

# The Tipulidae and Limoniidae of Greenland (Diptera, Nematocera, Craneflies)

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Artiklen rummer et overblik over stankelben-familierne Tipulidae og Limoniidae i Grønland. Der kendes seks arter af fam. Tipulidae; den ene af disse, *Tipula (Arctotipula) besseloides* Alexander, 1919, er en ny art for Grønland. *Tipula (Arctotipula) thulensis* Alexander, 1946 og *Tipula (Arctotipula) epios* Alexander, 1969 bliver betragtet som nye synonymer af *T. besseloides*; *Tipula (Vestiplex) nigrocorpis* Doane, 1912 som et nyt synonym for *Tipula (Vestiplex) arctica* Curtis, 1835. Af de 11 arter af Limoniidae er de tre nye arter for Grønland: *Symplecta (Symplecta) sheldoni* (Alexander, 1955), *Symplecta (Symplecta) sunwapta* (Alexander, 1952), og *Dactylolabis (Dactylolabis) rhicnoptiloides* (Alexander, 1919).

En illustreret nøgle omfatter alle de nævnte arter, synonymer og referencer samt et fundkort for Grønland. Desuden gives oplysninger om flyveperiode, udbredelse, habitat og biologi samt andre relevante oplysninger.

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## Abstract

An overview is presented of the Tipulidae and Limoniidae (Diptera, Nematocera, Craneflies) of Greenland. Six species of Tipulidae are known. One of them, *Tipula (Arctotipula) besseloides* Alexander, 1919, is new to Greenland. *Tipula (Arctotipula) thulensis* Alexander, 1946 and *Tipula (Arctotipula) epios* Alexander, 1969 are treated as new synonyms of *besseloides*; *Tipula (Vestiplex) nigrocorpis* Doane, 1912 as a new synonym of *Tipula (Vestiplex) arctica* Curtis, 1835. Of the 11 species of Limoniidae, three are new to Greenland: *Symplecta (Symplecta) sheldoni* (Alexander, 1955), *Symplecta (Symplecta) sunwapta* (Alexander, 1952), and *Dactylolabis (Dactylolabis) rhicnoptiloides* (Alexander, 1919).

An illustrated key for all species is given, as well as for each species the relevant synonymy and references, the Greenland localities including a distribution map, the period of flight, the general distribution, the habitat and biology, and as far as relevant information on other topics.

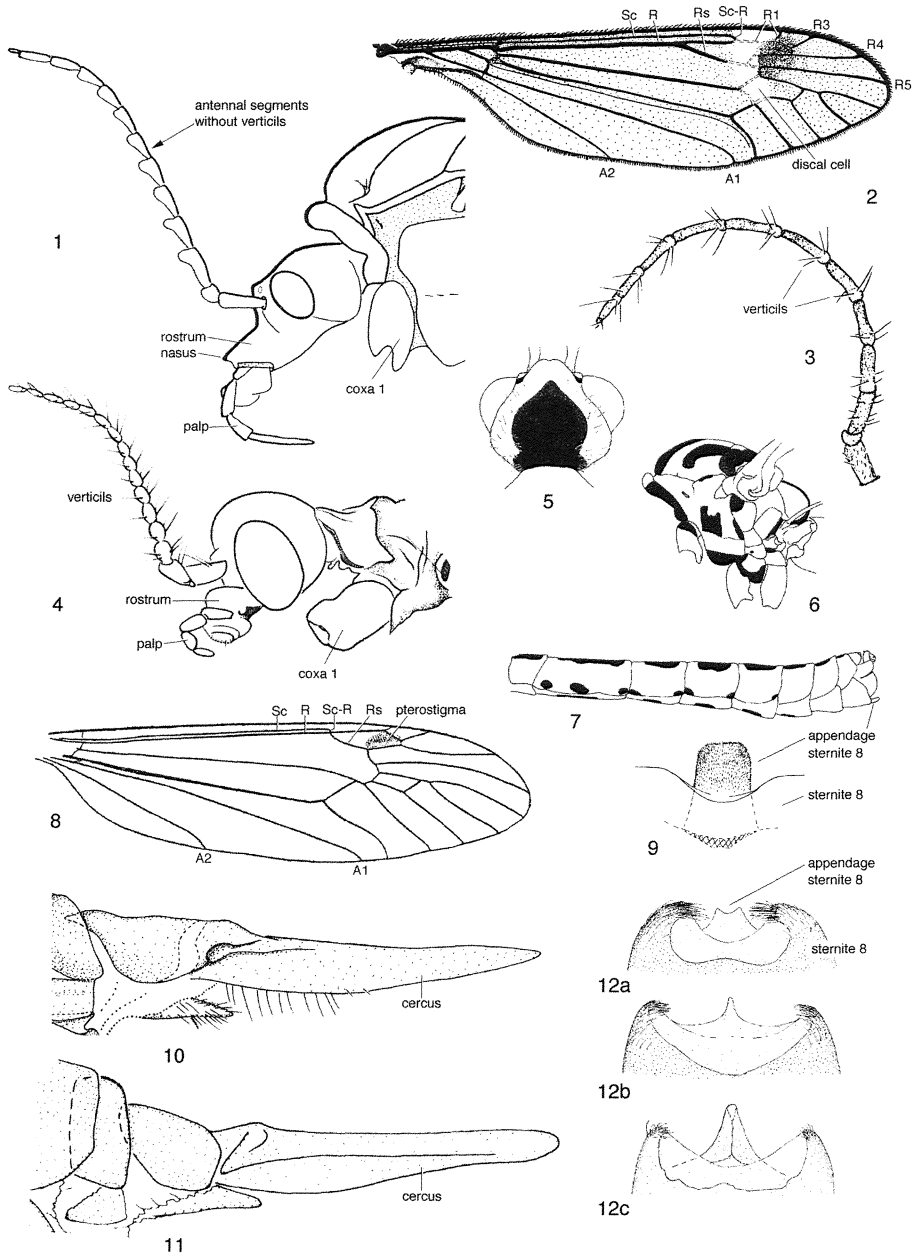


Fig. 1. antenna and head male *Prionocera* spec.; 2. wing *Prionocera* spec.; 3. antenna male *Nephrotoma flavescens*; 4. antenna and head male *Erioconopa trivialis*; 5. head *Nephrotoma flavescens*, dorsal view; 6. thorax *Nephrotoma flavescens*, lateral view; 7. abdomen male *Nephrotoma flavescens*, lateral view; 8. wing *Nephrotoma flavescens*; 9. sternite 8 male *Nephrotoma flavescens*, ventral view; 10. cercus female *Nephrotoma flavescens*, lateral view; 11. cercus female *Nephrotoma lundbecki*, lateral view; 12. sternite 8 male *Nephrotoma lundbecki*, ventral view, a-c showing variability of especially the medial appendage (1, 2: Brodo 1987; 3, 5-10: Oosterboek 1978; 4: Dienske 1987; 11, 12: Oosterboek 1979).

## Introduction

The families Tipulidae and Limoniidae belong to the superfamily Tipuloidea, together with the families Pediciidae and Cylindrotomidae. Since Stary (1992), it has become general usage to recognize four families, although some workers retain the concept of one family, Tipulidae (e.g., Byers 1992).

The Tipuloidea differ from other Nematocera by lacking ocelli, having a V-shaped mesonotal suture, and having two anal veins reaching the hind margin of the wing. Worldwide more than 15.000 species have been described. Information on these species is available online from <http://www.science.uva.nl/zma/> or <http://ip30.eti.uva.nl/ccw/>.

The Tipulidae fauna of Greenland comprises six species including older and single records for two species. Of the Limoniidae, 11 species are known, including one species only known from a single old record. As far as is known, the families Pediciidae and Cylindrotomidae are not represented in Greenland.

The first records of Greenland Tipulidae were by Otto Fabricius, who in 1780 mentioned four species of *Tipula*. One of these, *Tipula rivosa* Linnaeus, most probably refers to *Tipula arctica* Curtis; the other three belonging to non-tipuloid families (Lundbeck 1901). The Tipuloidea recorded or described from Greenland since 1780 were enumerated by Henriksen & Lundbeck (1918) and Henriksen (1939), and have been reviewed in more detail by Mannheims & Theowald (1971). Since then, as far as we know, only two papers have been published with new collecting data for Tipuloidea, namely Cotton (1979) and Messersmith (1982), both only mentioning *Tipula arctica*.

Mannheims & Theowald (1971) deals with 12 species, and this is taken as the starting point for the present survey, which includes the following 17 species:

### Tipulidae

1. *Prionocera* spec., in Mannheims & Theowald (1971) as *Prionocera parrii* (Kirby, 1824)
2. *Nephrotoma flavescens* (Linnaeus, 1758)
3. *Nephrotoma lundbecki lundbecki* (Nielsen, 1907)
4. *Tipula* (*Arctotipula*) *besselsi besselsi* Osten Sacken, 1877
5. *Tipula* (*Arctotipula*) *besseloides* Alexander, 1919; **new for Greenland**
6. *Tipula* (*Vestiplex*) *arctica* Curtis, 1835

### Limoniidae

1. *Ormosia* (*Ormosia*) *affinis* (Lundbeck, 1898)
2. *Ormosia* (*Ormosia*) *fascipennis* (Zetterstedt, 1838)
3. *Ormosia* (*Ormosia*) *subnubila* Alexander, 1920
4. *Rhabdomastix caudata* (Lundbeck, 1898)
5. *Symplecta* (*Symplecta*) *hybrida* (Meigen, 1804); recorded here again for Greenland
6. *Symplecta* (*Symplecta*) *scotica* (Edwards, 1938)
7. *Symplecta* (*Symplecta*) *sheldoni* (Alexander, 1955); **new for Greenland**
8. *Symplecta* (*Symplecta*) *sunwapta* (Alexander, 1952); **new for Greenland**
9. *Dactylolabis* (*Dactylolabis*) *rhicnoptiloides* (Alexander, 1919); **new for Greenland**
10. *Dicranomyia* (*Dicranomyia*) *modesta* (Meigen, 1818)
11. *Dicranomyia* (*Idiopyga*) *piscataquis* (Alexander, 1941)

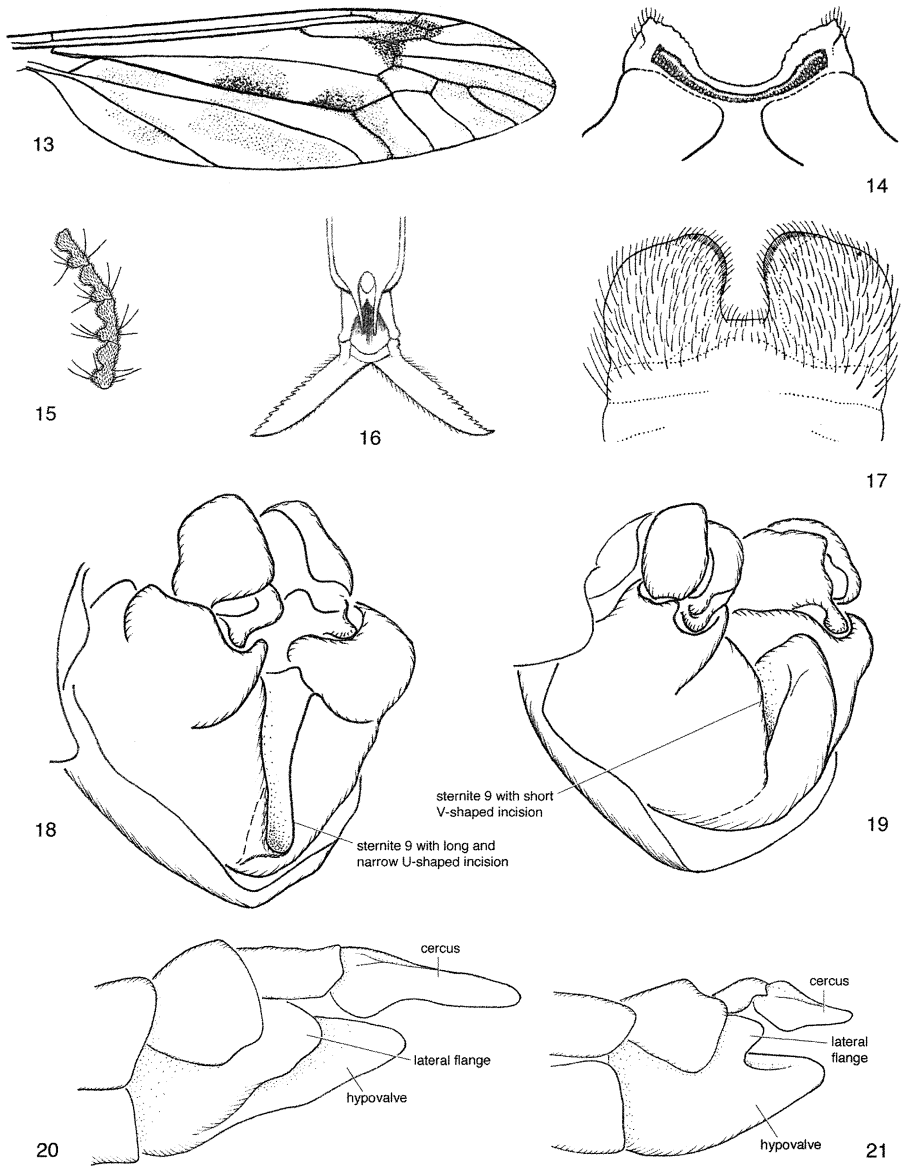


Fig. 13. wing *Tipula (Vestiplex) arctica*; 14. male tergite 9 *T. (V.) arctica*, dorsal view; 15. antennal segments 4-7 male *T. (V.) arctica*; 16. cerci *T. (V.) arctica*; 17. male tergite 9 *Tipula (Arctotipula) besselsi besselsi*, dorsal view; 18. hypopygium *T. (A.) besselsoides*, oblique-rear view; 19. hypopygium *T. (A.) b. besselsi*, oblique-rear view; 20. ovipositor *T. (A.) besselsoides*, lateral view; 21. ovipositor *T. (A.) b. besselsi*, lateral view (13: Alexander 1919; 14, 15: Savchenko 1964; 16: Curtis 1835; 17: Mannheims 1953; 18-21: original Pjotr Oosterbroek).

