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Two species with ventral receptacles in *Trichocera* MEIGEN (Diptera: Trichoceridae)

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Original article

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Abstract. The ventral receptacle is a kind of a sperm storage shaped as an elongated pouch and positioned at the ventral side of female genitalia. It is a novelty and an alternative system to the spermathecae present in a vast majority of Diptera, and insects in general. Among the Diptera the ventral receptacle is present in the families of Brachycera Acalyptrata; the subgenus *Trichocera* (*Staryia)* is the only taxon among the entire Diptera Nematocera known to date in which the ventral receptacle was found. The subgenus comprises 13 species known from northern and central Europe. In this paper two new species of *Staryia* are described, one from Switzerland, and the other from Scandinavia. Additionally, a revised description of a female of *T.* (*Metatrichocera*) *gigantea* DAHL, 1967, is provided, based on specimens from the far eastern locality in Siberia.

Key words: *Staryia*, new species, *Trichocera gigantea*, spermatheca, seminal receptacle.

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I. INTRODUCTION

The Holarctic genus *Trichocera* MEIGEN, 1803, with its c. 80 species is the largest genus of a small nematoceran family Trichoceridae RONDANI, 1841, which comprises c. 160 species (according to KRZEMIŃSKA et al. (2009), with later descriptions added). The genus has been divided into four subgenera: *Trichocera*, MEIGEN 1803, *Metatrichocera* DAHL, 1967, *Saltrichocera*, KRZEMIŃSKA 2002, and *Staryia* KRZEMIŃSKA & GORZKA, 2016. *Staryia* is unique among the entire large group of nematoceran flies in having the spermathecal system being replaced by the ventral, or seminal, receptacle. The ventral receptacle is a container for sperm storage shaped as an elongated pouch and positioned at the ventral side of female genitalia. It is a novelty and an alternative system to the spermathecae present in a vast majority of Diptera, and insects in general. Among the Diptera the ventral receptacle is present in the families of Brachycera Acalyptrata only (e.g., NONIDEZ 1920; STURTEVANT 1925, 1926); the trichoceriid subgenus *Staryia* is the only taxon among the Diptera Nematocera known to date in which the ventral receptacle is present (for further reading on evolution and importance of the ventral receptacle see: PITNICK et al. 1999, KOTRBA & MATHIS 2009).

Below there are two new species of *Staryia* described, based on females: *T.* (*St.*) *dufouri*, n. sp. from Switzerland, and *T.* (*St.*) *muelleri*, n. sp. from Sweden and Finland. A female of the latter species has been probably described previously as a female of *Trichocera* (*Metatrichocera*) *gigantea* DAHL 1967. This mistake was easy to make, as both species have wings with distinct spot on r-m, and may be sampled together, as is listed in the original description, and herein. The female of *T.* (*M.*) *gigantea* is here described based on the specimens from a Siberian locality in Yakutia (current name: Sakha Republic of the Russian Federation).

II. MATERIAL AND METHODS

The females of the first new species were found among a large collection of Trichoceridae collected in Switzerland in 1980' by Christophe DUFOUR and Willy GEIGER from the Musée National d'histoire naturelle, Neuchâtel, Switzerland. The females of the second new species belong to a large collection of Trichoceridae from north of Sweden gathered by Christine DAHL and Karl MÜLLER in years 1970-1980, now deposited in the ISEA. From the same collection come the males of *Trichocera gigantea*. Asiatic specimens of this species were collected by Vladimir ZHERIKHIN in 1990, in Yakutia, at Aldan River near Dzhebarika-Kaya.

The genitalia of specimens were prepared as described by KRZEMIŃSKA & GORZKA (2016), but the durance of soak in NaOH was much shorter, 2-4 hrs.

Institutional abbreviations

ISEA – Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków, Poland

MNHN – Musée National d'histoire naturelle, Neuchâtel, Switzerland

III. SYSTEMATIC PART

Family: **Trichoceridae** RONDANI, 1941

Tribe: **Trichocerini** RONDANI, 1941

Genus: ***Trichocera*** MEIGEN, 1803

Subgenus: ***Staryia*** KRZEMIŃSKA & GORZKA, 2016

The diagnosis of this subgenus was provided by KRZEMIŃSKA & GORZKA (2016) and remains unchanged.

