A NEW NEARCTIC SPECIES OF *PROTOPIOPHILA* DUDA (DIPTERA: PIOPHILIDAE), WITH NOTES ON ITS BEHAVIOUR AND COMPARISON WITH *P. LATIPES* (MEIGEN)

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Abstract

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Protopiophila litigata sp.nov. is described from Ontario and Nova Scotia. McAlpine's (1977) key to the species of *Protopiophila* is modified to facilitate identification of the new species. Behaviours of *P. litigata* and *P. latipes* were studied in Algonquin Park, Ontario. Whereas *P. latipes* reproduces on corpses in advanced stages of decay, *P. litigata* mates and oviposits on discarded cervid antlers, ignoring other carrion. Unlike *P. latipes*, males of *P. litigata* engage in 'mate guarding'. These traits probably represent autapomorphies of *P. litigata*.

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Résumé

On trouvera ici la description de *Protopiophila litigata* sp.nov. de l'Ontario et de la Nouvelle-Écosse. La clé des espèces de *Protopiophila* publiée par McAlpine (1977) a été modifiée pour permettre l'identification de la nouvelle espèce. Le comportement de *P. litigata* et celui de *P. latipes* ont fait l'objet d'une étude dans le parc Algonquin, en Ontario. Alors que *P. latipes* se reproduit sur des charognes en état avancé de décomposition, *P. litigata* s'accouple et pond ses oeufs exclusivement sur les bois rejetés des cervidés, jamais sur d'autres charognes. Contrairement à ceux de *P. latipes*, les mâles de *P. litigata* s'adonnent à la "garde de leur partenaire". Il s'agit sans doute là d'autapmorphies chez *P. litigata*.

[Traduit par la Rédaction]

Introduction

Protopiophila was elevated from a subgenus of *Piophila* Fallén to generic status by Harrison (1960*a*, 1960*b*). Members of the genus can be identified using the "Key to Subfamilies, Tribes and Genera" of Piophilidae in McAlpine (1977). According to McAlpine (1977), *Protopiophila* is the most primitive (plesiomorphic) genus in the subtribe Piophilina. Moreover, its worldwide distribution pattern suggests that the genus existed in Gondwana during the Cretaceous period. *Protopiophila* includes 10 species, of which only the Holarctic *P. latipes* and *P. litigata* sp.nov. are known from the Nearctic region (McAlpine 1977; Ozerov 1989). The new species was collected off discarded antlers of moose (*Alces alces* Linné) at the Wildlife Research Station, Algonquin Park, Ontario, Canada. At the same site, specimens of *P. latipes* were collected off the corpses of rodents and turtles in advanced stages of decay.

Materials and Methods

Abdomens were prepared for examination by boiling for approx. 2 min in a mixture of equal parts potassium hydroxide and hydrogen peroxide solutions, rinsing for 5 min in distilled water, and transferring to glycerol. Illustrations were prepared from abdomens in well-slides, by means of a Nikon compound microscope equipped with a camera lucida. Ovaries of 68 females freshly killed by freezing were also examined. The terminology generally follows McAlpine (1977), with the following exceptions, which follow McAlpine (1978): 'gonopod' is used in place of 'pregonite', and 'paramere' in place of 'postgonite'. Bristle 'strength' refers to girth and length together, as these bristle characteristics generally covary in *P. litigata*. Type specimens were deposited in the Canadian National Collection of Insects (CNCI), Ottawa, and the University of Guelph (UG) Insect Collection. Description

of *P. litigata* was supplemented by comparative examination of 85 specimens of *P. latipes*, two specimens (1 male, 1 female) of each of *P. atrichosa* McAlpine, *P. australis* Harrison, *P. contecta* (Walker), *P. pallida* McAlpine, and *P. scutellata* Harrison, and one specimen of *P. aethiopica* (Hennig). Behavioural observations of *P. latipes* and *P. litigata* were carried out in the summers of 1993–1995, at the Wildlife Research Station, Algonquin Park, Ontario. Final-instar larvae of *P. litigata* were collected from the surface of an antler in May 1995, and allowed to pupate in a jar at approx. 20°C. The behaviour of *P. litigata* will be detailed in a forthcoming paper.

