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A new Nearctic species of the fungus gnat genus *Tetragoneura* Winnertz, 1846 and notes on *Tetragoneura nitida* Adams, 1903

(Diptera, Mycetophilidae)

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A new Nearctic species of the fungus gnat genus *Tetragoneura* Winnertz, 1846 was discovered in western Michigan, USA. More than 100 males and seven females of *Tetragoneura lustra* spec. nov. flew to a Malaise trap over the course of several years in an ecotone between swamp and second-growth forest. The new species resembles published accounts of *Tetragoneura nitida* Adams, 1903, which is relegated herein to the status of nomen dubium. Juvenile stages of *T. lustra* are unknown.

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Introduction

It appears that approximately 110 species of *Tetragoneura* Winnertz are known world-wide (Chandler 1980, Polevoi & Jakovlev 2011, Taber 2013). Twelve Nearctic species were previously recognized (Laffoon 1965, Nomina Insecta Nearctica 1998, Polevoi & Jakovlev 2011, Taber 2013, 2015), but all published taxa except *Tetragoneura nitida* Adams, 1903 and *Tetragoneura caliga* Taber, 2013 appear to belong to other genera (Chandler 1980, Peter Chandler, pers. comm.). The new species described herein has the same Midwestern United States type locality as *T. caliga*.

Materials and methods

The type locality is a narrow ecotone between mostly deciduous second-growth forest and wetland in Newaygo County, Michigan, USA, 7 km east of Brohman, at a site within the Manistee National Forest known as "Oxford Swamp", with GPS coordinates of 43.41° N, 85.44° W. Forest trees and shrubs include black ash (*Fraxinus nigra* Marshall), paper birch (*Betula papyrifera* Marshall), red maple (*Acer rubrum* L.), American hornbeam (*Carpinus caroliniana* Walter), and grey alder (*Alnus incana* (L.) Moench). Nearby is an open marsh dominated by common cattail (*Typha latifolia* L.). Flies were collected with a large Malaise trap erected near the marsh but just inside the tree line.

Specimens were stored as frozen samples in Petri dishes until removed for identification during inspection with a stereomicroscope. They were soaked overnight or longer in a small tissue culture dish with one pellet of potassium hydroxide (KOH) to clear dark pigmentation and then placed directly onto a microscope slide with one or two drops of PVA (polyvinyl alcohol) as a mounting medium, or with Euparal after maceration in 99 % isopropanol. Cover slips were not used because it is important to reposition material for examination from different angles by applying additional mounting medium and waiting a few minutes for the previous application to soften. Photographs shown here were taken with stereoscopic and high-power compound microscopes (Olympus SZ40 Zoom and Olympus BH-2, respectively), provided with a digital SPOT idea camera. Stacking software was employed to combine series of images differing only in the chosen plane of focus into a single merged image with improved clarity (Zerene Stacker Version 1.04), thus overcoming depth-of-focus problems with thick specimens.

Descriptions follow examples provided for newly published Palaearctic and Nearctic *Tetragoneura* species (Polevoi & Jakovlev 2011, Taber 2013) while drawing upon the morphological terminology of the standard reference on Nearctic Diptera (Vockeroth 1981), and excluding certain characters that are either not normally used in identification, or are likely variable, or both.

Abbreviations

C	costa vein
CuA	anterior branch of cubitus vein
M	media vein
M1	a posterior branch of the media vein
Mp	petiole of media vein
R1	anterior branch of radius vein
R2+3	one of the posterior branches of radius vein
R4+5	one of the posterior branches of radius vein
r-m	radial-medial crossvein
Rs	radial sector
Sc	subcosta vein

Results

Tetragoneura lustra Taber spec. nov.

Diagnosis. According to old literature (Adams 1903, Johannsen 1910), the female of *T. nitida* differs from the new species by the latter's possession of black rather than yellow bristles on the scutellum, by black setae ("pile") on the head, mesonotum, and abdomen rather than yellow, and by a brown scape and pedicel rather than yellow. But the single type specimen of *T. nitida* is lost (Chandler pers. comm.) and because it is difficult to distinguish females of closely related species *T. nitida* is henceforth considered a nomen dubium. With this action taken the only two Nearctic species that clearly belong to *Tetragoneura* are *T. caliga* and *T. lustra*. The male *T. lustra* can be easily distinguished from the male *T. caliga* by the blackish abdomen of the new species as opposed to the dark and light bands of the latter and especially by the elongate gonostylus process of *T. lustra* that *T. caliga* lacks (Taber 2013, fig. 3). The male mid tibia of *T. lustra* bears two spurs whereas *T. caliga* bears only one spur but both species lack a setose organ near the base of that leg segment on its dorsal surface.