Type species: *Trichocera* (*Staryia*) *altipons*, STARÝ, 1998. Other species included, together with changes introduced herein: *T.* (*St.*) *basidens* STARÝ, 1998; *T.* (*St.*) *christinae* KRZEMIŃSKA & GORZKA, 2016; *T.* (*St.*) *dufouri*, n. sp.; *T.* (*St.*) *geigeri* STARÝ & KRZEMIŃSKA, 2000; *T.* (*St.*) *muelleri*, n. sp.; *T.* (*St.*) *polanensis* STARÝ, 2002; *T.* (*St.*) *rannanenae* KRZEMIŃSKA & GORZKA, 2016; *T.* (*St.*) *rectistylus* STARÝ, 1998; *T.* (*St.*) *transversa* STARÝ, 1998, *T.* (*St.*) *villosa* STARÝ, 2009; *T.* (*St.*) *viramoi* KRZEMIŃSKA & GORZKA, 2016.

Trichocera (***Staryia***) ***dufouri***, n. sp.

Fig. 1

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D i a g n o s i s. Antennae of medium length; flagellomeres oval, with soft verticils only c. twice exceeding length of pubescence. Thoracic pleura bare. Female: ovipositor bent to ventral side at angle close to 80°; tergite 9 with an outgrowth; a desclerotized roundish patch is visible in lateral view formed by incisions of sternite 8 and tergite 8. Genital plate short, apex round, proximal margin straight; supragenital plate broad but very short, subtriangular, with two bristles; ventral receptacle large, elongated, rounded at proximal apex. Male unknown.

C o m p a r i s o n. The female of a new species is similar to *T.* (*St.*) *altipons*, and differs in an outgrowth of the tergite 9 and by the seminal receptacle which is endowed with musculature.

E t y m o l o g y. A new species name is dedicated to Christophe DUFOUR, a friend and the long lasting Head of the Musée National d'histoire naturelle in Neuchâtel. I owe Him the possibility of studying the large collection of Swiss Trichoceridae, in great part collected by himself, including these remarkable specimens of a rare subgenus.

M a t e r i a l e x a m i n e d. Holotype: female MHNN_65.6377, Switzerland, ZH (Canton Zurich); Birmensdorf, Rameren; alt. 560 m; Pt 676,750/246, 300; 13-19.X. 1980. (coll. C. DUFOUR, W. GEIGER; MNHN); paratype female, same data (housed in ISEA).

D e s c r i p t i o n. Antennae (Fig. 1A): initial flagellomeres are oval; f1 twice as long as pedicel, and 1.5x f2; verticils are soft and only twice as long as pubescence. Thoracic pleura without setae. Wing (Fig. 1B): rather broad; R2+3+4 is almost twice as long as R3+4 in the holotype, but barely longer in the paratype; cell m1 is medium (twice dM1+2).

Female genitalia (Fig. 1C-J): ovipositor short, straight, subtriangular, bent to ventral side at angle close to 80°; apex obtuse; setulose area is large and round, but not delimited by a suture. There is an intraspecific difference in shape of the ovipositor between the holotype and the paratype, see Fig. D-E. The tergite 9 has a distinct outgrowth which retains its shape after preparation (*ou*, Fig. 1C, D, J); a desclerotized roundish patch visible in lateral view is formed by incisions of sternite 8 and tergite 8 (Fig. 1C, D). The genital plate (Fig. 1G-H) is short, with round apex and the proximal margin straight; the apodeme (fork) is detached from the plate, as in the subgenus, short and massive, as in Figs 1C, H, I. The supragenital plate is broad but very short axially, subtriangular, with two bristles; the ventral receptacle (Fig. 1H-I) is long, at