Genus *Protopiophila* Duda

Diagnosis (based on McAlpine 1977). Length 2 –4 mm. Frons weakly setulose. Face deeply concave. Lunule bare. Thorax mostly yellow to mostly black. Mesonotum densely setulose to nearly bare. Two postpronotal bristles, the inner medially directed. Usually one presutural and three postsutural dorsocentrals. Wing hyaline. Front tarsi frequently enlarged and flattened in males. Posterior margin of male abdominal sternite 7 with several peglike processes (Figs. 1, 2). Surstyli, gonopods, and paramere reduced (Figs. 1–4). Aedeagus long and densely hairy. Ovipositor long and slender (Figs. 5, 6).

Protopiophila litigata sp.nov.

(Figs. 1, 3, 5)

Derivation of Specific Epithet. Males of this species are extremely aggressive and were observed attacking flies (Muscidae) much larger than themselves. The name *litigata* is derived from *litis*, meaning 'strife' or 'dispute', and *ago*, 'to carry on'.

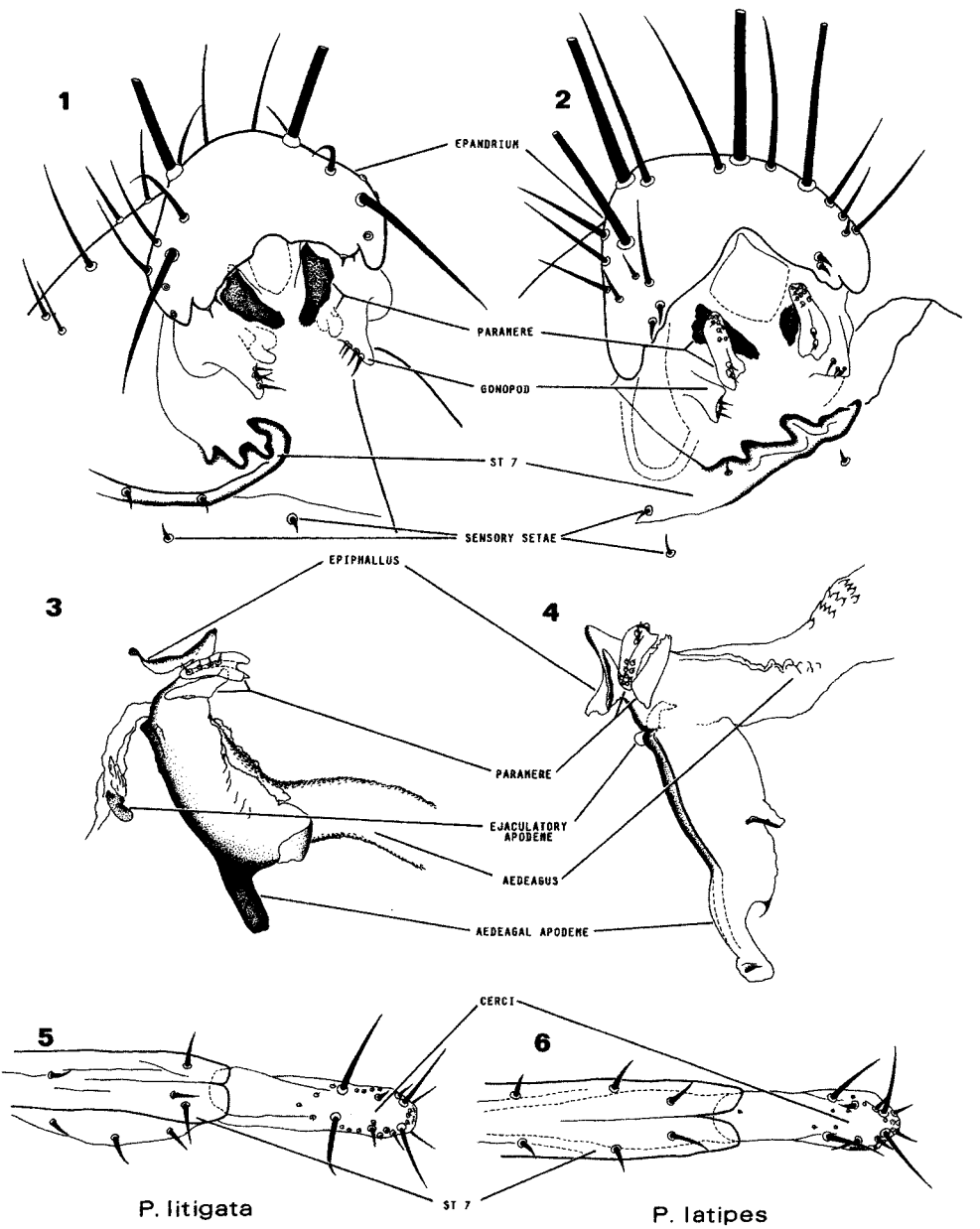
Description. Length 1.9–3.1 mm (females); 1.6–2.8 mm (males).