## Key to species

- 1 Antenna with more than 10 segments; flagellar segments (all segments beyond the second) rather uniform (Figs 1, 3, 4). Upper part of head (vertex) without ocelli. 2 anal veins reaching the hind margin of the wing (Figs 2, 8). Mesonotum with V-shaped transverse suture. **Tipuloidea: Tipulidae and Limoniidae – 2**  
– Combination of characters not as given above. **Non-Tipuloidea**
- 2 Rostrum and palpus well developed, rostrum sometimes with nasus (Fig. 1). Larger species, bodylength 9 mm or (usually) more. **Tipulidae – 3**  
– Rostrum and palpus short, rostrum without nasus (Fig. 4). Smaller species, bodylength usually about 5 mm, only in *D. rhinoptiloides* larger and in some specimen even slightly beyond 9 mm. **Limoniidae – 8**
- 3 Flagellar segments (all antennal segments beyond the second) with verticils (several thin but strong bristles at the basal part of the segment); flagellar segments rounded and basally thickened (Fig. 3), or kidney shaped (Fig. 15), but not serrate. **4**  
– Flagellar segments without verticils and serrate (Fig. 1). **Prionocera spec.**
- 4 Vein Rs short, arising more or less opposite crossvein Sc-R, which connects vein Sc with vein R (Fig. 8). **Genus Nephrotoma – 5**  
– Vein Rs longer, arising more toward the wingbase with respect to crossvein Sc-R (Fig. 2). **Genus Tipula – 6**
- 5 Head, thorax and abdomen largely yellow with dark brown markings; lateral stripes on dorsal thorax outcurved at front end, outcurved part dull or velvety; abdomen with narrow dorsal stripe and lateral spots (Fig. 5-7). Hind margin of male sternite 8 simple, centrally with rectangular appendage, which is set with short strong setulae (Fig. 9). Female cercus tapering to a pointed tip (Fig. 10). **Nephrotoma flavescens**  
– Body largely light to dark brown with grey pruinosity, especially on thorax and abdomen; outcurved part of black dorsal thoracic stripes shiny; abdomen with broad dorsal and lateral stripes. Hind margin of male sternite 8 concave, lateral corners provided with incurved bristles, centrally with an appendage of variable shape but without short strong setulae (Fig. 12). Female cercus with blunt tip (Fig. 11). **Nephrotoma lundbecki lundbecki**
- 6 Wing with conspicuous markings (colourplate; Fig. 13). Dorsal thoracic stripes separated by (at least traces of) brown. Male antennal segments 4-11 kidney-shaped (Fig. 15). Male tergite 9 with a broad saucer-shaped sclerotized plate (Fig. 14). Female ovipositor as in Fig. 16, cercus serrate, hypovalve without lateral flanges but with short, narrow, flexible tips. **Tipula (Vestiplex) arctica**  
– Wing with a light brown tinge and without markings except for pterostigma. Dorsal thoracic stripes separated by lighter grey. Male antennal segments simple (more or less as in Fig. 4). Male tergite 9 emarginate distally, forming two distal lobes (Fig. 17). Female with cercus not serrate and hypovalve broadly rounded distally and with lateral flanges (Figs 20, 21). **Tipula (Arctotipula) – 7**
- 7 Nasus present. Two halves of male sternite 9 separated by a long narrowly U-shaped incision that ends near the hind margin of sternite 8 (Fig. 18). Female cercus relatively short; lateral flanges of hypovalvae lying next to the dorsal margin of hypovalvae (Fig. 20). **Tipula (Arctotipula) besseloides**

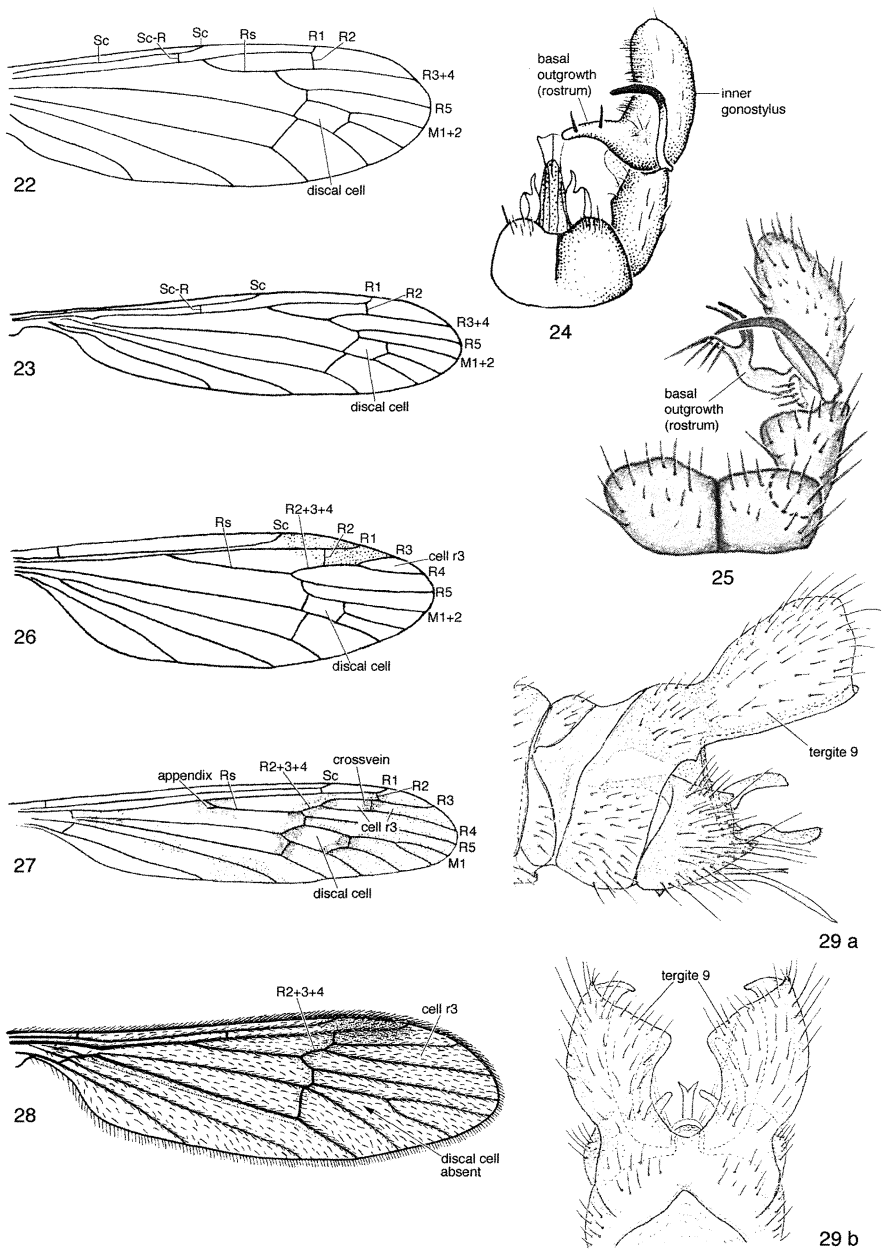


Fig. 22. wing *Dicranomyia (Dicranomyia) modesta*; 23. wing *Dicranomyia (Idiopyga) piscataquis*; 24. hypopygium *D. (D.) modesta*, dorsal view; 25. hypopygium *D. (I.) piscataquis*, dorsal view; 26. wing *Rhabdomastix caudata*; 27. wing *Dactylolabis (Dactylolabis) rhicnoptuloides*; 28. wing *Ormosia (Ormosia) affinis*; 29. hypopygium *O. (O.) affinis*, a. lateral view, b. dorsal view (22: Dienske 1987; 23: Lackschewitz 1964; 24: Geiger 1986; 25: Nielsen 1951; 26: Mannheims & Theowald 1971; 27: Alexander 1919; 28: Alexander & Byers 1981; 29 a&b: Tjeder 1970).

- Nasus absent. Two halves of male sternite 9 separated by a V-shaped incision that ends at some distance from the hind margin of sternite 8 (Fig. 19). Female cercus very short; lateral flanges of hypovalvae lying above the dorsal margin of hypovalvae (Fig. 21). **Tipula (Arctotipula) besselsi besselsi**
  
- 8 Three R-veins reach the margin of the wing (in the section between veins Sc and M1+2 these are R1, R3+4 and R5; Figs 22, 23). **Genus Dicranomyia – 9**
- Four R-veins reach the margin of the wing (in the section between veins Sc and M1 or Sc and M1+2 these are R1, R3, R4 and R5; Wing figs 26-35). 10
  
- 9 Thorax yellow to orange brown, with a distinct darker coloured median stripe dorsally that continues over the neck. Wing with Sc-R about its length before origin of Rs as in Fig. 22. Male terminalia: basal outgrowth of inner (ventral) gonostylus, so-called rostrum, simple, bearing spines at outer margin (Fig. 24). **Dicranomyia (Dicranomyia) modesta**
- Thorax brown and pruinose, dorsal stripe hardly indicated. Wing with Sc-R approximately the length of Rs before origin of Rs as in Fig. 23. Male terminalia: basal outgrowth of inner gonostylus with two long spines at outer margin and series of bristles or finer setae at inner margin (Fig. 25). **Dicranomyia (Idiopyga) piscataquus**
  
- 10 Vein R2+3+4 as long or longer than vein R3 (Fig. 26). **Rhabdomastix caudata**
- Vein R2+3+4 much shorter than vein R 3 (Wing figs 27-35). 11
  
- 11 Vein Rs with an appendix, so-called spur, at basal deflection (Fig. 27). Head, legs and dorsal thorax set with short black spines, on dorsal thorax in two rows. **Dactylolabis (Dactylolabis) rhicnoptiloides**
- Vein Rs without appendix (Wing figs 28-35). No short black spines on head, legs and thorax. 12
  
- 12 Wing membrane with numerous macrotrichia; cell r3 without crossvein (Figs 28, 30, 32). **Genus Ormosia – 13**
- Wing membrane without numerous macrotrichia, setae sometimes present on the veins only; cell r3 with crossvein (Figs 34, 35). **Genus Symplecta – 15**
  
- 13 Discal cell absent (Fig. 28). Male tergite 9 conspicuously enlarged (Fig. 29). **Ormosia (Ormosia) affinis**
- Discal cell present (Figs 30, 32). Male tergite 9 small (Figs 31, 33). 14
  
- 14 Discal cell small and distinctly shorter than vein CuA1 (Fig. 30). Male terminalia: inner gonostylus simple (Fig. 31). **Ormosia (Ormosia) fascipennis**
- Discal cell large and as long or longer than vein CuA1 (Fig. 32). Male terminalia: inner gonostylus provided with strong short spines at excavated inner margin (Fig. 33). **Ormosia (Ormosia) subnubila**
  
- 15 Discal cell asymmetrical, with cell m1+2 considerably shorter than cell m3; crossvein Sc-R not close to origin of Rs, mostly placed rather far beyond, often nearly at half length of Rs; A2 strongly sinuous distally (Fig. 34). **Symplecta (Symplecta) hybrida**
- Discal cell not as above, cell m1+2 and cell m3 of about equal length; crossvein Sc-R mostly placed close to origin of Rs; A2 less sinuous distally (Fig. 35). 16

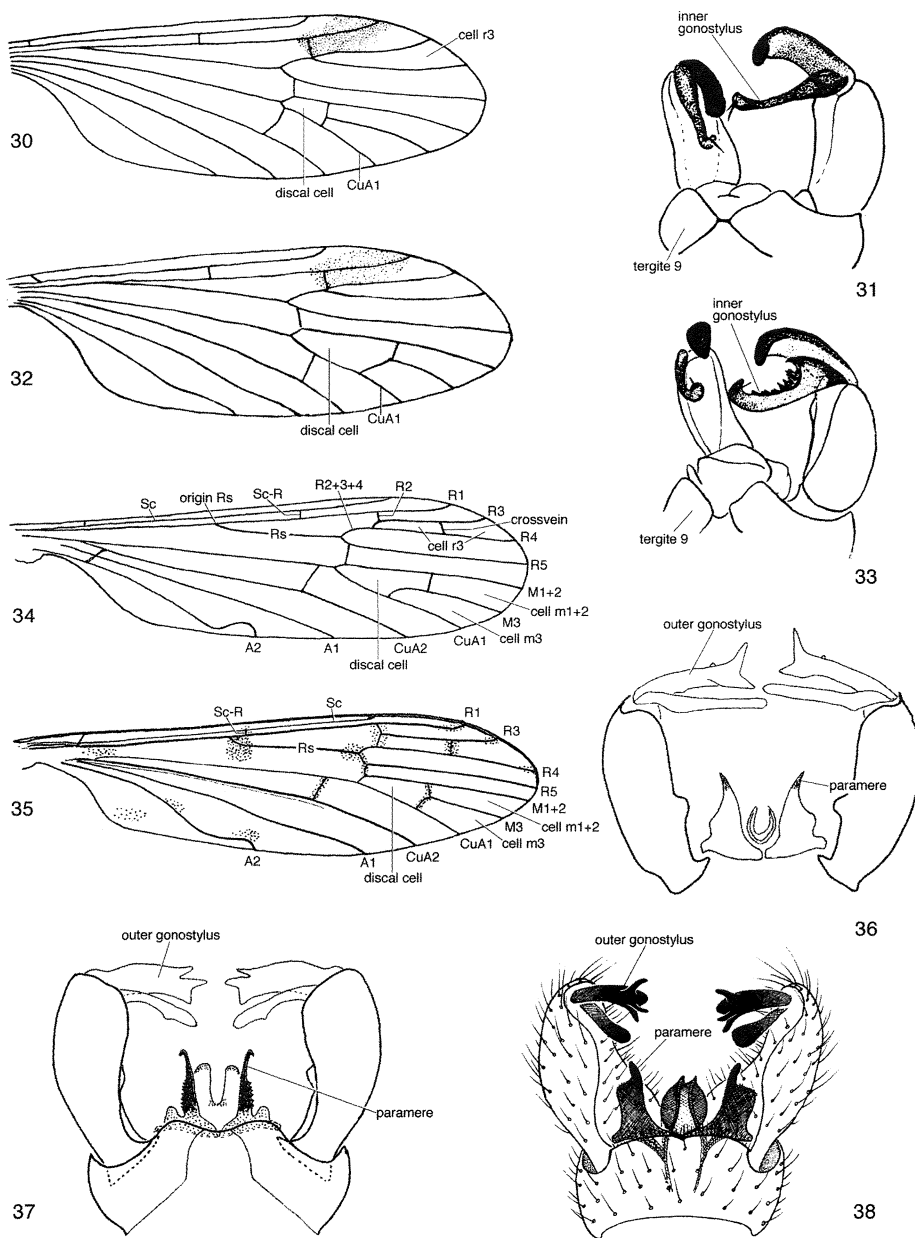


Fig. 30. wing *Ormosia (Ormosia) fascipennis*; 31. hypopygium *O. (O.) fascipennis*, oblique dorsal view; 32. wing *O. (O.) subnubila*; 33 hypopygium *O. (O.) subnubila*, oblique dorsal view; 34. wing *Symplecta (Symplecta) hybrida*; 35. wing *S. (S.) scotica*; 36. hypopygium *S. (S.) sunwapta*, dorsal view; 37. hypopygium *S. (S.) sheldoni*, dorsal view; 38. hypopygium *S. (S.) scotica*, dorsal view (30-33: Mannheims & Theowald 1971; 34: Theowald 1971; 35: Edwards 1938; 36, 37: original Fenja Brodo; 38: Theowald 1971).