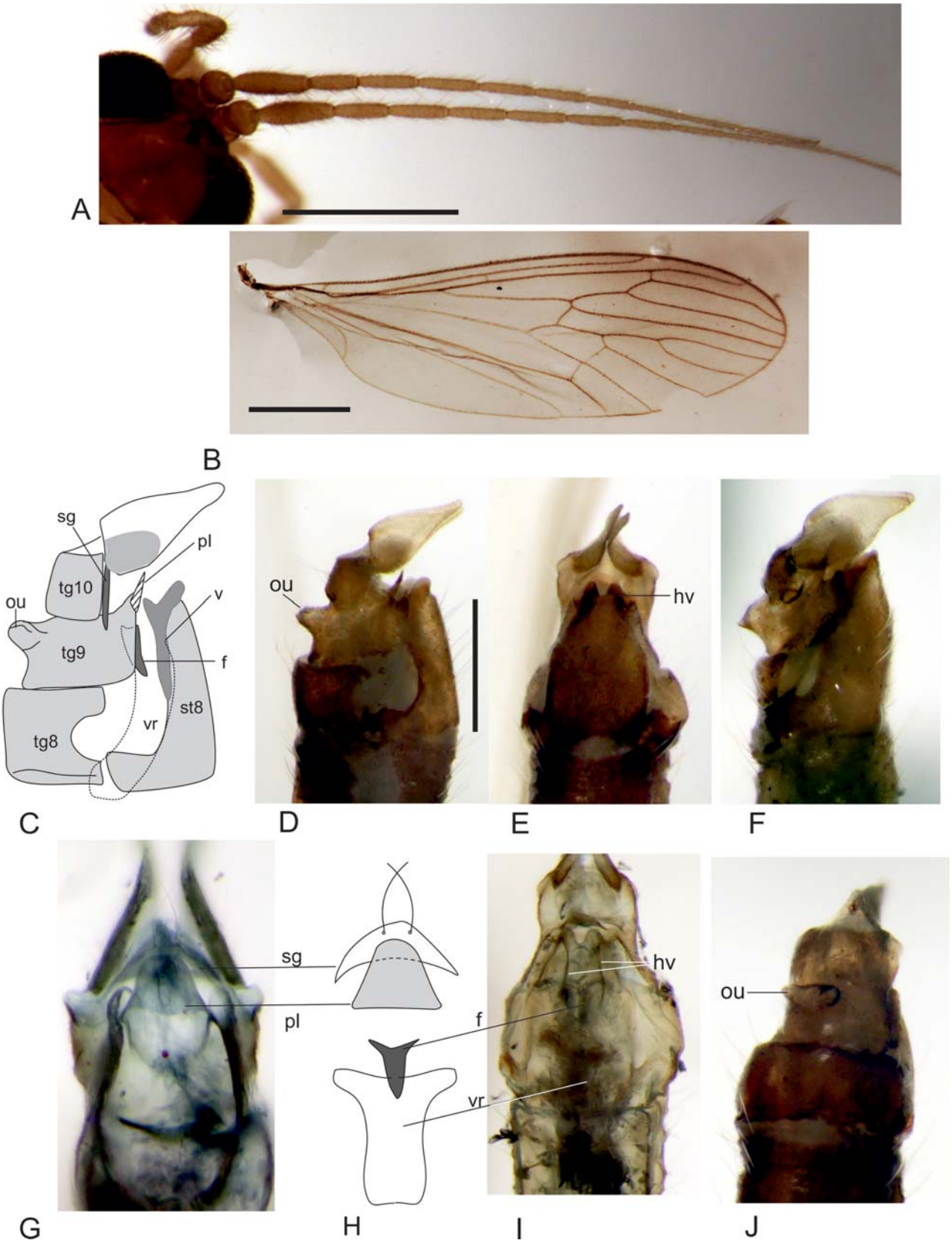

Fig. 1. *Trichocera* (*Starvia*) *dufouri*, n. sp., female, holotype # MHNN_65.6377, Switzerland, (A, B, D, F, J) and paratype (E, G, I). A, antenna; B, wing; C-I, genitalia: scheme laterally (C), variation in ovipositor' shape (D, E); hypogynial valves in ventral view (F); subgenital and genital plate (G), scheme of internal genitalia (H); ventral receptacle (vr) (I); outgrowth (ou) on tergite 9 in dorsolateral view (J). Scale bars: A, B – 1 mm; D – 0.5 mm.

least partially endowed with musculature visible as the assemblage of blackish thin springs in Fig. 1I (the colour comes from a black dye, chlorazol black E). Spermathecae absent.