Head. Head higher than long, entirely black. Compound eye nearly round, bare, reddish. Frons shining black, with a few fine hairs. Head bristles strong and black. Inner and outer vertical and post-vertical bristles approximately equal in strength. Ocellars somewhat stronger, followed posteriorly by three pairs of small setulae in two parallel rows, on either side of ocellar triangle. Two fronto-orbital bristles, variable in strength, the stronger one (usually the posterior) weaker than the verticals. Vibrissae approximately equal in strength to ocellars. Face concave, grayish, without median carina. Lunule bare. Cheeks gray pruinose, with row of moderately strong hairs on the lower margin, posterior to the vibrissa. Palpi and base of proboscis black. Flagellum brownish pruinose. Arista black, lightly plumose.

Thorax. Pleuron mostly gray pruinose. Mesothoracic anepisternum mostly shining anterodorsally, pruinose elsewhere. Prosternum whitish pruinose. Katepisternum and anepimeron entirely grayish pruinose. Scutum mostly grayish pruinose, with shining band along transverse suture. Notal hairs yellowish distally. Scutellum pruinose, the bristles of each of the two pairs often asymmetrical in strength and curvature. Thoracic bristles: third postsutural dorsocentral about twice as strong as the second; second postsutural slightly stronger than the first postsutural and about 1.5 times the length of the presutural dorsocentral. Wing hyaline. Subcostal vein brownish, the others yellowish. Halter pale yellow to white. Calypter white. Forecoxa yellow. Forefemur yellowish proximally, darkening to black distally. Foretibia and foretarsus black. Midlegs and hind legs variable: femora yellow proximally, darkening distally; midtibia yellow, sometimes with a brown patch; hind tibia mostly dark; tarsi mostly yellow, fifth tarsomere darker.

Abdomen. Tergites and sternites dark brown to black, grayish pruinose anteriorly, sometimes shining posteriorly, densely hairy. Hairs longer than on mesothoracic notum, and becoming longer posteriorly.

Male terminalia (Figs. 1, 3). Sternite 7 (Fig. 1) with two to four distinctive pegs and left side enlarged. Very long, thick, hairy aedeagus. Parameres and gonopods small (Fig. 3).



FIGS. 1–6. Male and female terminalia of *Protopiophila litigata* and *P. latipes*. **1,2**, male terminalia (posteroventral view): 1, *P. litigata*; 2, *P. latipes*. **3,4**, phallus and paramere (left lateral view): 3, *P. litigata*; 4, *P. latipes*. **5,6**, tip of ovipositor (ventral view): 5, *P. litigata*; 6, *P. latipes*.

Anterior portion of paramere finely toothed and darkly sclerotized. Posterior, fork-shaped portion of paramere with four median bristles on the lateral surface. Epandrium with four strong bristles and several smaller hairs.

Female terminalia (Fig. 5). Ovipositor tip (fused cerci) with several rows of microsetulae between major bristles (Fig. 5). Spermatheca smooth, mushroom-shaped. Ovaries

frequently asymmetrical, typically with a total of approximately 40 ovarioles (range 22–52; $N = 68$ females).

Immature stages. Egg 0.6 mm long. Final-instar larva approximately 5 mm long, 0.5 mm wide. Puparium approximately 3 mm long, dorsoventrally flattened anteriorly, narrower and cylindrical posteriorly, with one pair of minute projections at posterior tip.

Holotype. Male labelled: "Piophilidae/ 7/6/1993, moose antler/ W.R.S. [Wildlife Research Station], Algonquin Park (carrion)/ R. Bondurianskу"; "HOLOTYPE/ Protopiophila/ litigata/ Bondurianskу" [red label] (CNCI).

Paratypes. 28 males, 25 females. *Ontario.* Algonquin Park, T.H. Scholten, 24 June 1958, 1 female (UG); Algonquin Park, Wildlife Research Station, moose antlers, July 1993, RB, 5 males, 3 females (CNCI); 21 males, 20 females, incl. 2 copulating pairs, (UG); rodent corpse, late June 1993, RB, 1 male (UG). *Nova Scotia.* South Harbour beach, mixed dry mesophytic woods, PG962943, 6 July 1983, J.R. Vockeroth, ident. Protopiophila n. sp., 1985, J.F. McAlpine, 1 female (CNCI); C.B.H. [Cape Breton Highlands] National Park, Mackenzie Mountain, Picea, Betula woods, PG645851, 7 July 1983, J.R. Vockeroth, 1 female (CNCI).