16 A2 rather long, ending approximately at half length of wing. Female terminalia: cercus comparatively short, strongly upturned. Male terminalia: outer gonostylus slender, bifurcate at apex, with subterminal tooth short; paramere broad at base, narrower inner spine sword-shaped, blackened, and provided with abundant setulae (Fig. 36). **Symplecta (Symplecta) sunwapta**

– A2 shorter, ending before half length of wing (Fig. 35). Female terminalia: cercus longer, less upturned. Male terminalia with outer gonostylus and paramere not as above. 17

17 Dorsal side of thorax often dark bluish grey, with stripes chestnut brown, dull. Male terminalia: outer gonostylus having 3 narrow, blackened lobes and a flange ventrally; paramere long rod-like, serrate at outer margin (Fig. 37).

– Dorsal side of thorax more brownish, with stripes dark brown, somewhat shiny. Male terminalia: outer gonostylus more slender, with four short, blackened lobes at apex; paramere broad, provided with inner spine (Fig. 38). **Symplecta (Symplecta) sheldoni**  
**Symplecta (Symplecta) scotica**

## Tipulidae

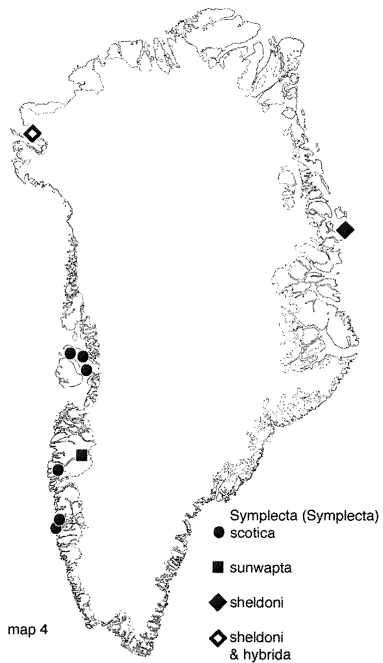
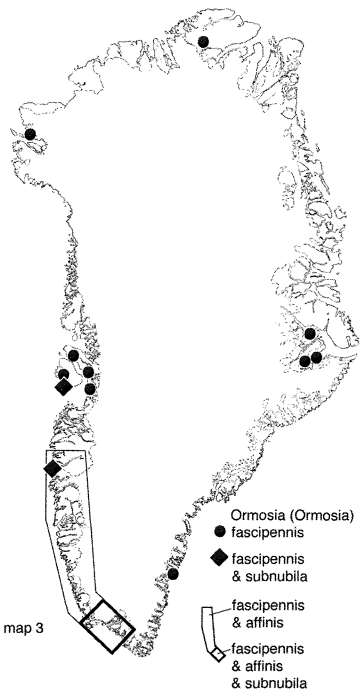
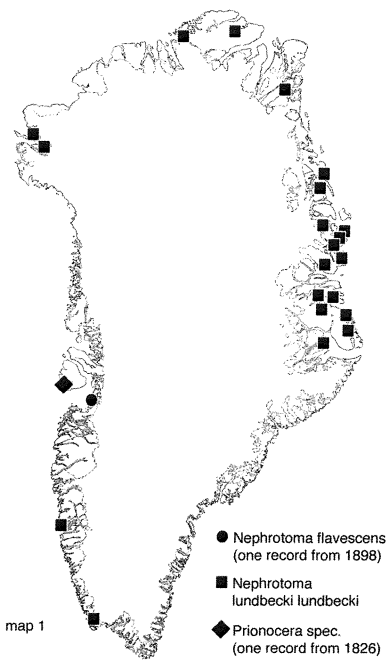
### Introduction

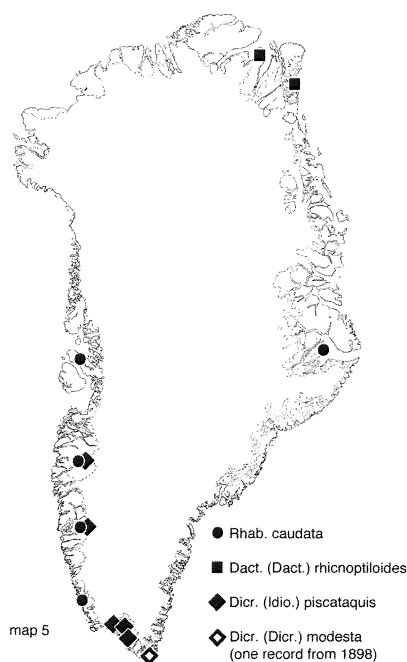
Tipulidae are medium- to large-sized, slender-bodied Diptera, and include some of the largest forms among the Nematocera (body length up to 60 mm, wing length up to 40 mm). Adults are distinguished by the following combination of characters. Elongate maxillary palps, the last segment usually being longer than the combined length of the preceding segments. Usually 13 antennal segments. Rostrum well developed and often with nasus. Compound eyes large, separated and bare. Ocelli absent. Thorax with a transverse V-shaped mesonotal suture. Wings elongate with 2 anal veins reaching wing margin. Vein Sc usually ending in R (not in C). No short cross vein proximal to tip of Sc. Cell m-1 usually present. Wings sometimes reduced. Legs very long and slender. Tibiae without or with 1 or 2 apical spurs. Abdomen long and slender. Male terminalia (hypopygium) with a variety of characteristic features. Female terminalia (ovipositor) including 2 pairs of elongate valves (cerci and hypovalvae).

Larvae elongate cylindrical with a tough cuticle (“leatherjackets”). Body consisting of 3 thoracic and 8 abdominal segments. Head capsule massive, hemicephalous and largely enclosed in prothoracic segments. Respiration metapneustic. Truncate posterior end of larvae divided into a spiracular field with 2 spiracles and 6 lobes, and an anal field with anus and sometimes anal papillae or pushing organs; spiracular lobes sometimes partly reduced.

Pupae obtect and usually provided with short mesothoracic horns. Eyes, palpi, antennae, wings and legs clearly visible within sheaths. Abdominal segments, especially 4-7, usually with spines along posterior margin.

Larvae rarely aquatic, usually in semi-aquatic or terrestrial environments, such as along streams, lakes, ponds, or marshes, in moist to wet cushions of mosses or liverworts, wood or sodden logs in various stages of decay, leaf litter, mud, sandy or gravelly riversides, dry soils of pasturelands, lawns, steppes and even semi-deserts. Life-cycle consisting of a usually brief egg stage (1-2 weeks), 4 larval stages, and a short pupal stage (1-2 weeks) before emergence of the short-lived adult. Summer as well as winter diapause of certain stages have been noted. Species under temperate conditions produce one or two generations a year, but depending on the species and the environmental conditions, the entire cycle may be as short as 10 weeks or as long as 6 years. Larvae feed on a variety





of material such as decaying plant and animal matter, mosses and algae. A few species, especially in *Tipula* (*Tipula*) and *Nephrotoma*, are destructive feeders on pasture grasses, seedlings and crops and may cause severe commercial losses. Some aquatic species in *Tipula* (*Arctotipula*) and *Prionocera* are apparently facultatively carnivorous. Adults do not appear to feed to any extent but can be observed taking liquids at flowers or wet substrates and surfaces.

Tipulidae are to be found from the northernmost lands in the arctic (82°30'N) to equatorial forests, and from sea-level to about 5200 m elevation. Usually they are associated with moist and temperate environments of forested or more open areas, such as swamps, marshes and meadows. Some species can be very abundant locally and of great ecological importance as food for a variety of animals.

The family comprises about 4000 described species, the majority of which were described by Charles P. Alexander. Most Palaearctic species were described by western European and Russian workers.

## Species

### ***Nephrotoma flavescens***

*Tipula flavescens* Linnaeus, 1758 – Syst. Nat., Ed. 10, 1: 586.

Relevant synonymy: *N. flavescens* has been recorded from Greenland under the synonymic names *histrion* (Fabricius, 1794) and *lineata* (Scopoli, 1763).

Greenland records (Map 1): A single specimen is recorded by Lundbeck (1898, as *Pachyrrhina histrion* F.) from West Greenland, Kristiaanshaab [68°49'N], without date, collected by Kolonibestyryer P. Müller. It was examined by Theowald who states (in Mannheims & Theowald 1971) that it represents a male of *Nephrotoma flavescens*

(Linnaeus). Examination by one of us (PO) confirms this, and the label shows 7-90 as date of collecting.

Distribution: Greenland, Europe from Ireland and Portugal to the western part of European Russia, in Norway and Sweden as far north as 62°N, in Finland to 65°N.

Discussion. The distribution of *N. flavescens* is restricted to Europe. The species is not known from the Faroe Islands, Iceland, or the Nearctic. It therefore seems likely that the old Greenland record refers to a single accidental transport. The larva of this species lives in the soil of grasslands, gardens, scrubs, etc. Accidental transport of this species is not known, but has been reported from Europe to the Nearctic for several other crane-fly species whose larvae are living in soils, such as *Nephrotoma cornicina* (Linnaeus), *Tipula* (*Tipula*) *oleracea* Linnaeus and *T. (T.) paludosa* Meigen.

References (not cited above): Oosterbroek (1978, revision, biology, distribution); Oosterbroek (1980), De Jong (1993, 1998, phylogeny, biogeography); Dufour (1986), Podenas (1995), Podeniene (2003a, 2003b), Podeniene & Gelhaus (2002, habitat, larva, phenology).

### ***Nephrotoma lundbecki lundbecki***

*Pachyrrhina lundbecki* Nielsen, 1907 – Meddr Grønland 29: 390.

Greenland records (Map 1): Originally described by Nielsen (1907) from East Greenland (without mentioning localities; type-locality: Hekla Havn, by lectotype designation of Mannheims (1962); details on type-material in Mannheims (1962) and Oosterbroek (1979); series of paralectotypes damaged in the mail from Copenhagen to Amsterdam in 2005). Known now from 14 localities in East Greenland (from Jameson Land [70°30'N] northward to Danmarks Havn [76°46'N]), four in West Greenland (from Rypefjeld [61°12'N] to Inglefield fjord [77°30'N]) and three in North Greenland (Centrum Sø [80°09'N 22°30'W], Peary Land [82°N 45°W, 82°N 30°W]). As all other crane-flies except *Ormosia fascipennis*, the species is not known from the East coast south of Jameson Land. We were unable to trace for this species the locality Sjøünartalik.

Period of flight: End of May until mid August, with a single record from 15 October.

Distribution: USA (Alaska), Canada (Nunavut – from northern Ellesmere Island, Northwest Territories, Yukon, northern Quebec), Greenland, Finland (north), Norway (as far south as Dovrefjell), Sweden (north), northern part of European Russia, most of Asiatic Russia excluding Kamchatka and Sakhalin, Kazakhstan (southeast), Kyrgyzstan, Mongolia. In polar regions as far north as 82°30'N. The subspecies *alexanderi* Oosterbroek and Tangelder, 1987, is known from Canada (Manitoba) and the USA (Michigan).

Habitat: *N. lundbecki lundbecki* is a widespread, common species, found for example in all the Canadian arctic ecosystems, extending from northern Ellesmere Island to the Boreal forest (Brodo 1990), but primarily in cold, exposed and open habitats. On Ellesmere Island the larvae have been found in the soil of moist slopes, in troughs between tundra hummocks, and in wet mud at the edge of water bodies. Usually these larvae were not found close to plant material, however, one larva was found in association with roots of *Polygonum viviparum*. Probably these larvae feed on micro-organisms or detritus in the soil (Brodo 2000 and unpublished field notes). In the Altai and Amur regions the species was found in snowberry (*Symphoricarpos*) vegetations at altitudes between 2000 and 2100 m. (Savchenko et al. 1972) and tall herbaceous *Calamagrostis* meadows (Zinovyjev & Savchenko 1962).

Discussion: The marked variability of *N. lundbecki* in colouration and accessory male copulatory structures throughout its Circumpolar and Asiatic Russian distribution was discussed by Oosterbroek (1979), concluding that the variability is apparently non-clinal. Greenland specimens are dusted grey and this colouration is rather uni-

form; copulatory structures in the male, however, can be rather variable, for example as given in figures 12a-c.

References (not cited above): Oosterbroek (1984, revision Nearctic material).

### **Prionocera spec.**

*Ctenophora parrii* Kirby, 1824 – Suppl. App. Parry's Voy. NW Pass.: 218.

Greenland record (Map 1): A single female is recorded, by Ross (1826), as *Ctenophora parrii*, from the Whalefish Islands, according to Mannheims and Theowald (1971), a group of islands near Disko Island [West Greenland, 69°15'N].