Male unknown.

Trichocera (*Staryia*) *muelleri*, n. sp.

Fig. 2

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D i a g n o s i s. Wings with spots on r-m. Antennae: initial flagellomeres in female are greatly expanded. Ovipositor massive, short, downcurved, ending sharp; hypogynial valves stiff, detracted from ovipositor's base; genital plate reduced as in subgenus; genital fork short; spermathecae absent.

E t y m o l o g y. A new species name is dedicated to its collector, Karl MÜLLER.

C o m p a r i s o n. The female may at the first sight resemble *T. regelationis* L., 1758, by the spots on wing, dilated first flagellomeres, and a curved, sharp ending ovipositor, but is easily discerned by the hypogynial valves not adherent to the ovipositor's base.

M a t e r i a l e x a m i n e d. Holotype female: Sweden, Messauregruppen, Abisko 4-11.08.1975 (coll. K. MÜLLER). Paratype female: Finland, Ks Kuusamo, 29.08.1983 (coll. J. VIRAMO). Both specimens housed in ISEA.

A d d i t i o n a l d e s c r i p t i o n. The genitalia of a female show all characters of the subgenus. The ovipositor may be more narrow at base than that shown in Fig. 2G. The hypogynial valves are stiff and prominent; between them and the ventral base of ovipositor there is a distinct gap visible even without aid of a microscope; in this gap the apical portion of genital plate is protruding (Fig. 2G). Lateral portions of the valves are very wide, thin and poorly sclerotized, but ending with round structures (Fig. 2D-F). Inner genitalia are very similar to those previously described in, e.g., *T.* (*St.*) *altipons*, *T.* (*St.*) *viramoi*, *T.* (*St.*) *rannanenae* and *T.* (*St.*) *dufouri*, n. sp. The plate is short and reduced to a narrow curved plate, slightly incised at apex. There is no connection between the plate and the fork (at least such connection is not visible after preparation). The fork is delicate and short; in ventral view its apical funnel-like part makes appearance of being divided into two teeth (Fig. 2I). The supragenital plate is triangular, wide, with two bristles closely set. The ventral receptacle is wide and long, protruding into segment 7, probably provided with musculature (the remnants of which are visible as black thin springs in Fig. 2E). Spermathecae are absent.

Trichocera (*Metatrichocera*) *gigantea* DAHL, 1967

Fig. 3

Trichocera (*Metatrichocera*) *gigantea* DAHL, 1967: Opusc. ent. 32 (Lund).

D i a g n o s i s. Wings with spots on r-m. Antennae: flagellomeres cylindrical, thin and long. Genitalia, male: sternite 9 expanded into large, tubular projection dilated laterally at end; gonocoxites baloon-like; gonostyles narrow, with a basal process almost as long as remainder of gonostylus and directed to inside; aedeagal sheath with parameres thin, short, lateral apodemes long, narrow, basal apodemes long and wide. Female: ovipositor slender, longer than genital segment, gently curved at midlength. Genital plate heart-like incised, two „prongs" of fork are short, massive. Supragenital plate with two bristles.

C o m p a r i s o n. The female is very similar to *T.* (*M.*) *mackenziei* DAHL, 1967 (see KRZEMIŃSKA & GORZKA 2016: fig. 1C, D) in having a long ovipositor and a similar genital plate; in the latter the extensions of genital fork seem to be longer. The main difference between both species is a spotted wing in *T.* (*M.*) *gigantea*. Incidentally, the males of these species are also similar; their genitalia differ mainly by the shape of a large projection of sternite 9 (the male of *T.* (*M.*) *mackenziei* is illustrated in DAHL, 1967: figs 12-14).

M a t e r i a l e x a m i n e d. Yakutia (current name: Sakha Republic of the Russian Federation): Aldan River near Dzhebarika-Kaya, 27.08.1990 (leg. V. ZHERIKHIN) – 2 m, 1f. Sweden: Messaure, Kaltisjokk, 3-10.09.1973 – 15 m, 8-15.10.1973 – 8 m (coll. Ch. DAHL). Finland: Ks Kuusamo, 29.08.1983 – 1 m (coll. J. VIRAMO).