Morphological Comparison with *P. latipes*. *Protopiophila litigata* is smaller and more extensively pruinose than *P. latipes*. Unlike *P. litigata*, *P. latipes* has a conspicuously white forecoxa. Midfemur, hind femur, and hind tibia of *P. latipes* are entirely yellow or lightly brown-patched, rarely as extensively patched as in *P. litigata*. Asymmetry in strength and curvature within scutellar bristle pairs is usually more pronounced in *P. litigata* than in *P. latipes*. The paramere of *P. litigata* (Figs. 1, 3) differs from that of *P. latipes* (Figs. 2, 4) in the number and position of microsetulae on the forked, posterior section. The ovipositor tip of *P. litigata* (Fig. 5) has a similar pattern of major bristles, but a denser interspersion of microsetulae than that of *P. latipes* (Fig. 6).

Identification. *Protopiophila litigata* is easily distinguished from all cogeneric species except *P. contecta* by its extensively pruinose body. *Protopiophila litigata* can be distinguished from *P. contecta* by its generally smaller body, denser pruinescence (especially on the pleuron), and extensive brown or black patches on the midlegs and hind legs. All described species of *Protopiophila* (adults) can be distinguished using the key in McAlpine (1977), supplemented by the following couplets.

8. Anepisternum entirely glossy (Holarctic) ..... *latipes* (Meigen)
8′. Anepisternum partly pruinose 9

9. Anepimeron glossy to lightly pruinose; usually >3 mm; midlegs and hind legs evenly yellow or light brown (Oriental) ..... *contecta* (Walker)
9′. Anepimeron entirely pruinose; usually <3 mm; midfemur and hind leg with large dark patches (Nearctic) ..... *litigata* **sp.nov.**

Ecology and Behaviour of *P. litigata* and *P. latipes*

Protopiophila litigata larvae develop in the porous matrix inside discarded cervid antlers. Adult activity occurs over three full months (June–August) in Algonquin Park, Ontario. Eggs deposited in late summer overwinter in the antler. The final-instar larva migrates to the surface of the antler after rain and travels to the tip of a projecting point. Here it curls into a circle and springs off the antler [an ability possessed by larvae of the cheese skipper, *Piophila casei* (Linné), and several other piophilid species (McAlpine 1977)]. The larva lands up to 0.5 m from the antler and pupates in the leaf litter. The adult emerges after 12–16 days at 20°C ($N = 52$ pupae).

Protopiophila litigata males spent several hours per day on antlers. Some males defended territories in leks [arenas where males compete for social status or position, and to which females come for mating (Emlen and Oring 1977; Clutton-Brock et al.

1993)] on the upward-facing surfaces of moose antlers. Other males aggregated near copulation and oviposition sites, where they attacked coupled pairs. Males used "assault type" courtship (see Kaneshiro 1983). If the female accepted the male, she carried him away from areas of male aggregation, often to the underside of the antler. Following copulation (approx. 2 h duration), the female oviposited into cracks or pores on the antler surface while the male remained mounted and warded off the advances of unpaired males ['postinsemination mate grasping' (Alcock 1994)]. Few flies were seen on antlers at temperatures below 17°C, and few copulations were observed below 20°C. Adults of both sexes appeared to ingest food (possibly microorganisms) from the antler surface.

Males of the sympatric *P. latipes* engaged in agonistic interactions on and around corpses in advanced stages of decay (where they comprised approximately 9% of the piophilid assemblage in 1993). *Protopiophila latipes* females came to these corpses to mate and oviposit, but 'mate guarding' was never observed. A moose skull with some adhering flesh and one attached antler attracted both species, but *P. latipes* preferred the skull, whereas *P. litigata* preferred the antler. Heterospecific copulations were attempted, without success, by males of both species. A limited degree of overlap in resource recognition was noted for the two species: a few *P. litigata* individuals were collected off carrion and *P. latipes* individuals were occasionally observed on antlers.

Although very little is known of the behaviour or ecology of the eight equatorial and southern-hemisphere species of *Protopiophila*, the most likely plesiomorphic condition for this genus is oviposition on corpses and an absence of 'mate guarding', the probable plesiomorphic state of the subtribe Piophilina (see McAlpine 1977). Hence, whereas *P. latipes* appears to retain this plesiomorphic condition, 'mate guarding' and the use of antlers as reproductive media probably represent autapomorphies of *P. litigata*.

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