Habitat and biology: *Prionocera* species have truly aquatic larvae (Alexander 1919; Theowald 1967, Lantsov 1984; Lantsov & Chernov 1987; Brodo 1987, 1990, 2000). Larvae of *Prionocera* in the arctic are phytophagous, feeding on mosses and algae (Lantsov 1984; Lantsov & Chernov 1987). Occasional and facultative necrophagy and carnivory (larvae of tipulids and tabanids) have been documented (Lantsov 1984; Brodo 1990).

Discussion: It is remarkable that not a single species of *Prionocera* seems to be indigenous to Greenland. The genus *Prionocera* is primarily boreal and a characteristic component of the wetlands in the taiga and forest-tundra regions of North America and the taiga and tundra regions in the Palaearctic; 16 species occur north of 60°N (Holarctic 9, Nearctic 2, Palaearctic 5), in the Nearctic as far north as Victoria Island and the southern half of Baffin Island (Brodo 1987).

From the description and remarks by Ross (1826, cited in full and discussed in Mannheims & Theowald 1971) it is almost certain that a true *Prionocera* is involved, but it is not clear which species. *Prionocera parrii* (Kirby, 1824) is considered a nomen dubium by Brodo (1987). She furthermore states that, given the far northern type-locality and the description of especially its wing, *P. parrii* could well be identical with *P. recta* Tjeder, 1948, or *P. ringdahli* Tjeder, 1948.

### **Tipula (Arctotipula) besselsi besselsi**

*Tipula besselsi* Osten Sacken, 1877 – Proc. Boston Soc. nat. Hist. 19: 42.

Greenland records (Map 2): The species was described after both sexes collected by Dr. Bessels at Polaris Bay [81°28'N 61°00'W] on 7 June 1872. Examined were 2 male and 2 female syntypes, dry (MCZH; details on the type-material will be published by Brodo, in preparation). No other Greenland material has been recorded since 1877, but here we present material examined from Peary Land as follows: Nedre Midsommer Sø [82°15'N 34°15'W], Can. Peary Land Expedition, Collectors D.M. Wood & J.E.H. Martin, 28-VI-1966: 1 male, 2 females, 25-VII-1966: 1 male, det. Brodo 1987, dry (ZMAN); 28-VI-1966: 19 males, 9 females, 29-VI-1966: 1 male, 13-VII-1966: 1 female, det. Brodo 1987, dry (CNCI), 28-VI-1966: 3 males, 1 female, det. Oosterbroek 2006, dry (CMNH, specimen numbers 248.224, 250.254, 253.828, 259.120; the latter being a male, with a female of *T. (A.) besselsoides* on the same pin).

Period of flight: Collected in Greenland between 7 June and 25 July.

Distribution: USA (Alaska), Canada (from northern Ellesmere Island south to Repulse Bay on the Arctic Circle, west to Yukon and northern British Columbia), Greenland, far eastern Russia (Magadan province). The subspecies *centrasiatica* Savchenko, 1961, is known from eastern Russia (Irkutsk province) and Mongolia.

Habitat and biology: In northern Canada, *T. (A.) besselsi besselsi* is widespread, found from the high arctic to the boreal forest (Brodo 1990). Following observations for the subgenus *Arctotipula* at the arctic tundra of the Taimyr Peninsula (Lantsov & Chernov 1987; Lantsov 1997), the larvae are predators on Chironomidae larvae, Plecoptera larvae and Tipulidae eggs as well. According to these authors and observations by us

at the arctic tundra of the Taimyr Peninsula (VL) and the Canadian arctic (Nunavut; FB), females put eggs into wet sand of riverbanks and the larvae are truly aquatic and occur in small rivers and wide stony rivulets among stones near the banks of stream and in flooded stony split of rivers. Larger larvae (3rd and 4th instar) tunnel along just under the water in slowly moving to stagnant water bodies thereby leaving networks of lines in the silt of creek beds, thus advertising their presence and making this taxon a particularly useful environmental indicator, for example of climatic changes (Brodo 2000).

Discussion: The year of description is usually given as 1876, but the issue with the description was not published before April 1877, the month and year printed at the bottom of some of the issue pages.

References (not cited above): Mannheims (1953), Savchenko (1961, review); Mannheims & Theowald (1971, review Greenland material).

### **Tipula (Arctotipula) besselsoides**

*Tipula besselsoides* Alexander, 1919 – Rep. Can. Arctic Exped., 1913-18, 3 (C: Diptera): 15.

Relevant synonymy: *Tipula (Arctotipula) thulensis* Alexander, 1946. **New Synonymy.** *Tipula (Arctotipula) epios* Alexander, 1969. **New Synonymy.**

*Tipula besselsoides* was described from a holotype male collected by Fritz Johansen at Bernard Harbour (68°47'N 114°49'W), Northwest Territories (now Nunavut), July 1-14, 1916, No. 422, and a paratopotype, male, No. 417. The pinned holotype in the CNCI is in poor condition. Only the scape and pedicel of both antennae remain; only the left wing is intact; of the legs: 1st femur on left fore leg and part of femur on mid left leg remaining; only the base of 1st segment of abdomen remains. The right wing is on the holotype slide (USNM). No slide with the genitalia was found; the genitalia are apparently missing. The pinned holotype has the following labels: (1) (white, in ink) Bernard/ harbour/ N.W.T./ July 1-14; (2) (white) Canadian/ Arctic/ Expedition/ F.J. 1916; (3) (white) 422; (4) (red) Holotype (printed)/ *Tipula besselsoides* (ink)/ C.P. Alexander (printed). The pinned paratype is also severely damaged, covered in dirt, with only the head, thorax and part of both wings remaining. The antennae are broken and a damaged leg is glued to a small card below the specimen. The male genitalia of the topoparatype are on a slide in the USNM and although the 9th tergite is distorted and the inner gonostylus is fragmented, the distinguishing characters of this species are visible, especially the strong spine on the inner gonostylus. George W. Byers is thanked for making a careful drawing of the paratype, reconstructing the inner gonostylus from the fragments on the slide.

*Tipula (Arctotipula) thulensis* was described from a single male collected in Canada, Northwest Territories (now Nunavut), Baffin Island, River Clyde, 70°N. The pinned holotype (USNM) has only the left scape of the antennae; both palpi are broken with only 1st segment remaining on left; left wing nicked (right wing on slide); legs: only the hind left leg intact. The specimen bears the following labels: (1) (white, ink) Canada/ Baffin Isl./ vi-1945/ Jack P. Woolstenhulme; (2) (big white folded label, ink) River Clyde, Northwest Territories/ Canada/ Baffin Island June 1945 Jack P. Woolstenhulme; (3) (red) HOLOTYPE (printed)/ male *Tipula thulensis* (ink)/ C.P. Alexander (printed). There are two holotype slides both numbered 8472. One has the genitalia and the other has a wing, legs, antennal segments and part of a palpus.

This species is described as having “squamae with setae”. The holotype (as seen on slide) as well as a few specimens from Clyde River (Baffin Island), Spence Bay, Southampton Island and Lady Melville, have a few (no more than 4) slender setae along the edge of the squamae. These seem to be proximal extensions of the fine setae along the lower costa and not the typical grouping of squamal bristles or setae,

characteristically found on species of the subgenus *Lunatipula*. No other species of *Arctotipula* with such setae are known to us. Alexander compared this species with *besselsi* Osten Sacken 1876 and *suttoni* Alexander 1934, but not with *besseloides*.

*Tipula (Arctotipula) epios* Alexander was also described from a single male. It was collected in British Columbia, Canada, Alaska Highway, Mile 316, along 107 Creek. The pinned holotype has a complete right antenna (left missing), right wing (left on holotype slide), abdomen glued to pin (but genitalia on holotype slide). Of the legs: fore legs with right entire but left leg gone; mid legs: femur and tibia glued to right side, no left leg; no hind legs (one on slide). The specimen is pinned laterally through the thorax and bears the following labels: (1) (white, ink) B. Col./ 107 Creek/ MP. 316/ VI-26.52/ M.E. Smith; (2) whitish, printed) Marion E. Smith/ Collector; (3) (red) HOLOTYPE (printed)/ male *Tipula epios* (ink)/ C.P. Alexander (printed). The holotype slide nr 12262 (USNM) has the 9th tergite, gonostyli, aedeagus and aedeagal guide (splayed out) and a tip of a leg with tarsal claw.

Alexander suggested that this species differs from *thulensis* by having “acutely pointed lobes of the 9th tergite and the broad outer dististyle”. The 9th tergite, however, lies ventral side up on the slide and is somewhat flattened, causing the more sclerotized structure on the ventral surface of the tergite (with glabrous pointed lobes) to be more prominent than the dorsal, broadly rounded tergal lobes. The scutum of *epios* is described as having “vestiture short and very sparse.” The pinned specimen does not quite fit Alexander’s description. The long, dark fine setae on the thorax of the type of *epios* and specimens of *besseloides* are in narrow, but dense rows, outlining the mid and lateral stripes. These setae thin out behind the scutal suture on most specimens. Both the types of *thulensis* and *epios* have similar, short, broad outer gonostyli. Comparisons with the two well-preserved inner gonostyli of *epios* on the holotype slide with those of other *besseloides* specimens, confirms this synonymy.

Greenland records (Map 2): Reported here for Greenland for the first time, from Nedre Midsommer Sø [82°15'N 34°15'W], Can. Peary Land Expedition, Collectors D.M. Wood & J.E.H. Martin, 28-VI-1966, 1 female, det. Oosterbroek 2006, dry (CMNH, specimen number 254.605, with a male of *besselsi besselsi* on the same pin).

Period of flight: Only one record, 28 June.

Distribution: Canada (Mainland Northwest Territories and Nunavut including Baffin Island, Yukon, northern British Columbia), Greenland.

Habitat and biology: In Canada this species is found in the mid to low arctic, barely getting into the forest-tundra zone. Nothing is known about its biology but it is likely to be similar to the other species of the subgenus *Arctotipula*. Because of its dark, hairy aspect and relatively shorter legs, this species was mentioned by Alexander (1934) as being one of the characteristic arctic Tipuloidea in the Nearctic.

### ***Tipula (Vestiplex) arctica***

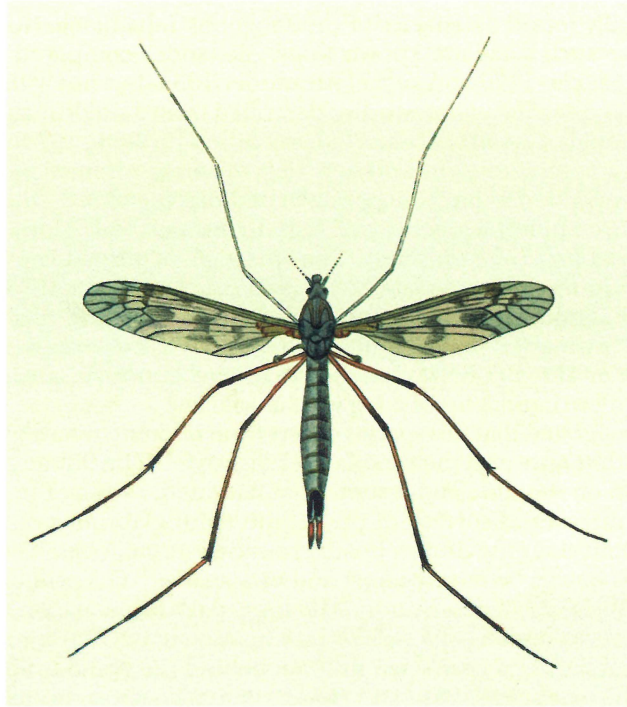
*Tipula arctica* Curtis, 1835 – App. Narr. Sec. Voy. Arctic Reg.: 78.

Relevant synonymy:

*Tipula nodulicornis* Zetterstedt, 1838; described from “Groenlandia”; synonymy: Schiødte (1857).

*Tipula nigrocorporis* Doane, 1912. **New Synonymy.**

*Tipula nigrocorporis* was described from a single male collected in Estes Park in the Rocky Mountains of Colorado. The type, borrowed from CAS, is intact except that it lacks legs, but a femur and tibia are glued to the collector’s label. The following labels are pinned beneath the specimen: 1) Estes Park/August ‘92/F.H. Snow (off-white, printed). 2) 27 (off-white, red ink). 3) Type (off-white, printed). 4) *Tipula* n. sp. goes to *eluta* Loew but color is not right (off-white, pencil). 5) *Tipula nigrocor-*



Colourplate: *Tipula (Vestiplex) arctica*, female, after Curtis, 1835. The antennae and front legs have no colour because: "Specimens only of the female were preserved, and none of them had antennae, or the anterior feet" (Curtis (1835)).

poris 1911 Doane (off-white, red border, ink). 6) California Academy of Sciences Type no. 5654 (white, printed, number in ink). The type as well as other specimens from the Rocky Mountains, Colorado (seen by FB), tend to have shorter fine setae on the thoracic dorsum.

*T. (V.) arctica* has furthermore been recorded from Greenland under the names *rivosa* by Fabricius 1780 and *truncorum* by Gerstaecker 1874.

Greenland records: *Tipula (V.) arctica* is the most frequently collected crane fly from Greenland, being first recorded from the island already by Otto Fabricius in 1780 (as *Tipula rivosa*). Its Greenland distribution is discussed in detail by Hemmingsen & Jensen (1957), including its absence along the East coast south of 69°N. Their map shows 31 localities along the entire West coast, 29 along the East coast and 7 north of 80°N.

Since 1957, the species has been collected at some 30 additional localities, including Kap København [82°24'N 22°12'W]. However, none of the new records refers to the East coast south of 69°N. It therefore seems very likely that, as suspected already by Hemmingsen & Jensen (1957), *T. (V.) arctica* does not occur in this part of Greenland.

Period of flight: Greenland records are from the end of May until mid August, with a distinct peak in the first half of July. Year to year variations in the dates of first appearance are presumably due to differences in the onset of Spring (Hemmingsen & Jensen 1957). In neighboring northern Ellesmere Island, flight records are from mid June to the end of July.



Distribution: USA (Alaska, Colorado), Canada (northern British Columbia, Alberta, Northwest Territories, Nunavut – as far north as northern Ellesmere Island, northern Quebec and Labrador), Greenland, entire northern Russia including Novaya Zemlya.