A d d i t i o n a l d e s c r i p t i o n. Wings with spots on r-m and darker clouds on m-cu (Fig. 3A, B). Antennae (Fig. 3C, D): flagellomeres of male are cylindrical, very thin and long; in female initial flagellomeres are slightly expanded; pubescence short, verticils are only up to twice longer and distributed over entire area of flagellomeres. Ovipositor (Fig. 3E) is slender, c. 1.5x as long as genital segment, gently curved at midlength. Setulose area only mildly convex, short. Sternite 8 with flat, narrow hypogynial valves (Fig. 3G). Genital plate (Fig. 3F) heart-like incised, fork long, apically divided into two teeth which are short, massive, and exposed outside. Supragenital plate with two bristles. Three small spermathecae with ducts as long as diameter and curved pararelly to spermathecal surface.

The male genitalia have been detailly described and illustrated by DAHL (1967: fig. 15-19), and the main characters are listed in the diagnosis herein. The males from Yakutia do not differ from those from Scandinavia; most probably the distribution of this species is continuous across the northern regions of Eurasia, from Scandinavia to the Far East of Asia.

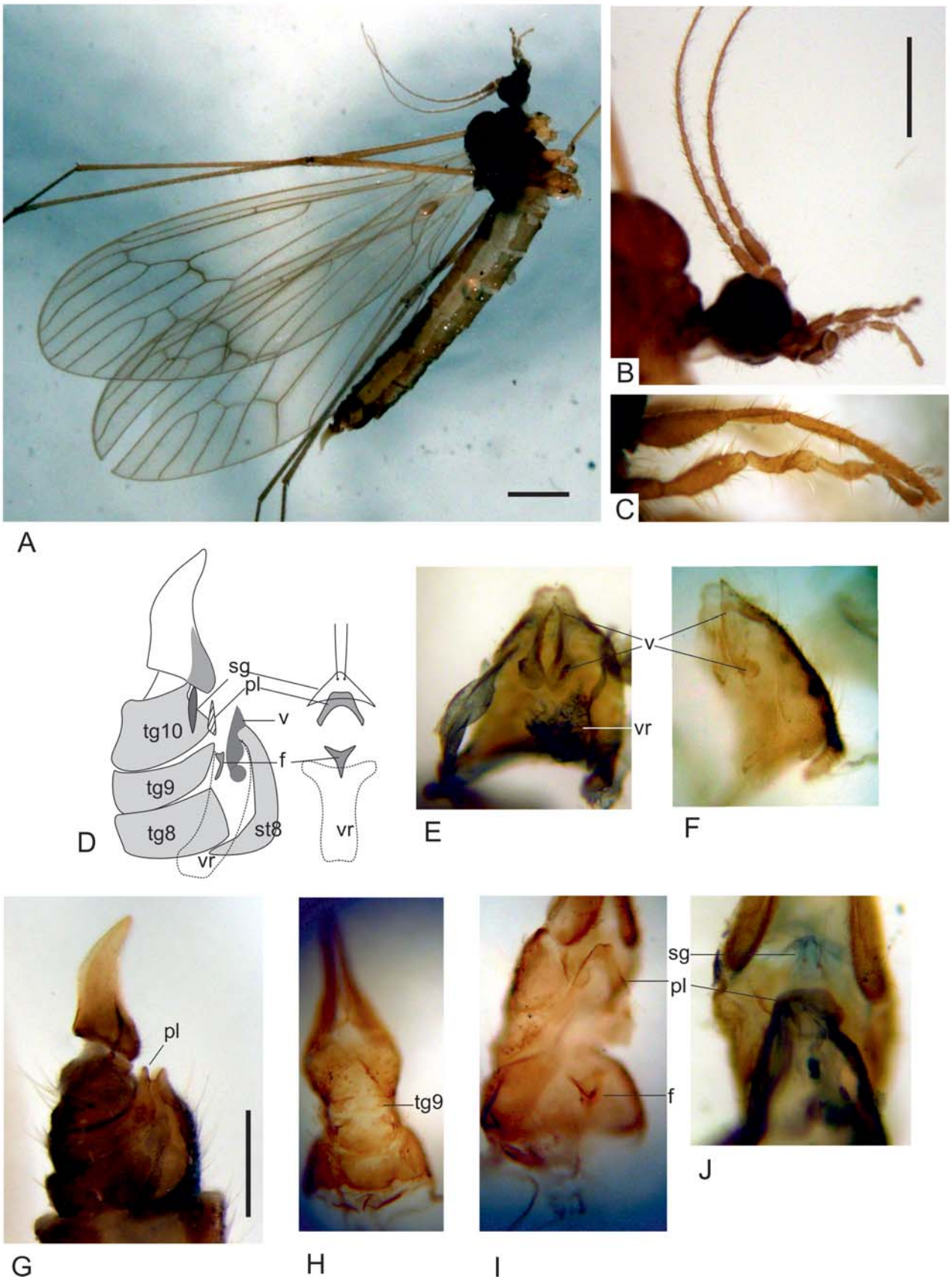

Fig. 2. *Trichocera* (*Staryia*) *muelleri*, n. sp., paratype female (Finland: Ks Kuusamo, 29.08.1983). A, habitus; B, head; C, basal flagellomeres (upper) and palpus (lower) magnified; D, explanatory drawing of genitalia in lateral view (left) and inner genitalia in ventral view (right); E-F, sternite 8 and hypogynial valves in apical (E) and lateral views (F); G, genitalia in lateral view; H, tergites 8-10; I, genital plate and fork; J, subgenital plate. Abbreviations as in Fig. 1. Scale bars: A, B – 1 mm; G – 0.5 mm.