Description

Male (Figs 1–9). Total length of holotype in 80 % ETOH = 2.3 mm; wing length (root to apex) = 2.0 mm. In addition to the sexual dimorphism of terminalia and more robust hind femora, males differed from females by having paler wings and paler bristles and setae, except for the setae of the last several abdominal segments and the longer bristles of the scape and pedicel, which are usually blackish or at least darkened instead, and one or more bristles along the lateral edge of the mesonotum, which are dark in some cases; scape and pedicel usually yellowish and therefore much lighter than those of the females, but occasionally darker. Mid tibia with two spurs but lacking dorsal setose organ.

Wing (Fig. 2): Sc short, ending free; small cell formed by Rs + R2+3 present, the cell shorter than R1 distal to R2+3, the segment R1 longer than r-m but shorter than petiole of M (Mp); r-m much shorter than Mp; M forks slightly distal to R2+3; C continues past R4+5 toward M1 by a distance of about ⅔ the distance between the terminus of R4+5 and the terminus of M1; CuA forks distal to base of r-m but not as distal as the mid point of Mp. M, Mp, and the basal portion of M1 are devoid of setae, faint, and obliterated to various degrees; halteres yellow.

Terminalia: Ninth tergite (Fig. 3) divided medially, forming two adjacent triangular plates, these with long setae on their posterior margin; cerci large, rounded, covered with long, fine setae; submedian processes of gonocoxites (Figs 4, 5) elongate, digitiform, with strong setae on the apical half, each adjacent cleft narrow, U-shaped, sides nearly parallel, side of each cleft farthest from the submedian process with a few fine setae on a prominence; blade of gonostylus (Fig. 6) pistol-shaped with fine setae along and near the median extension and on an edge lateral to the extension, a perforation near the lateral edge, and a long, thin, curved, needle-like process articulated at the dorso-lateral extremity near the connection of the gonostylus with the gonocoxite, but the process is often not entirely apparent due to its substantial length, its slender shape, its curvature, and its various orientations, though the process and blade are nearly equal in length in their longest dimensions; aedeagus complex (Figs 7–9) H-shaped, length = 0.19 mm, width = 0.17 mm.

Female (Figs 10–12). Total length in 80 % ETOH = 3.1 mm; wing length (root to apex) = 2.6 mm. Head, thorax, and abdomen shiny black without yellow spots or bands (Fig. 10); antenna scape and pedicel brown but flagellum darker brown; palps yellow; coxae, femora, tibiae, tarsi, and tibial spurs yellow except distal ¼ of hind femora which are blackish and duskier hind tibiae with blackish apices; trochanters yellow with margins partially blackened; bristles and finer setae (pile) of head, thorax (including scutellum), and abdomen black except for those on the apex of gonocoxite 8 which are pale and those of tergite 1 which are occasionally pale; scape and pedicel setae black, setae of coxae a mixture of both black and pale with strong, dark setae more apically

located, remaining setae and bristles of legs black except for the fore femur which has sparse pale setae and a few dark setae at the apex; fore tibia 1.6 times the length of adjacent tarsomere. Antenna with 14 flagellomeres, these nearly square in lateral view except basal flagellomere which is slightly more elongate and apical flagellomere which is bullet-shaped; halteres yellowish like the coxae. Wing tinged with brown and darkest in the region of the small cell. Total length of cercus = 0.3 mm (Fig. 11).

Egg (Fig. 12): Two females died with an egg exposed between the cerci and gonocoxite 8 as if they were being oviposited. Both eggs were yellow. One was removed and measured with a resulting length of 0.36 mm and a width of 0.14 mm. The chorion is covered with numerous small polygons.

Type material. Holotype male: Manistee National Forest, Newaygo Co., MI, USA; 7 km east of Brohman, 18 August, 2007, S. W. Taber, Saginaw Valley State University Insect Collection, University Center, Michigan. All paratypes with same collection locality as holotype. Six males with same date as holotype. Five females from 11 August, 2007, one from 12 August, 2006, and one from 20 May, 2012.

Distribution. The new species is known only from its type locality.

Etymology. The fly is named for its similarity to *T. nitida*. The specific epithet of the latter species also referred to a shiny surface.

Remarks. Slight variation was found among the 7 female type specimens regarding two forks of the wing and the length of the costa. The fork of CuA can be opposite the base of r-m, slightly distal to it, or slightly basal. Similarly, the fork of M can be opposite R2+3, slightly distal to it, or slightly basal. The costa can extend ½ of the distance between the terminus of R4+5 and the terminus of M1 or closer to ⅔ of the distance. Variation among the 7 male types was similar with respect to the forks of wing veins but there was a tendency for CuA to fork slightly more distally among males and one specimen had the costa extending almost as far as the apex of M1. Though most material was collected in August, a small amount collected in May suggests that these flies have at least two generations per year.