Habitat and biology: One of the most typical species of the circumpolar arctic faunistic complex. The species is found in all northern landscapes of Eurasia and North America, from the boreal forest in the south as far north as the high arctic (Lundström 1915; Riedel 1919; Alexander 1922, 1924b; Lackschewitz 1936; Carpenter 1938; Oliver 1963; Savchenko 1964; Lantsov & Chernov 1987), in the USA also found in the southern Rocky Mountains of Colorado (Brodo 1990), in Greenland as far north as 82°30'N. The body length of the species decreases towards the north of the island in both sexes as one of the mechanisms to save energy (Hemmingsen & Jensen 1957; Brodo 2000). Both in the south of the island (at 61°N and 65°N) and in the north (at 82°N) there are records at rather high altitudes (up to about 600-700 m), and in several localities between 61°N and 79°N, also in the valleys and near the coast below at about 50 m or lower (Hemmingsen & Jensen 1957).

Species habitats are sides of lakes and marshy places (Ross 1826), stony tundra, wet lowland tundra with dry patches, coastal lowland, plateau (after material collected by Y.I. Chernov in Devon Island in 1991, identified by V. Lantsov, unpubl. data). For oviposition, females prefer rather loose, not too dry, but not wet earth and observations showed *T. (V.) arctica* to belong to the group of deep-boring ovipository species (Hemmingsen 1956). The larvae likewise live in tundra soils, to be found for example under *Dryas* clumps and are probably saprophagous (detritophagous) (Brodo 2000).

The following life-history account is from the observations made by Johansen (1910), in North-East Greenland: "The larvae of the large *Tipula arctica* hibernate down in the ground, and if we dig at places which are mouldy and not too dry, e.g. under *Cassiope* tufts, we easily find their large maggots. A little after the end of June they assume the pupa stage and begin to work up towards the surface, and here and there under stones etc. we may find circular holes leading down to a vertical passage, in which sits the active pupa with the head end upwards. It is thus well-protected against enemies, whilst at the same time having plenty of air. At the end of the month appear the imagines; it is the male especially, which is seen and only in flight; if it rests on the ground namely, its colour blends perfectly with that of the surroundings it prefers (bare, sunny, stony spots with patches of vegetation of *Cassiope*, grass etc.) ... Towards the middle of August the summer already begins to wane. The large *Tipula arctica* imagines are no longer seen".

The duration of the life cycle in Greenland was estimated at two years (Nielsen 1910). Bearing in mind our data on *Tipula (Pterelachisus) carinifrons* Holmgren, 1883, with a life cycle as long as up to 6 years (arctic tundra, West of Taimyr) (Lantsov 1982) and the comparable big size of *T. (V.) arctica* specimens, the duration of the life cycle in the northern divisions of Greenland can be estimated as at least 3 or 4 years, especially under less favourable climatic conditions.

Larvae and adults serve as an essential part of the food of certain birds (Curtis 1835; Hemmingsen & Jensen 1957; De Korte 1986; Brodo 1990).

References (not cited above): Alexander (1919), Theowald (1967, description larva, pupa); Mannheims & Theowald (1971, review Greenland records).

## Limoniidae

### Introduction

Small to medium-sized slender-bodied Nematocera distinguished by the following combination of characters. Last segment of maxillary palpus mostly short, about as long as the two preceding segments together. Antenna usually with 14 to 16 segments. Rostrum usually short (elongate in *Elephantomyia*, *Helius* and *Toxorhina*; mouthparts elongate in *Geranomyia*). Nasus always absent. Ocelli absent. Compound eyes bare. Thorax with transverse V-shaped mesonotal suture. Wings elongate with 2 anal veins reaching wing margin. Vein Sc ending in C; usually crossvein Sc-R present before tip of Sc. M1+2 sometimes absent. Wings sometimes reduced. Legs usually very long and slender. Tibiae without or with 1 or 2 apical spurs. Abdomen usually long and slender. Male terminalia (hypopygium) with a variety of characteristic features. Two pairs of gonostyli usually present, sometimes 1 or 3. Female terminalia (ovipositor) variously modified, but in general including a pair of dorsal valves, the cerci, which are usually elongate, upturned and pointed, and a pair of ventral valves, called hypovalvae or hypogynial valves.

Larvae elongate, hemicephalic and metapneustic, rarely apneustic. Head capsule distinct, well sclerotized anteriorly, deeply incised ventrally and sometimes dorsolaterally, rigid parts reduced to 6 longitudinal bars in most Chioneinae and Limnophilinae. Posterior two-thirds or more of head capsule enclosed by and retractable within prothoracic segment. Abdominal segments smooth or with transverse rows of fine setae, in several instances with creeping welts or fleshy projections. Terminal segment bearing posterior spiracles; spiracular disk usually surrounded by 5 or fewer lobe-like projections of variable length. Usually 4 anal lobes present.

Pupae obtect, elongate. Eyes prominent. Mesothoracic horns usually simple, ranging from short sessile to very elongate. Antennal sheaths long. Tarsal sheaths arranged side by side, not superimposed. Abdomen parallel-sided or almost so, usually more or less smooth except for welts. Anal segment usually with spines, prominent marginal or other abdominal spines especially in Hexatomininae.

Larvae usually in various aquatic and semi-aquatic environments during most of their development, moving to margins or dryer places for pupation. Usually in more or less wet, organic soils or decaying vegetation in or along streams, lakes, swamps, marshes and woodlands. Other habitats include drier soils (*Dicranoptycha*, some species of *Cheilotrichia*, *Dicranomyia* and *Limonia*), intertidal zones or brackish water (some Limoniini), wet cliffs, piles or bridge piers supporting algal growths (some species of *Limonia*, *Orimarga*, *Elliptera*, *Dactylolabis*), mosses or liverworts (various Limoniinae), decaying wood, or sodden logs in streams, where larvae commonly feed on fungal mycelia (*Gnophomyia*, *Teucholabis*, *Lipsothrix*), sandy or gravelly borders of streams with moderate humus (many Eriopterinae), woody or fleshy fungi (*Metalimnobia*). Most larvae feed on decaying plant material, many Limoniinae feed on algae and the like; Limnophilinae are carnivorous.

Limoniidae, with some 10500 described species worldwide, is one of the largest families of Diptera.

### Species

#### **Ormosia (Ormosia) affinis**

*Rhypholophus affinis* Lundbeck, 1898 – Vidensk. Meddr Dansk naturh. Foren. (5) 10: 266.

Relevant synonymy: *Rhypholophus manicatus* Doane, 1900; until the redescription of the species by Tjeder (1970) treated as a species separate from *O. affinis*.

Greenland records (Map 3): The species was described from four Greenland localities (Tunugdliarfikfjord, Sermiligarsukfjord, Neriafjord, Ivigtut; type locality: Ivigtut by lectotype designation of Tjeder 1970). In total it is now known from 17 localities, all from a small part of Southwest Greenland, namely from Upernaviarssuk [60°45'N] to Kapisigdlit [64°30'N].

Period of flight: The Greenland material was collected between July 3 and August 12, with a small peak during the last 10 days of July.

Distribution: USA (Washington to Maine, south to California, Ohio and Pennsylvania), Canada (British Columbia, Ontario, Quebec, Nova Scotia and Newfoundland), Greenland, far eastern Russia (Sakhalin, Kuril Islands).

Habitat: According to Young and Gelhaus 2000, *O. (O.) affinis* is a semi-aquatic species. For the Northwest USA (New York and New England) the following habitats have been listed: dryer woods above swamp, *Sphagnum* bog, arborvitae swamp, very old bogs, swales, in hellebore patches (Alexander 1924a, 1925, 1927, 1936); habitats for far eastern Russia are open fur-larch woodland (Sakhalin) and mixed forests (Kuril Islands) (Savchenko & Krivolutskaya 1976).

References (not cited above): Mannheims & Theowald (1971, short description, review Greenland material).

### **Ormosia (Ormosia) fascipennis**

*Erioptera fascipennis* Zetterstedt, 1838 – Insecta Lapp.: 831.

Relevant synonymy: *Erioptera fuscipennis* Zetterstedt, 1837; preoccupied by Meigen, 1818, replaced by *Erioptera fascipennis* Zetterstedt, 1838, the next available name.

Greenland records (Map 3): The species was described by Zetterstedt (1838) after material from Norway (“Tromsø”) and “Groenlandia”. The first locality for Greenland is given by Lundbeck (1896), namely East Greenland, Gaaseland. In total, 24 Greenland localities are known now, 19 of them situated along the West coast, from Upernaviarssuk [60°45'N] as far North as Thule [77°30'N]. The species was collected in East and North Greenland much less frequently, namely from five localities, as follows:

– East Greenland, Mestersvig [72°09'N], 18-V-1953, Chr. Vibe, 1 male, det. Oosterbroek 2006, preserved in alcohol (ZMUC); 5-VII-1953, Chr. Vibe, 2 males, det. Mannheims 1964, dry (ZMUC); 5-VII-1953, Chr. Vibe, 5 males, det. Oosterbroek 2006, preserved in alcohol (ZMUC).

– East Greenland, Gaaselandet [70°15'N], 12-VII-1892, Deichmann, 1 male, 1 female, dry (ZMUC) (this is the material mentioned in Lundbeck (1896) and Nielsen (1907)).

– East Greenland, Gåseland, Faxe Sø [70°00'N], 350 m, 3-VII-1958, Chr. Vibe, 8 males, 2 females, preserved in alcohol (ZMUC).

– East Greenland, Skjoldungen, “Bygden”, 19-27-VII-1972, S. Andersen, 1 female, preserved in alcohol (ZMUC). This represents the only crane fly record along the East coast south of 69°N; searching the online Geonet Name Server resulted in A) Skjoldungen [= Saqqisikuik], 63°13'N 41°19'W, and B) Skjoldungen, 63°19'N 41°30'W).

– North Greenland, Nedre Midsommer Sø [82°15'N 34°15'W], 24-VII-1966, Can. Peary Land expedition, collectors D.M. Wood & J.E.H. Martin, 2 males, 2 females, det. Brodo 2006, dry (ZMAN).

Period of flight: The dates of collecting of this species in Greenland cover a rather long period of time. Early records are May 15 (Mestersvig) and June 3 (Ivigtut), the other records are from mid-June until end-August, with the majority of the records throughout July.

Distribution: Canada (Nunavut, Quebec), Greenland, Europe (including Iceland, as far south as France, Italy, Romania and Ukraine), northern and far eastern Russia (includ-

ing Novaya Zemlya, Bering and Kuril Islands), southern Russia (North Caucasus, Tyva, Baykal region), Georgia, Armenia, Azerbaijan, North Korea, Japan (Honshu). This species has a very spotty distribution in the Canadian arctic, having been collected on Axel Heiberg Island (specimens in the CNCI identified by FB) and at Lake Hazen, Ellesmere Island (Oliver 1963), but not found some 300 km south on the Fosheim Peninsula (Brodo 2000). Furthermore, only females have been collected.

Habitat: *O. (O.) fascipennis* is a species of boreal and mountainous habitats (Savchenko & Parkhomenko 1980), found in spot-medallion tundra<sup>1</sup> (Taimyr Peninsula, pers. comm. E.N. Savchenko), dry slopes along river banks with yernik<sup>2</sup> (Polar Ural), as well as small mire between hald mountains<sup>3</sup> (Chukotka; Savchenko & Parkhomenko 1980) and brooks, small rivers, swamps, moist soil (Romania; Ujvarosi 2005). Examined Greenland material was collected flying over Willow scrub and in heathland at sea level.

References (not cited above): Mannheims & Theowald (1971, short description, review Greenland material).

<sup>1</sup> term to indicate nano-relief of the tundra landscape surface in the arctic, divided into spots of polygonal medallion shape of open ground free (or practically free) of vegetation (also named polygonal tundra, mottled tundra).

<sup>2</sup> dwarf birch shrub formation with *Betula nana* L., etc. in polar or alpine regions.

<sup>3</sup> general term for hills or isolated mountains with rounded tops in the Far East of Russia.

### **Ormosia (Ormosia) subnubila**

*Ormosia subnubila* Alexander, 1920 [1920a] – Ohio J. Sci. 20: 196.

Greenland records (Map 3): First recorded from Greenland by Mannheims and Theowald (1971), now known from four localities along the West coast only, based on material examined as follows:

- Eqalet-Landet (Julianehaab) [60°40'N], 20-VII-1948, Chr. Vibe, 1 male, preserved in alcohol (ZMUC, as *fascipennis*, no identifier) (most probably this male refers to the *O. fascipennis* record from Eqalet in Mannheims & Theowald (1971), no material of *O. fascipennis* from Eqalet was examined during the present study).
- Ivigut [61°00'N], 6-VII-1950, Chr. Vibe, 1 male, preserved in alcohol (ZMUK).
- Holsteinsborg [66°55'N], 6-VIII-1954, A.M. Hemmingsen, 2 males, preserved in alcohol (ZMAN).
- Godhavn [69°18'N], 11-VIII-1954, A.M. Hemmingsen, 1 male preserved in alcohol (ZMAN).

Period of flight: The four records cover the period July 6 until August 11.

Distribution: USA (Alaska, Colorado), Greenland.

Discussion: The distribution is given in the Nearctic catalogue (Alexander 1965) as Alaska to Colorado, but according to Alexander (in Mannheims & Theowald 1971), known from Alaska and Colorado only.

### **Rhabdomastix caudata**

*Goniomyia caudata* Lundbeck, 1898 – Vidensk. Meddr Dansk Naturh. Foren. (5) 10: 267.

Greenland records (Map 5): The species was described after one female from Greenland. It is now known from no more than six records, as far as examined or published (Alexander 1914) all females:

- West Greenland, Sermiliarsuk fjord [61°30'N], holotype female; label with the date 6-VIII-1889, dry (ZMUC).

– West Greenland, Kapisigdlit [64°30'N], 19-VII-1950, Chr. Vibe, 1 female, det. Theowald, dry, no longer preserved, needle only (ZMAN).