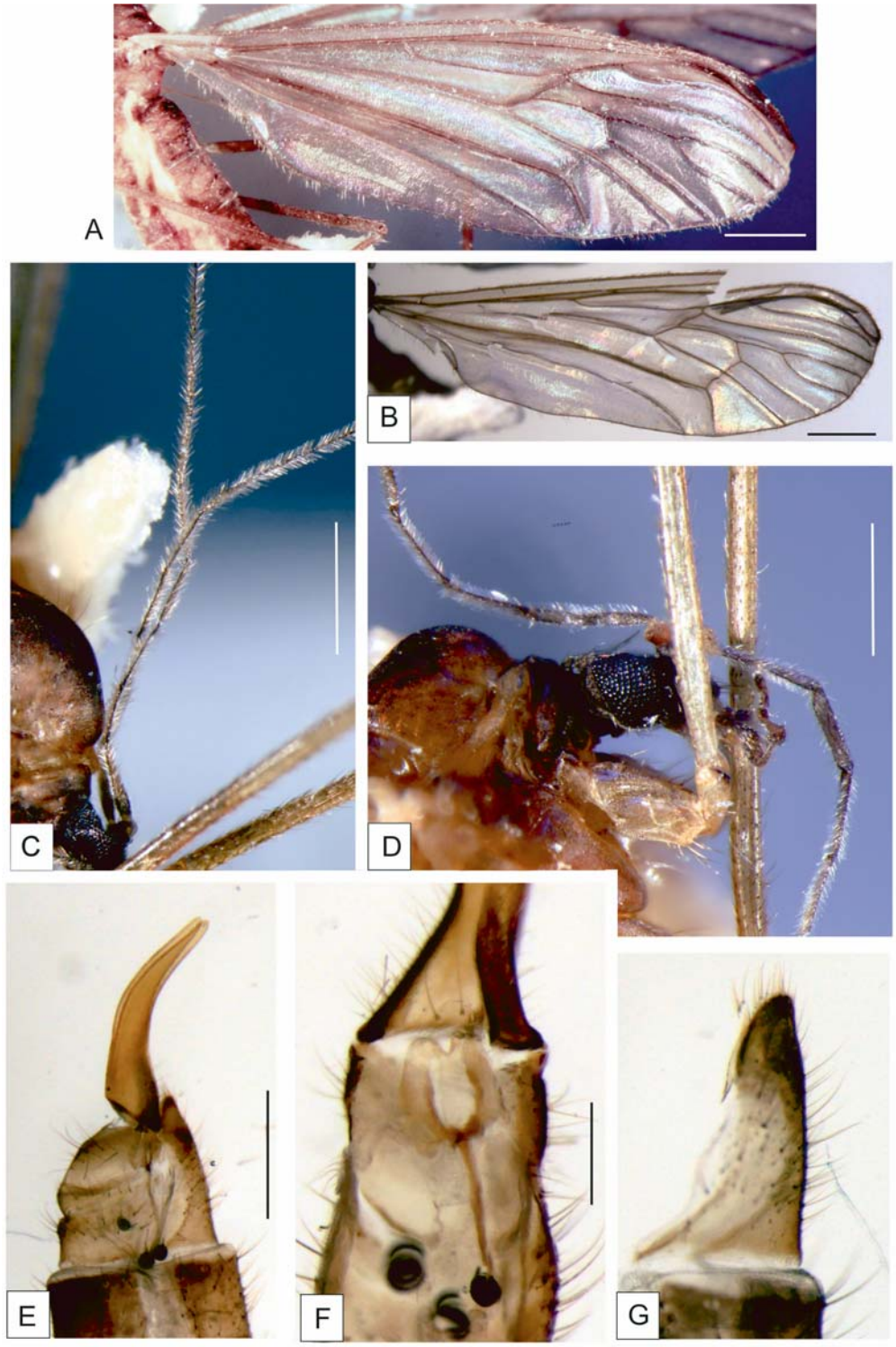

Fig. 3. *Trichocera* (*Metatrichocera*) *gigantea* DAHL, 1967 (Yakutia, Aldan river n. Dzhebarika-Kaya). A, B, wings of female and male, resp.; C, D, basal flagellomeres of female and male, resp. E-G, female genitalia: ovipositor (E), genital plates (F), and sternite 8 (G). Scale bars: A, B – 1 mm; C, D, E – 0.5 mm; F – 0.2 mm.

IV. DISCUSSION

The subgenus *Staryia* is still poorly known, and the specimens are difficult to find, therefore every new species merits a description even if based on one sex only. *Trichocera* (*Staryia*) *dufouri*, n. sp. belongs to a group of species with ovipositor fixed in a bent position: *T.* (*St.*) *altipons*, *T.* (*St.*) *rectistylus* and *T.* (*St.*) *villosa*. The male of this new species remains unknown. From Switzerland there is described *T.* (*St.*)

geigeri STARÝ & KRZEMIŃSKA (2000), based on a male only. It shows some resemblance to a female of *T.* (*St.*) *dufouri* in the soft setation of antennae; proportions of initial flagellomeres are different, therefore I have decided to describe this new species based only on a female.

Trichocera (*Staryia*) *muelleri*, n. sp. can easily be ascribed to *Trichocera* (*Metatrichocera*) *gigantea*; both species are large and both have spotted wings. This mistake was probably committed by DAHL (1967: figs 28-31; the ovipositor is here very similar to that of *T.* (*St.*) *muelleri*, n. sp., although the pictured genital plate is of usual shape; no mention on spermathecae is made). I was also close to repeat this misclassification; fortunately, the sample of specimens of *T.* (*M.*) *gigantea* from Yakutia allowed me to identify the female of this species.

The adequate way to confirm the identity of specimens would be the molecular analysis; however, specimens come from old collections, and Scandinavian collections have been stored in (probably) 70% alcohol for c. 50 years. Therefore, the morphological comparison remains at present the only available method of identification until the fresh specimens are collected.

V. CONCLUDING REMARKS

Staryia is the only known group of species among the Diptera Nematocera which had evolved the ventral receptacle in place of spermathecae, and therefore offers an interesting case of parallel evolution in the lower and higher Diptera (KRZEMIŃSKA & GORZKA 2016). The advantage of a ventral receptacle is an enhanced control of a female over the genetic material provided by a male. According to PITNICK et al. (1999) this control is executed by following means:

– the receptacle allows to collect more sperms than the spermathecae;

– in the receptacle the sperms are kept straightened "in better order", and not randomly twisted as they are inside the spermathecae;

– many receptacles have muscular walls that may be used for controlled expulsion of sperms; these muscles are much more powerful than the musculature surrounding the short sections of spermathecal ducts.

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