Discussion

A female was tentatively selected as the holotype of *T. lustra* before a male was chosen instead because the only type specimen of *T. nitida* was a female and these appear to be sister species. The single known specimen of the latter fly was described twice. First in its original description (Adams 1903, p. 23) and later when it was believed that the male had been discovered (Johannsen 1910, pp. 131–132; figs 85, 108). Both descriptions agree that the female had yellow "pile" on its head, mesonotum, and abdomen, yellow bristles on its scutellum, and a yellowish scape and pedicel. The new species has black pile on its head, mesonotum and abdomen, black bristles on its scutellum, and a brown scape and pedicel. A mention of black bristles on the margins of the mesonotum in the original description suggests that if additional bristles were present nearby they were pale like the pile. All of the bristles on the female mesonotum of the new species are black. The dark setae on the last several abdominal segments of the male *T. lustra* and on nearly all of the abdominal segments of the female are distinctions from *T. nitida* according to Adams (the female) and Johannsen (both sexes).

But the identity of the *T. nitida* male is problematic. Johannsen had only one specimen reported as such and it was from "L. Toxaway", North Carolina, presumably meaning Lake Toxaway, with an elevation of 908 m. This might represent a third species rather than the previously unknown, and perhaps still unknown, male of *T. nitida*, which was described from a single female collected in Missouri at an elevation closer to 223 m. The elevation of the type locality of *T. lustra* is approximately 283 m, but its habitat is dominated by paper birch, black ash, red maple, American hornbeam, and grey alder. The two localities are in different biogeographical regions (Voss 1972, Castillon 1991), and the absence of all five plant species from the more southern Missouri collection locality of *T. nitid*a adds ecological support to a specific distinction based upon morphological comparison.

A review of the literature found four illustrations purporting to represent the male of *T. nitida*. These include one drawing of a wing (Johannsen 1910, fig. 85), and three of terminalia (Johannsen 1910, fig. 108; Chandler 1980, figs 1, 2). The wing and the earliest terminalia drawing were those of the North Carolina male but this terminalia drawing is poor and of marginal utility. The provenance of the specimen figured by Chandler (1980) was not reported; it was part of a series from North Carolina and Tennessee from the Iowa State University collection, and was identified as *T. nitida* on the basis that it was the only true *Tetragoneura* species to have then been recorded from North America (Peter Chandler, pers. comm.). These drawings show nearly straight-sided, almost evenly tapering, triangular submedian processes of the gonocoxites whereas those of *T. lustra* are not so wide near the base, do not taper to their apex as evenly, and suggest fingers more than triangles as a result (Chandler 1980, p. 28; fig. 2 there vs. Fig. 4

