accommodated within the Microgastrinae (e.g., Muesebeck 1935; Tobias 1967; Marsh 1979) or within the Adelini (Telenga 1955; Capek 1970; Shenefelt 1973). Nixon (1965) recognised the unique status of the genus, but was unable to place it in relation to other genera, although he excluded it from the Microgastrini (= Microgastrinae *sensu* Mason). Mason (1981) agreed with Nixon’s scheme in excluding *Dirrhope* from his more restricted definition of the Microgastrinae, but did not discuss the genus further. Subsequent workers place *Dirrhope* within the Miracinae (e.g., Tobias 1986; Belokobylskij 1989), choosing to ignore van Achterberg (1984) who accommodated the genus in its own subfamily, the Dirrhopinae, on the basis of having the spiracles of the first tergite situated posteriorly. In his hypothesis for subfamily relationships,
van Achterberg (1984) placed the Dirrhopinae as the sister group to Ichneutinae + (Miracinae + Acaelininae) remote from the Microgastrinae and other higher-level taxa that constitute the microgastrid group of subfamilies (sensu Whitfield & Mason 1994). Belokobylskij (1989) discussed the morphological similarities and differences between Dirrhope and Mirax Haliday, particularly in regard to the structure of the first and second tergites and their associated spiracles. However, because of a number of putative plesiomorphic characters in Dirrhope (i.e., presence of a prepectal carina; variable number of antennal segments; long vein r in fore wing; 6-segmented maxillary palps; presence of the well-developed labial sclerite in the last larval stage – Capek 1970), Belokobylskij (1989) considered the genus to be more archaic in comparison with other genera of Miracinae.

More recent cladistic analyses of morphological datasets (Quicke & van Achterberg 1990; Wharton et al. 1992; Whitfield & Mason 1994) consistently place the Dirrhopinae as a basal group within the microgastrid group, and therefore distant to either the Microgastrinae or Miracinae. Although this position appears to be reasonably stable, it is hoped that a more concrete picture of microgastrid relationships will be forthcoming once material of the rarer groups, viz. Dithopinae, Mendesellinae, Khoikholinae and Economiinae, are available to include in more comprehensive molecular studies.

Given that the genus is collected rarely, not surprisingly only one host, a leaf-mining nepticulid, B. philoeophaga from North America, has been reported (Muesebeck 1935). However, all species are predicted to be leaf-miner parasitoids, given their small body size and short ovipositor, consistent with the hosts of other small members of the microgastrid group such as Adeliinae and Miracinae that also parasitise leaf miners.

Clearly D. minor as recognised here has an extremely wide distribution being found from the southern far-east of Russia, to Vietnam and Australia. Presumably, this species occurs more-or-less continuously through south-east Asia to Australia. However, given that bracoonids of this region are relatively poorly collected and studied, and that the genus is only rarely encountered, it is not surprising that it has not yet been recorded from anywhere in Malaysia or Indonesia.

This record of the subfamily from Australia and that by Nixon (1965) from South Africa clearly indicate that the Dirrhopinae have an almost cosmopolitan distribution, although it may be quite disjunct in some regions. Dirrhope is yet to be recorded from South America and south-east Asia. However, the fact the specimens of D. minor from Australia were all collected at light, points to this as a being a worthwhile collecting technique when searching for this rather elusive bracoonid genus in areas where it has not been recorded.

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