– West Greenland, Søndre Strømfjord, Camp Lloyd, head of fjord [67°02'N], 11-VIII-1936, H.G. Vevers, 1 female, dry (OMNH; with an associated label stating: 1 female, 11-VIII, Camp Lloyd, Willow scrub on Salix, Retained by Edwards; this apparently refers to the 2nd female mentioned by Carpenter (1938)).

– West Greenland, Marrait (Nugssuaq) [71°00'N], 16-VII-1949, Chr. Vibe, 2 females, alc. (ZMUC, as *Gonempeda caudata*, no identifier); 16-VII-1949, Chr. Vibe, 1 female, det. Theowald 1973, dry (ZMAN).

– East Greenland, Hekla Havn [70°27'N], 8-91, Deichmann, 1 female, dry (ZMUC) (this is the material mentioned from Hekla Havn in Lundbeck (1896) and Nielsen (1907)).

– Canada, Baffin Land, Signuia [62°54'N 64°37'W], 2-VIII-1897, 1 female (Alexander (1914); other material of *R. caudata* mentioned in Alexander (1914) from Canada, British Columbia, was described in Alexander (1916) as *Rhabdomastix monticola*; the Signuia record remained contributed to *R. caudata*, as given in Alexander (1965)).

Period of flight: On Greenland collected between 16 July and 11 August.

Distribution: Canada (Baffin Island), Greenland.

Habitat: The only reference to a habitat is in Carpenter (1938): “Willow scrub, on Salix” (as mentioned above).

Discussion: *R. caudata*, a species of which only females are known, is assigned by Stary (2003) to a group of six species centering around *R. parva* Siebke, 1863. The subgeneric position of this group of species could not yet be established (Stary 2003). A character of the group is R2 preserved, although sometimes less distinct than other veins. In the examined material of *R. caudata* this vein is at most present as a fold in the wing or it is absent. Vein R2 very weak or absent is also found in *R. parva* (cf. Tjeder 1964) and in other species of the *R. parva* species-group; for example, Alexander (1916) writes about *R. monticola*: “With *caudata* this new species agrees in the possession of the radial cross-vein [= vein R2], but this is here very faint and evidently in process of being eliminated. The limited material available of both *R. caudata* and *R. parva*, including only females, does not make possible to decide whether or not the two are identical (Stary 2003).

References (not cited above): Alexander 1943 (reprint: 1966) (key); Mannheims & Theowald 1971 (short description of female, review Greenland material).

### **Symplecta (Symplecta)**

Until recently only one species of *Symplecta* (*Symplecta*) was recorded from Greenland. Before 1971 this was considered to be *S. (S.) hybrida* (Meigen, 1804) but Theowald, in Mannheims & Theowald (1971), transferred all Greenland records to *S. (S.) novaezembrae* (Alexander, 1922), subspecies *scotica* (Edwards, 1938).

The arctic species of *Symplecta* (*Symplecta*) are presently under review (Stary & Brodo, in preparation). Examination of the available Greenland material by these co-authors revealed that four species of *Symplecta* (*Symplecta*) occur in Greenland. Apart from *S. (S.) scotica*, these are *S. (S.) hybrida* (Meigen, 1804), *S. (S.) sheldoni* (Alexander, 1955) and *S. (S.) sunwapta* (Alexander, 1952).

These species can be divided over the eight localities listed in Mannheims & Theowald (1971) for *S. (S.) novaezembrae scotica* as follows:

- Kangikerdlar (Diskofjord): ? (no material examined by us from this locality).
- Klitlven: ?*scotica* (1 female in alcohol, identification therefore uncertain).
- Majuala: *scotica* (examined).
- Marrait (Nugssuaq): *scotica* (examined).

- Sabine Is: *sheldoni* (examined).
  - Sarqaq: ?*scotica* (1 female in alcohol, identification therefore uncertain).
  - Søndre-Strømfjord: *scotica* (examined).
  - Thule: *hybrida* and *sheldoni* (both examined).
- Furthermore, Edwards' 1931 record of *hybrida* from Kugssuk, Godthaab Fjord also refers to *scotica* (examined).

### **Symplecta (Symplecta) hybrida**

*Limonia hybrida* Meigen, 1804 – Klass. Beschr. 1: 57.

Relevant synonymy: *S. (S.) hybrida* was recorded from Greenland for the first time in Henriksen & Lundbeck (1918), as *Symplecta punctipennis* (Meigen, 1818), a junior synonym of *hybrida*. This record, however, pertains to the species *sheldoni* (as specified below). The only other published pre-1971 records we know of are by Edwards (1931), as *Helobia hybrida*, 3 females from Kugssuk and Matuola; examination of this material showed that it belongs to *scotica* (as specified below).

Greenland records (Map 4): The only confirmed Greenland record of this species is from West Greenland, Thule [77°30'N], 200 m, 4-VII-1952, Chr. Vibe, 1 male, dry, det. Stary 2006 (ZMUC).

Period of flight: Only one record, 4 July. In Western Europe adults occur during all vegetation periods but with a maximum abundance at the beginning and at the end of the season, demonstrating a bivoltine life cycle (Savchenko 1982).

Distribution: Canada and USA (Alaska to Ellesmere Island), Greenland, Western Europe (including Iceland, Azores, Corsica, Sicily), European and Asiatic Russia (including Kotel'nyy Island), North Korea, Japan, Morocco, Algeria, Egypt, Lebanon, Israel, Iran, Georgia, Armenia, Azerbaijan, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, Afghanistan, Pakistan, India (West Bengal, Uttar Pradesh), Nepal, China (as far south as Tibet and Sichuan).

Habitat and biology: *S. (S.) hybrida* is a very widespread species, found in a large variety of habitats, such as near water reservoirs, flooded meadows, swamps, on wet rocks along shores, near hot springs, intertidal zone of small rivers in silt, sand and leaf fallings of *Alnus*, brooks in hilly districts, lowland boggy or brackish meadows, etc. (Wrage 1982, Lantsov & Chernov 1987, Reusch 1988, Podeniene 2001, Chandler & Crossley 2003). Females oviposit eggs, and the larvae develop, in wet sand near water, in open terrain (for example as described in detail by Alexander 1920b for Iceland), as well as in deciduous forests (Beling 1879). The larvae create hollows of different shape under the surface of the ground, most probably feeding on a variety of organic matter (Alexander 1920b, Savchenko 1982).

Discussion: One of the *S. (S.) sheldoni* females from Thule has identical labels as the above-mentioned male.

References (not cited above): Alexander (1955, description hypopygium); Theowald (1971, review three Holarctic *Symplecta* species); Noll (1985, short description, phenology, review literature, distribution map).

### **Symplecta (Symplecta) scotica**

*Erioptera (Symplecta) scotica* Edwards, 1938 – Trans. Soc. Br. Ent. 5: 127.

Greenland records (Map 4): As mentioned above, this species was recorded from nine Greenland localities. Because only females are known, reliable identification is possible only for dried material, identification of females preserved in alcohol is less reliable. All material seen by us is from Greenland's West coast, from 64°N (Kugssuk) to 71°N (Marrait, Klitelven, Sarqaq), as listed below:

Dry material, all identified by Jaroslav Stary 2006, as *scotica*:

- Godthaab Fj., Kugssuk, 24-VI-1928, 30ft, on heath, R.W.G. Hingston, 1 female, det. Edwards 1928 (as *Helobia hybrida*) (OMNH).
- Godthaab Fj., Matuola [= Majuala, see Henriksen 1939], 6-VII-1928, 2100ft, on heath, R.W.G. Hingston, 2 females, det. Edwards 1928 (as *Helobia hybrida*) (OMNH).
- Marrait (Nugssauq), 16-VII-1949, Chr. Vibe, 1 female (ZMUC).
- Marrait (Nugssauq), 17-VII-1949, Chr. Vibe, 3 females (ZMUC).
- Søndre Strømfjord (BW8), 21-VI-1952, Chr. Vibe, 1 female (ZMUC).
- Søndre Strømfjord (BW8), 22-VI-1952, Chr. Vibe, 7 females (ZMUC), 2 females (ZMAN).
- Søndre Strømfjord (BW8), 25-VI-1952, Chr. Vibe, 1 female (ZMUC).
- Søndre Strømfjord (BW8), 27-VI-1952, Chr. Vibe, 1 female (ZMUC).
- Søndre Strømfjord (BW8), 16-VII-1952, Chr. Vibe, 5 females (ZMUC).

Preserved in alcohol, all identified by Jaroslav Stary 2006, as probably *scotica*:

- Arnangarngup Kua, Søndre Strømfjord, 20-VII-1984, Jens Böcher, 1 female (ZMUC).
- Klitelven, 21-VII-1949, Chr. Vibe, 1 female (ZMUC).
- Locality 543, 17-VII-1949, 1 female (ZMUC).
- Locality 574, 18-VII-1949, 1 female (ZMUC).
- Locality 592, 19-VII-1949, 1 female (ZMUC).
- Marrait (Nugssauq), 16-VII-1949, Chr. Vibe, 2 females (ZMUC).
- Marrait (Nugssauq), 17-VII-1949, Chr. Vibe, 5 females (in 3 vials) (ZMUC).
- Marrait (Nugssauq), 18-VII-1949, Chr. Vibe, 1 female (ZMUC).
- Marrait (Nugssauq), 18-VII-1949, Chr. Vibe, 3 females (ZMUC).
- Sarqaq, 24-VII-1949, Chr. Vibe, 1 female (ZMUC).
- Søndre Strømfjord, 26-VI-1952, Chr. Vibe, 1 female (ZMUC).

Period of flight: Dry material was collected from 21 June until 17 July, in alcohol preserved material until 24 July

Distribution: Greenland, Finland, Great Britain, Norway, Sweden, northern part of European Russia.

Habitat: In Europe known from brooks in hilly districts and lowland boggy meadows (Chandler & Crossley 2003).

Discussion: Variation of the wing venation among 40 specimens from Greenland was discussed and illustrated in Theowald (1971). It is, however, not known if this includes specimens now identified as *hybrida* or *sheldoni*.

References (not cited above): Mannheims & Theowald (1971, review Greenland material).

### **Symplecta (*Symplecta*) sheldoni**

*Erioptera* (*Symplecta*) *sheldoni* Alexander, 1955 – Misc. Publs Mus. Zool. Univ. Mich. 90: 28.

Relevant synonymy: The material from Sabine Island was recorded under the name *punctipennis* by Henriksen & Lundbeck 1918, and as *hybrida* in Henriksen (1939); Thule was listed in Mannheims & Theowald (1971) as one of the localities from which *novaezemiae scotica* was known.

Greenland records (Map 4): Reported here for Greenland for the first time, on the basis of the following material, identified by Jaroslav Stary 2006:

- East Greenland, Sabine Is [74°40'N], VII-1900, Deichmann, 1 female, det. Lundbeck [no year] (as *punctipennis*), det. Theowald 1965 (as *scotica*), dry (ZMUC).
- West Greenland, Thule [77°30'N], 200 m, 4-VII-1952, Chr. Vibe, 1 female, det. Mann-

heims 1965 (as *scotica*), dry (ZMUC); 26-VII-1951, Chr. Vibe, 2 females, det. Nielsen 1951 (as *hybrida*), det. Theowald 1965 & 1967 (as *scotica*), dry (ZMUC).

Period of flight: Collected in Greenland in July only.

Distribution: USA (Alaska: McKinley Nat. Park), Greenland, Far East Russia (Chukotka).

Habitat: Information is available for Chukotka only: tundra willow communities along river (Savchenko & Parkhomenko 1980).

Discussion: The only specimen of *S. (S.) hybrida* known from Greenland has identical labels as the above-mentioned female from Thule.

### **Symplecta (Symplecta) sunwapta**

*Erioptera (Symplecta) sunwapta* Alexander, 1952 – Ent. News 63: 267.

Greenland records (Map 4): Reported here for Greenland for the first time, on the basis of the following material:

– West Greenland, Søndestrøm Air Base [67°05'N], 18-VI to 1-VII-1952, M.J. Brown, 5 females, det. Brodo 2006, dry (CNCI); Søndestrøm Air Base, 1-VII-1952, M.R. Mason, 1 female, det. Stary 2006, dry (CNCI).

Period of flight: Not clear from the available data, but probably second half of June and first half of July.

Distribution: USA (Alaska), Canada (Yukon, Alberta), Greenland.

Habitat: About the type-material, collected end of July and early August 1949 at the Sunwapta Pass, Alberta, Alexander (1952) writes: "The fly was not uncommon in the wet boggy meadows at the pass. The specimens were swept from the tundra-like vegetation, including dwarf birch and willow, with grasses and sedges. Conditions were cold and bitter, even on sunny days, since the glaciers of Mount Athabasca and the Columbia Icefield are close at hand."

In the typical tundra subzone of the Taimyr Peninsula *S. (S.) sunwapta* is usually abundant near water biotopes, presumably in shingle and uliginous shoals of rivulets and small rivers. It occurs together with other species of Limoniidae, such as *Dicranota polaris*, *Arctocnopa obscuripes*, *Molophilus pleuralis*, *Molophilus propinquus* (Lantsov & Chernov 1987, as *Symplecta intermedia*).

References (not cited above): (Alexander 1955, description hypopygium).

### **Dactylolabis (Dactylolabis) rhicnoptiloides**

*Limnophila rhicnoptiloides* Alexander, 1919 – Rep. Can. Arctic Exped., 1913-18, 3 (C: Diptera): 6.

Greenland records (Map 5): Reported here for Greenland for the first time, on the basis of the following 3 specimens from Northeast Greenland:

– Holm Land [80°22'N 18°00'W], 23-VII-1993, 1 male, 1 female, dry (ZMUC).

– Kap København [82°24'N 22°12'W], VII-1986, Jens Böcher, 1 male in alcohol (ZMUC).

Period of flight: In Greenland collected in July only. On northern Ellesmere Island this species emerges slightly later than the other tipuloid species, not appearing before the first week in July and is on the wing into the second week of August (FB unpublished).

Distribution: Canada and USA (from Alaska to Ellesmere Island, Quebec and Labrador), Greenland.