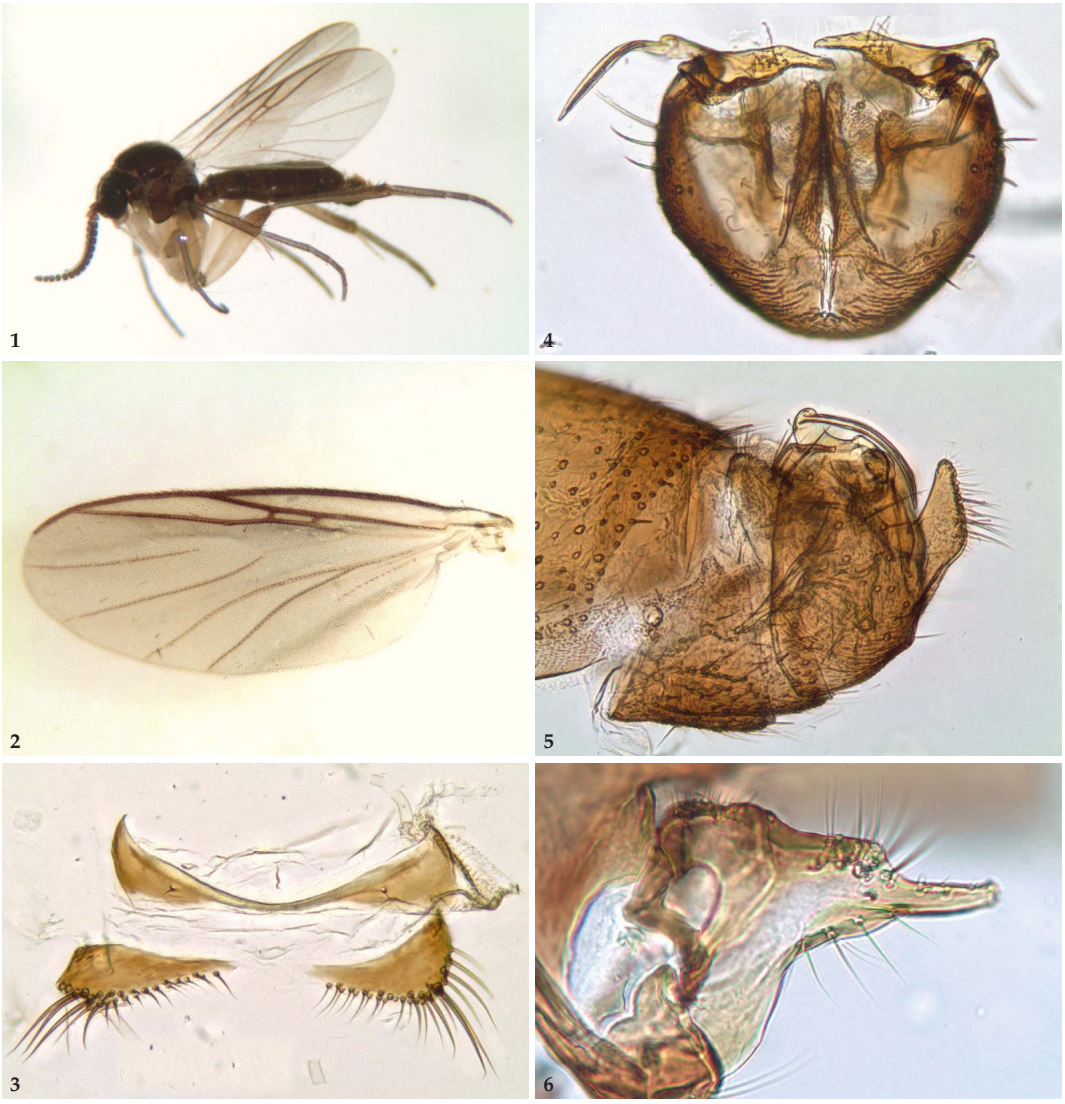

Fig. 1–6. *Tetragoneura lustra*. **1.** Male. **2.** Male wing. **3.** Male 9th tergite (bottom); 8th tergite (top). **4.** Male terminalia; posterior view. **5.** Male terminalia; lateral view. **6.** Gonostylus blade.

herein), and the long process of the gonostylus of *T. lustra* was not present in the material used for those drawings (Peter Chandler, pers. comm.).

The wings of both sexes of *T. lustra* differ from the drawing of the purported *T. nitida* wing (Johannsen 1910, fig. 85) by the weaker development in the new species of the basal portion of M, the distal half of Mp and the basal ⅓ of M1 in the wing. This difference is emphasized by the absence of setae where the veins would be. The drawing does not show such near obliterations for what Johannsen believed to be the wing of a male *T. nitida*, though some lines were drawn thinner than others on that figure and additional drawings for different species on the same page indicate that Johannsen noticed weakened wing veins and drew them. The drawing also shows a slight posterior deflection of R4+5 that was not observed among the many *T. lustra* specimens examined, which had a nearly straight R4+5 in all cases instead.

The Palaearctic species *Tetragoneura ruuhijarvii* Polevoi & Jakovlev, 2011 is similar to *T. lustra* with

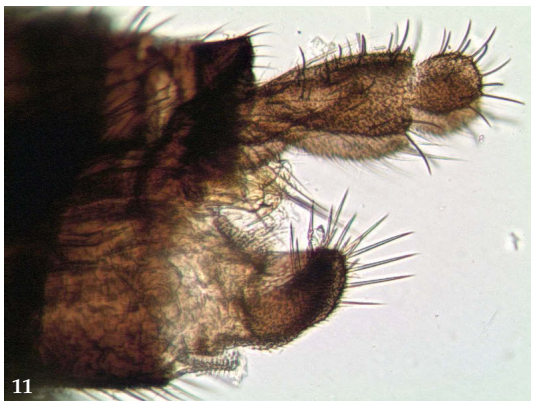

Fig. 7–12. *Tetragoneura lustra*. **7–9.** Aedeagus complex. **7.** Ventral view. **8.** Lateral view. **9.** Dorsal view. **10.** Female. **11.** Female cercus. **12**. Egg.

a medially divided ninth tergite, gonocoxites bearing a pair of submedian ventral lobes, and a slender process of the gonostylus (Polevoi & Jakovlev 2011, figs 2E–F), but the ventral lobes of *T. ruuhijarvii* are short and broad instead of long and narrow, and each gonocoxite bears a small "complementary appendage" that *T. lustra* lacks. A much larger setose lobe possessed by *T. lustra* on a similar part of the gonocoxite might be homologous to the complementary appendage.

In conclusion it seems best to relegate *T. nitida* to the status of nomen dubium (Peter Chandler pers. comm.) because the species was described from a single female that is now lost, because males are

typically selected as holotypes to take advantage of more taxonomically useful genitalia, and because of the great confusion that exists in the literature as indicated herein.

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