Habitat. In the Canadian arctic, the species is found from the boreal forest tundra as far north as the high arctic (Brodo 1990). On high arctic Devon Island, Y. I. Chernov found the species in 1991 at a variety of habitats: plateau near slopes, polar desert, coastal sea lowland with dry crushed stone patches, stony tundra, wet lowland tundra with dry patches (VL unpublished). On Ellesmere Island the larvae have been found



under *Dryas* clumps (Brodo 2000) and larvae were also collected in pitfall traps and in the mud and silt beside water bodies, in ice-wedge depressions between tundra hummocks, and by clumps of *Carex* (FB unpublished).

Discussion: Figure 27 shows a crossvein in cell r<sub>3</sub>. This crossvein is always present in several species of *Dactylobasis* but in *D. (D.) rhinoptiloides* it tends to be evanescent (Alexander 1929). Figure 27 was drawn after the single paratype male. However, in the holotype the crossvein is absent (Alexander 1919), as it also is in the examined Holm Land specimens. The male from Kap København has the crossvein distinctly present in the left wing only; in the right wing there is no trace of it. The crossvein is also absent in 2 males, 2 females examined from Canada, Ellesmere Island, Hot Weather Creek but is present in other specimens from Ellesmere and Melville Islands and the Yukon (FB unpublished). Variability in size among specimens from Ellesmere Island is reported in Alexander (1924b).

References: Alexander (1943 (reprinted: 1966, key, short description)).

### **Dicranomyia (Dicranomyia) modesta**

*Limnobia modesta* Meigen, 1818 – Syst. Besch. 1: 134.

Greenland record (Map 5): Recorded for Greenland only once, by Lundbeck (1898), from the most southern part, Tunugdliarfik-Fjord [60°55'N 46°04'W], without further details. The record is confirmed in Lundbeck (1901), from which it can be concluded that a male is involved. According to Mannheims & Theowald (1971), the original Greenland material of this species is no longer preserved.

Period of flight: Unknown for Greenland.

Distribution: Canada (Northwest Territories), USA (Utah), Greenland, Western Europe (excluding Iceland), European and Asiatic Russia, Japan (Hokkaido, Honshu, Shikoku, Kyushu), Georgia, Armenia, Azerbaijan, Iran, Kazakhstan, Turkmenistan, Tajikistan, Kyrgyzstan, Afghanistan.

Habitat and biology: *D. (D.) modesta* is one of the most common eurytopic species of the genus (Savchenko 1982, Salmela 2004), occurring in a large variety of wet biotopes, such as different kinds of forest, shrub, bog and meadow communities. In mountain regions it does not penetrate above forest level (Tjeder 1958). In at least part of the range there are two or even more generations a year (Savchenko 1982, Salmela 2001). Females lay 130-160 eggs. The larvae are terrestrial to semi-aquatic, with habitats ranging from spring and brook environments to brackish (Lindner 1959) or even halophilous conditions (Schmidt 1913).

Discussion: Given the Holarctic distribution of the species, and the latitude of the record, it is possible that *D. (D.) modesta* has been indigenous to the very southern part of Greenland. Whether that is still the case seems questionable. Since 1898, crane-fly material has become available from some 25 localities at about or south of 61°N, without a further record for the species. On the other hand, the situation might turn out to be as in *T. (A.) besselsi besselsi*, collected in Greenland in 1872 and again in 1966.

References (not cited above): Noll 1985 (short description, phenology, review literature, distribution map).

### **Dicranomyia (Idiopyga) piscataquis**

*Limonia (Dicranomyia) piscataquis* Alexander, 1941 – Can. Ent. 73: 86.

Relevant synonymy: *Limonia (Dicranomyia) vibei* Nielsen, 1951; described from Greenland; synonymy: Alexander (1962).

Greenland records (Map 5): The species is known from five localities along the West coast between 60°40'N and 67°05'N. Material examined is from:

- Upernaviarssuk [60°45'N], 9-16-VIII-1982, Peter Nielsen, 1 male, det. Oosterbroek 2006, alc. (ZMUC).
  - Kapisigdlit [64°30'n], 12-VIII-1950, Chr. Vibe, 1 male, paratype of *vibei* Nielsen, 1951, alc. (ZMUC).
  - Locality 157 [= Kapisigdlit], 1-VIII-1950, Chr. Vibe, 2 males, paratypes of *vibei* Nielsen, 1951, alc. (ZMUC).
  - Søndestrøm Air Base [67°05'N], 15-VIII-1952, M.J. Brown, 2 males, 2 females, det. Brodo 2006, dry (CNCI).
- Mannheims & Theowald (1971) furthermore mention the localities Eqaqut [60°40'N] and Julianehaab [60°43'N].

Period of flight: Collected in Greenland between 1 and 25 August (material examined; Mannheims & Theowald 1971).

Distribution: USA (Alaska, Washington, Oregon and Maine), Canada (British Columbia), Greenland, far eastern Russia (Magadan province, Kamchatka, Kuril Islands).

Habitat: The type-material of *vibei* was collected on the bank of a river with a grass and *Salix* vegetation (Nielsen 1951). In Juneau, Alaska, this species was collected along a trail cutting through *Salix-Alnus-Tsuga* thickets. In Canada this species was trapped in clear-cut logging areas, Carmanah Valley, Vancouver Island (FB unpublished).

References (not cited above): Alexander (1954, description hypopygium).

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## Abbreviations

- CMNH: Carnegie Museum of Natural History, Pittsburgh, USA.  
 CNCI: Canadian National Collection of Insects, Ottawa, Canada.  
 MCZH: Museum of Comparative Zoology, Harvard University, Cambridge, USA.  
 OMNH: Oxford University Museum of Natural History, Oxford, UK.  
 ZMAN: Zoological Museum, University of Amsterdam, The Netherlands.  
 ZMUC: Zoological Museum, University of Copenhagen, Denmark.

## References

- Alexander, C.P., 1914. New or little-known crane-flies from the United States and Canada. Tipulidae, Diptera. – *Proceedings of the Academy of Natural Sciences of Philadelphia* 66: 579-606.  
 Alexander, C.P., 1916. New or little-known crane-flies from the United States and Canada: Tipulidae, Ptychopteridae, Diptera. Part 3. – *Proceedings of the Academy of Natural Sciences of Philadelphia* 68: 486-549.  
 Alexander, C.P., 1919. The crane-flies collected by the Canadian arctic expedition, 1913-18. – In: Anderson, R.M., Report of the Canadian arctic expedition 1913-18, Vol. III: Insects; Part C: Diptera: 3c-30c.  
 Alexander, C.P., 1920a. Scientific results of the Katmai expedition of the National Geographic Society. The crane-flies (Tipulidae, Diptera). – *Ohio Journal of Science* 20: 193-203.  
 Alexander, C.P., 1920b. The crane-flies of New York. Part II. Biology and phylogeny. – *Memoirs, Cornell University Agricultural Experiment Station* 38: 691-1133.

- Alexander, C.P., 1922. Report of the scientific results of the Norwegian expedition to Novaya Zemlya 1921. No. 5. The crane-flies (Superfamily Tipuloidea, Order Diptera), Videnskapselskapet, Kristiania, pp. 1-16.
- Alexander, C.P., 1924a. The crane-flies of New York: second supplementary list. – *Bulletin of the Brooklyn Entomological Society* 19: 57-64.
- Alexander, C.P., 1924b. Report of the second Norwegian arctic expedition in the Fram 1898-1902. – *Norsk Entomologisk Tidsskrift* 1: 296-297.
- Alexander, C.P., 1925. The crane-flies (Tipulidae) of New England: first supplementary list. – *Occasional Papers of the Boston Society of Natural History* 5: 169-174.
- Alexander, C.P., 1927. The crane-flies (Tipulidae) of New England: second supplementary list. – *Occasional Papers of the Boston Society of Natural History* 5: 223-231.
- Alexander, C.P., 1929. Undescribed species of crane-flies from the Eastern United States and Canada (Dipt.: Tipulidae). Part V. – *Entomological News* 40: 44-49.
- Alexander, C.P., 1934. Diptera collected on Southampton Island by George Miksch Sutton. Trichoceridae and Tipulidae. – *Memoirs of the Carnegie Museum* 12(2) (4): 3-10.
- Alexander, C.P., 1936. The crane-flies (Tipulidae) of New England: fourth supplementary list. – *Occasional Papers of the Boston Society of Natural History* 8: 273-292.
- Alexander, C.P., 1941. New Nearctic crane-flies (Tipulidae, Diptera). Part XV. – *Canadian Entomologist* 73: 85-90.
- Alexander, C.P., 1943. Family Tipulidae. In: Crampton, G.C. et al., Guide to the insects of Connecticut. Part VI. The Diptera or true flies of Connecticut. First Fascicle. – *Bulletin Connecticut State Geological and Natural History Survey* 64: 196-486. [Reprinted 1966]
- Alexander, C.P., 1946. Undescribed species of crane-flies from the eastern United States and Canada (Dipt.: Tipulidae). Part X. *Entomological News* 57: 245-252.
- Alexander, C.P., 1952. Undescribed species of crane-flies from the western United States and Canada (Dipt.: Tipulidae). Part XIII [concl.]. – *Entomological News* 63: 267-271.
- Alexander, C.P., 1954. Records and descriptions of North American crane-flies (Diptera). Part IX. The Tipuloidea of Oregon. I. – *American Midland Naturalist* 51: 1-86.
- Alexander, C.P., 1955. The crane flies of Alaska and the Canadian Northwest (Tipulidae, Diptera). The genus Erioptera Meigen. – *Miscellaneous Publications, Museum of Zoology, University of Michigan* 90: 1-33.
- Alexander, C.P., 1962. The crane flies of Maine. – *University of Maine, Agriculture Experiment Station Bulletin T4, Technical Series*: 1-24.
- Alexander, C.P., 1965. Family Tipulidae. In: Stone, A. et al., A catalog of the Diptera of America north of Mexico. – *United States Department of Agriculture, Agriculture Handbook* 287: 16-90.
- Alexander, C.P. 1969. Undescribed species of nearctic Tipulidae (Diptera). X. *Great Basin Naturalist*. 29: 1-10.
- Beling, T., 1879. Zweiter Beitrag zur Naturgeschichte (Metamorphose) verschiedener Arten aus der Familie der Tipuliden. – *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 28: 21-56.
- Brodo, F., 1987. A revision of the genus Prionocera (Diptera: Tipulidae). – *Evolutionary Monograph* 8: 1-93.
- Brodo, F., 1990. Crane flies (Diptera: Tipulidae) of the arctic islands. – In: Harrington, C.R. (ed.), *Canadas missing dimension*, Vol. 2. Canadian Museum of Nature, Ottawa: 471-484.
- Brodo, F., 2000. The insects, mites, and spiders of Hot Weather Creek, Ellesmere Island, Nunavut. – *GSC Bulletin* 529: 145-173.
- Byers, G.W., 1992. Crane flies – three families or one. – *Acta Zoologica Cracoviensia* 35: 37-41.
- Carpenter, G.D.H., 1938. Notes on insects collected in West Greenland by the Oxford University Greenland expedition, 1936. – *Annals and Magazine of Natural History* (11) 1: 529-553.
- Chandler, P.J. & Crossley, R., 2003. Symplecta chosenensis (Alexander, 1940) (Diptera, Limoniidae) new to Britain, with comments on the status of S. scotica (Edwards, 1938). – *Dipterists Digest* 10: 49-54.
- Cotton, M.J. 1979. Records of insects from north-east Greenland. – *Entomologist's Monthly Magazine* 113: 213-217.
- Curtis, J., 1835. Descriptions, andc. of the insects brought home by commander James Clark Ross, R.N., F.R.S., andc. In: Ross, J., Appendix to the narrative of a second voyage in search of

- a north-west passage and of a residence in the arctic regions during the years 1829, 1830, 1831, 1832, 1933. London: lix-lxxx.
- Doane, R.W., 1900. New north American Tipulidae. – *Journal of the New York Entomological Society* 8: 182-198.
- Doane, R.W., 1912. New western Tipula. – *Annals of the Entomological Society of America*, 5: 41-61.
- Dufour, C., 1986. Les Tipulidae de Suisse (Diptera, Nematocera). – *Documenta Faunistica Helvetiae* 2: 1-187, fiches 1-149.
- Edwards, F.W., 1931. Oxford University Greenland expedition, 1928. Diptera, Nematocera. – *Annals and Magazine of Natural History* (10) 8: 617-618.
- Edwards, F.W., 1938. British short-palped craneflies. Taxonomy of adults. – *Transactions of the Society for British Entomology* 5: 1-168.
- Fabricius, J.C., 1794. Entomologia systematica emendata et aucta. Secundum classes, ordines, genera, species, adjectis synonymis, locis observationibus, descriptionibus. Hafniae [= Copenhagen], 4: i-viii, 1-472.
- Fabricius, O., 1780. Favna Groenlandica. – J.G. Rothe, Hafniae et Lipsiae [= Copenhagen & Leipzig]: i-xvi, 1-452.
- Gerstaecker, A., 1874. Die zweite deutsche Nordpolfahrt in den Jahren 1869 und 1870. 2: 404-406.
- Hemmingsen, A.M., 1956. Deep-boring ovipository instincts of some crane-fly species (Tipulidae) of the subgenera *Vestiplex Bezzi* and *Oreomyza* Pok. and some associated phenomena. – *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* 118: 243-315.
- Hemmingsen, A.M. & Jensen, B., 1957. The occurrence of *Tipula* (*Vestiplex*) *arctica* Curtis in Greenland and its decreasing body length with increasing latitude. – *Meddelelser om Grønland* 159: 3-20.
- Henriksen, K.L., 1939. A revised index of the insects of Grønland containing a supplement to the insect list in Kai L. Henriksen and Will. Lundbeck: Grønlands Landarthropoder. – *Meddelelser om Grønland* 119: 1-112.
- Henriksen, K.L. & Lundbeck, W., 1918. Landarthropoder (Insecta et Arachnida). – *Meddelelser om Grønland* 22: 481-823.
- Johansen, F., 1910. I. General remarks on the life of insects and arachnids in North-East Greenland. In: Johansen, F. & Nielsen, I.C., The insects of the Danmark expedition. – *Meddelelser om Grønland* 43: 35-54.
- Jong, H. de, 1993. The phylogeny of the *Nephrotoma flavescens* species group (Diptera: Tipulidae). – *Tijdschrift voor Entomologie* 136: 235-256.
- Jong, H. de, 1998. In search of historical biogeographic patterns in the western Mediterranean terrestrial fauna. – *Biological Journal of the Linnean Society* 65: 99-164.
- Kirby, W., 1824. Land invertebrate animals. – In: Parry, W.E., A supplement to the appendix of Captain Parry's voyage for the discoverage of a North-West Passage, in the years 1819-20. London: ccxiv-ccxix.
- Korte, J. de, 1986. Ecology of Long-tailed Skua, *Stercorarius longicaudatus* at Scoresby Sund, East Greenland. Part 5: Food and feeding habits: 1-30. – Thesis University of Amsterdam.
- Lackschewitz, P., 1936. Das Genus *Tipula* in der Arktis und dem borealen Waldgebiet Eurasiens. – *Trudy Zoologicheskogo Instituta, Akademiya Nauk SSSR, Leningrad* 4: 245-312.
- Lantsov, V.I., 1982. Adaptive peculiarities of the life cycle of the arctic crane-fly *Tipula carinifrons* (Diptera, Tipulidae). – *Ekologiya* 1: 71-76 (in Russian) (English translation: 1982, *Soviet Journal of Ecology* 13: 67-71).
- Lantsov, V.I., 1984. Ecology, morphology and taxonomy of arctic crane-flies of the genus *Prionocera* (Diptera: Tipulidae). – *Zoologicheskii Zhurnal* 63: 1196-1204 (in Russian).
- Lantsov, V.I., 1997. Trophic relations of aquatic crane-flies (Diptera, Tipulidae) in the arctic. – In: Diptera (Insecta) in Ecosystems, Zoological Institute, Russian Academy of Sciences, St. Petersburg: 73-75 (in Russian).
- Lantsov, V.I. & Chernov, Y.I., 1987. Tipuloid crane-flies in the tundra zone. Moscow: 1-175 (In Russian).
- Lindner, E., 1959. Beiträge zur Kenntnis der Larven der Limoniidae (Diptera). – *Zeitschrift für Morphologie und Ökologie der Tiere* 48: 209-319.

- Linnaeus, C., 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum caracteribus, differentiis, synonymis, locis*. Ed. 10. Salvii, Holmiae [= Stockholm], I: i-iv, 1-824.
- Lundbeck, W., 1896. Fortegnelse over de indsamlede insekter. – *Meddelelser om Grønland* 19: 105-120.
- Lundbeck, W., 1898. Diptera groenlandica. – *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kjobenhavn* 1898: 236-314.
- Lundbeck, W., 1901. Diptera groenlandica. – *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kjobenhavn* 1900: 281-316.
- Lundström, C., 1915. Diptera-Nematocera aus den arctischen Gegenden Sibiriens. – *Memoires de l'Academie Imperiale des Sciences de St.-Petersbourg* (8) 29(8): 1-33.
- Mannheims, B., 1953. 15. Tipulidae. – In: Lindner, E. (ed.), *Die Fliegen der palaearktischen Region*, 3(5)1, Lief. 173: 113-136.
- Mannheims, B., 1962. Zur Synonymie der europäischen Tipuliden (Dipt.), VII. – *Bonner Zoologische Beiträge* 13: 193-195.
- Mannheims, B. & Theowald, Br., 1971. Die Tipuliden von Grönland (Diptera, Tipulidae). – *Bonner Zoologische Beiträge* 22: 332-342.
- Meigen, J.W., 1804. Klassifikation und Beschreibung der europäischen zweiflügeligen Insekten (Diptera Linn.). Braunschweig, I: i-xxviii, 1-152; 2: i-vi, 153-314.
- Meigen, J.W., 1818. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Aachen, I: i-xxxvi, 1-333.
- Messersmith, D.H., 1982. A report on the a collection of Diptera from Iceland and Greenland. – *Fauna Norvegia*, Serie B 29: 36-39.
- Nielsen, I.C., 1907. The insects of East-Greenland. – *Meddelelser om Grønland* 29: 363-409.
- Nielsen, I.C., 1910. II. A catalogue of the insects of north-east Greenland with description of some larvae. In: Johansen, F. & Nielsen, I.C., *The insects of the Danmark expedition*. – *Meddelelser om Grønland* 43: 55-68.
- Nielsen, P., 1951. *Limonia* (*Dicranomyia*) *vibeii* n.sp. from Grønland (Dipt. Tipul.). – *Entomologiske Meddelelser* 26: 185-186.
- Noll, R., 1985. Taxonomie und Ökologie der Tipuliden, Cylindrotomiden, Limoniiden und Trichoceriden unter besonderer Berücksichtigung der Fauna Ostwestfalens. – *Decheniana, Beiheft* 28: 1-265.
- Oliver, D.R., 1963. Entomological studies in the Lake Hasen area, Ellesmere Island, including a list of species of Arachnida, Collembola and Insects. – *Arctic* 16: 175-180.
- Oosterbroek, P., 1978. The western palaeartic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae), part 1. – *Beaufortia* 27: 1-137.
- Oosterbroek, P., 1979. The western palaeartic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae), part 4, including a key to the species. – *Beaufortia* 29: 129-197.
- Oosterbroek, P., 1980. The western palaeartic species of *Nephrotoma* Meigen, 1803 (Diptera, Tipulidae), part 5, Phylogeny and Biogeography. – *Beaufortia* 29: 311-393.
- Oosterbroek, P., 1984. A revision of the crane-fly genus *Nephrotoma* Meigen, 1803, in North America (Diptera, Tipulidae), Part II, the non-dorsalis species-groups. – *Beaufortia* 34: 117-180.
- Oosterbroek, P.; Tangelder, I.R.M., 1987. A new subspecies, *Nephrotoma lundbeckii alexanderi*, described from south of the maximum extent of the Laurentide Ice and new distribution records for other nearctic *Nephrotoma* (Diptera: Tipulidae). – *Canadian Entomologist* 119: 49-53.
- Osten Sacken, C.R., 1877. Report on the Diptera brought home by Dr. Bessels from the arctic voyage of the *Polaris* in 1872. – *Proceedings of the Boston Society of Natural History* 19: 41-43.
- Podenas, S., 1995. The families Tipulidae, Limoniidae, Cylindrotomidae, Trichoceridae and Ptychopteridae in Lithuania: an eco-faunistic approach. – These, Faculte des Sciences, Universite de Neuchatel: 1-119 + 286 synthetical cards (distribution, phenology, etc.).
- Podeniene, V., 2001. Notes on the larvae of Lithuanian Tipulidae from the subgenera *Tipula* (*Acutipula*), *T.* (*Beringotipula*) and *T.* (*Platytipula*). – *Ekologija* 2001 (2): 81-89.
- Podeniene, V., 2003a. Morphology and ecology of the last instar larvae of the crane flies (Diptera, Tipulomorpha) of Lithuania. Doctoral dissertation Vilnius University, Biomedical sciences, Zoology: 1-295 (In Lithuanian).

- Podeniene, V., 2003b. Morphology and ecology of the last instar larvae of the crane flies (Diptera, Tipulomorpha) of Lithuania. – Summary of Doctoral dissertation Vilnius University, Biomedical sciences, Zoology: 1-35 (In English with Lithuanian summary).
- Podeniene, V. & Gelhaus, J.K., 2002. The first description of the larva of the crane fly genus *Gonempeda* Alexander, 1924 (Limoniidae: Chioneinae), with new information understanding the phylogenetic relationships of the genus. – *Proceedings of the Academy of Natural Sciences of Philadelphia* 152: 67-73.
- Reusch, H., 1988. Faunistische und phanologische Untersuchungen über Stelzmücken des Niedersächsischen Tieflandes (Diptera: Limoniidae). – *Braunschweiger Naturkundliche Schriften* 3: 171-203.
- Riedel, M.P., 1919. Resultats scientifiques de l'expédition des freres Kuznecov (Kouznetzov) a l'Oural Arctique en 1909, sous la direction de H. Backlund, 8. Nematocera polyneura. – *Zapiski Rossijskoi Akademii Nauk, Leningrad* (8) 28(8): 1-10.
- Ross, J.C., 1826. Appendix, Zoology. In : Ross, J.C., Journal of a third voyage for the discovery of a North-West passage from the Atlantic to the Pacific performed in the years 1824-25, in his majesty's ships Hecla and Fury, under the orders of captain William Edward Parry, R.N., F.R.S., and commander of the expedition. Murray, London: 111-115.
- Salmela, J., 2001. Adult craneflies (diptera: Nematocera) around springs in southern Finland. – *Entomologica Fennica* 12: 139-152.
- Salmela, J., 2004. Semiaquatic flies (Diptera, Nematocera) of three mires in the southern boreal zone, Finland. – *Memoranda Societatis pro Fauna Flora Fennica* 80: 1-10.
- Savchenko, E.N., 1961. Crane-flies (Diptera, Tipulidae), Subfam. Tipulinae, Genus *Tipula* L., 1. – *Fauna USSR, Diptera*, 2(3) (N.S.) 79: 1-488 (in Russian).
- Savchenko, E.N., 1964. Crane-flies (Diptera, Tipulidae), Subfam. Tipulinae, Genus *Tipula* L., 2. – *Fauna USSR, Diptera*, 2(4) (N.S.) 89: 1-503 (in Russian).
- Savchenko, E.N., 1982. Limoniid-flies (subfamily Eriopterinae). – *Fauna Ukrainy* 14(3): 1-335 (in Ukrainian).
- Savchenko, E.N., 1989. Limoniidae fauna of the USSR. Akad. Nauk Ukrainian SSR, Kiev: 1-377 (In Russian).
- Savchenko, E.N. & Krivolutskaya, G.O., 1976. Limoniidae of the south Kuril Islands and south Sakhalin. Akad. Nauk. ukr. SSR, Kiev: 1-160 (In Russian).
- Savchenko, E.N. & Parkhomenko, S.I., 1980. Preliminary data on the Limoniid-flies (Diptera, Limoniidae) fauna of Chukotka. – *Freshwater Fauna of the Far East, Vladivostok*: 95-109 (in Russian).
- Savchenko, E.N., Violovich, N.A. & Narchuk, E.P., 1972. Review of the crane-flies (Diptera, Tipulidae) of the Altai mountains. – *Entomologicheskoe Obozrenie* 51: 74-95 (in Russian) (English translation: 1972, *Entomological Review* 51(1): 45-57).
- Schiødte, J.M.C., 1857. Udsigt over Grønlands land, ferskvands og strandbreds arthropoder. – In: Rink, H.J., Grønland, geographisk og statistisk beskrevet. Kopenhagen, 2 vols. (German translation in Berliner Entomologische Zeitschrift 3: 134-157 [1859].)
- Schmidt, R., 1913. Die Salzwasserfauna Westfalens. – *Jahresbericht des Westfälischen Provinzial-Vereins für Wissenschaft und Kunst* 1913: 29-94.
- Scopoli, J.A., 1763. Entomologia carniolica exhibens insecta carnioliae indigena et distributa in ordines, genera, species, varietates, methodo Linnaeana. Vindobonae [= Vienna]: 1-424.
- Siebke, H., 1863. Beretning om en i Sommeren 1861 foretagen entomologisk reise. – *Nyt Magazin for Naturvidenskapene* 12: 105-192.
- Sary, J., 1992. Phylogeny and classification of Tipulomorpha, with special emphasis on the family Limoniidae. – *Acta Zoologica Cracoviensia* 35: 11-36.
- Sary, J., 2003. Revision of European species of the genus *Rhabdomastix* (Diptera: Limoniidae). Part 1: Introduction and subgenus *Lurdia* subgen. n. – *European Journal of Entomology* 100: 587-608.
- Theowald, Br., 1967. Familie Tipulidae (Diptera, Nematocera). Larven und Puppen. – *Bestimmungsbücher zur Bodenfauna Europas* 7: 1-100.
- Theowald, Br., 1971. Drei holarktische Symplecta-Arten (Diptera, Limoniidae). – *Beaufortia* 19: 45-56.
- Tjeder, B., 1948. The Swedish Prionocera. – *Opuscula Entomologica* 13: 75-99.
- Tjeder, B., 1958. A synopsis of the Swedish Tipulidae, 1. Subfam. Limoniinae: tribe Limoniini. – *Opuscula Entomologica* 23: 133-169.

- Tjeder, B., 1964. Neuroptera, Trichoptera and Diptera-Tipulidae from Iceland with a redescription of *Rhabdomastix parva* Siebke. – *Opuscula Entomologica* 29: 143-151.
- Tjeder, B., 1970. *Rhypholophus affinis* Lundbeck, 1898, from Greenland; redescription and lectotype designation (Diptera: Tipulidae). – *Entomologiske Meddelelser* 38: 253-256.
- Ujvarosi L., 2005. Limoniidae and Pediciidae (Insecta: Diptera) assemblages along mountainous streams: additions to assess the biodiversity in wet habitats in Carpathians, Romania. – *Acta Biol. Debr. Oecol. Hung.* 13: 233-248.
- Wrage, H.-A., 1982. Ökologie der Stelzenmücken (Limoniidae) des Litorals und angrenzender Gebiete im Nordseekostenbereich (Diptera, Nematocera). – *Faunistisch-Ökologische Mitteilungen*, Supplement 3: 1-48.
- Young, C.W. & Gelhaus, J.K., 2000. Crane Flies of Pennsylvania: Preliminary checklist and database development with emphasis on aquatic species. Reprint submitted to Pennsylvania Wild Resource Conservation Fund: i-ii, 1-256 (Available from the authors).
- Zetterstedt, J.W., 1837. Conspectus familiarum, generum et specierum Dipteroorum, in fauna insectorum Lapponica descriptorum. – *Isis* (Oken) 1837(1): 28-67.
- Zetterstedt, J.W., 1838. Sectio tertia. Diptera. Dipterologis Scandinaviae amicis et popularibus carissimus. *Insecta Lapponica*. Lipsiae [=Leipzig]: 477-868.
- Zinovjev, G.A. & Savchenko, E.N., 1962. On the fauna of crane-flies (Diptera, Tipulidae) of the Amur and Zea rivers interarea. – *Entomologicheskoe Obozrenie* 41: 554-571 (in Russian).