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Tanytarsus aquavolans, spec. nov. and *Tanytarsus nearcticus*, spec. nov., two surface-swarming midges from arctic tundra ponds

(Insecta, Diptera, Chironomidae)

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Two new species of *Tanytarsus* van der Wulp, 1874 are described from adult specimens collected on coastal tundra ponds in arctic Alaska and Canada. *T. aquavolans*, spec. nov. is an early-emerging, pelagic-swarming midge showing pronounced modifications to wings, legs, male antennae and hypopygium associated with surface mating. *T. nearcticus*, spec. nov. is a later-emerging midge that also swarms and mates on the water surface, but shows modification of only leg and antennal proportions, relative to aerially-swarming species in the *gregarius* group.

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Introduction

In their revision of European *Tanytarsus*, Reiss & Fittkau (1971) proposed the *gregarius* group for two very similar species, *T. gregarius* Kieffer and *T. inaequalis* (Goetghebuer). Characteristic of profundal and sublittoral benthos in oligotrophic to eutrophic lakes of central Europe, these have remained the only members of this species group (Cranston et al. 1989). During studies of Alaskan arctic tundra ponds near Barrow (Butler et al. 1980, Butler 1980a, b) and Prudhoe Bay (Butler 1982), two new species were discovered which also belong in or near the *gregarius* group. Because they were among the most abundant of over 20 chironomid taxa emerging from the Barrow ponds, these two species became a focus of my systematic work at the Zoologische Staatssammlung in 1980-81, under the tutelage of Drs F. Reiss and E. J. Fittkau. Dr. J. E. Sublette (Tucson, Arizona) subsequently provided additional material of both species collected from the Barrow ponds in earlier years, and specimens of one species from two other arctic localities. Here I describe the adults of *Tanytarsus aquavolans*, spec. nov. and *Tanytarsus nearcticus*, spec. nov., and comment on some morphological, ecological, and behavioral characteristics of these arctic midges.

Methodology

Locations of the ponds sampled are described by Butler (1980b, 1982). Large numbers of adults and pupal exuviae of both species were collected with emergence traps at the Barrow sites (Butler 1980a,b). Because many trapped specimens were recently eclosed and thus not fully hardened, most measure-

Fig. 1a. *Tanytarsus aquavolans*, spec. nov.; adult male. Hypopygium, dorsal (scale: 100 μm).

ments were made on specimens collected by dipping adults from the pond surface during swarming, or by rearing. Some individual life stage associations were obtained by laboratory rearing of larvae or pupae at 10 °C. All material was preserved in 70 % ethanol until mounted in Euparal. Measurements were made according to Schlee (1968), and are presented as means, followed by ranges and numbers of measurements as applicable. Terminology follows Sæther (1980). Abbreviations used below are: CNC = Canadian National Collections (Ottawa, Ontario); IBP = International Biological Programme; USNM = United States National Museum (Washington, D.C.); ZSM = Zoologische Staatssammlung Munich (Germany).

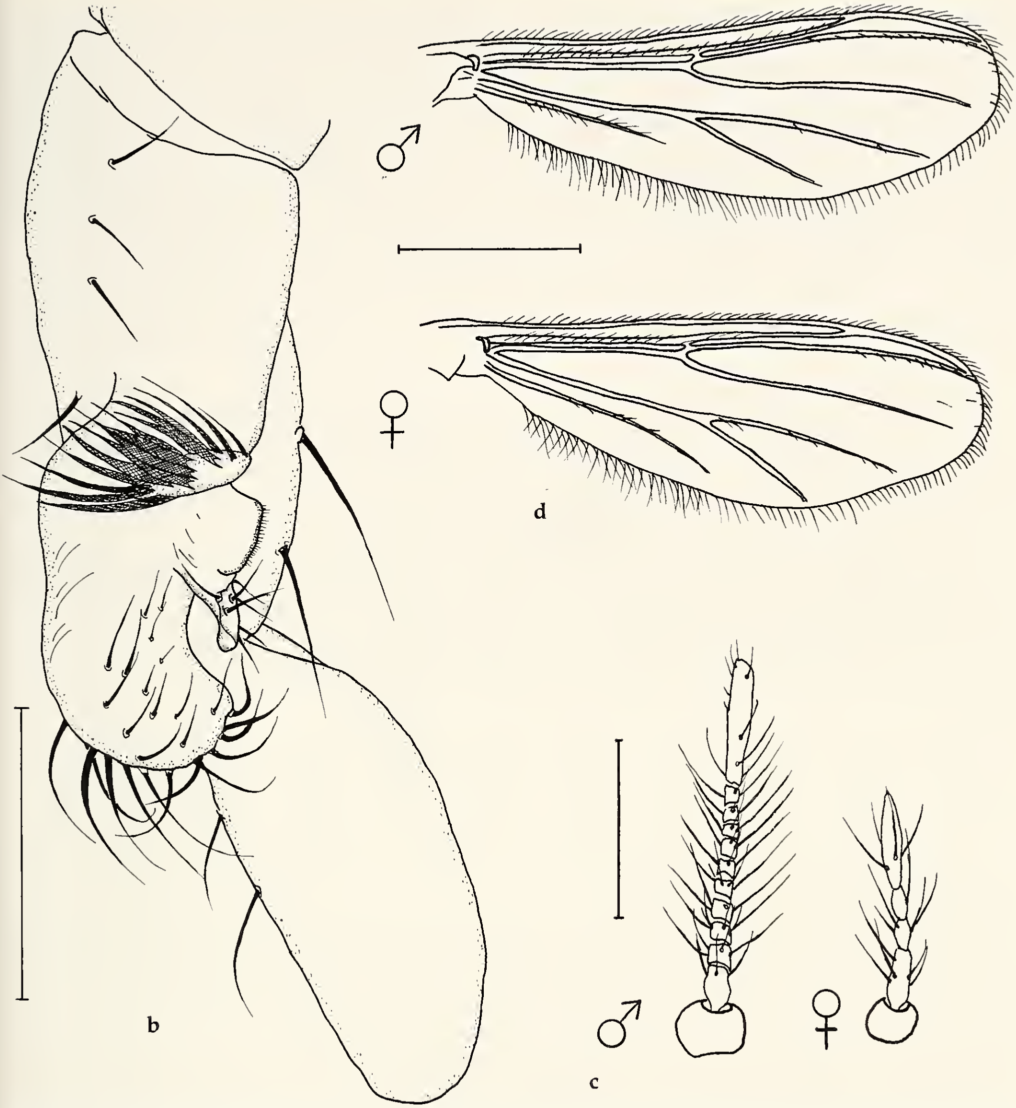


Fig. 1b-c. *Tanytarsus aquavolans*, spec. nov.; adult male. **b.** Gonocoxite/gonostylus and appendages, median aspect (scale: 100 μm). **c.** Male and female antennae (scale: 25 μm). **d.** Male and female wings (scale: 50μm).

Tanytarsus aquavolans, spec. nov.

Fig. 1

"*Tanytarsus gregarius* gr.-sp. 2" Butler 1980a; Butler et al. 1980; ecology and phenology.
"*Tanytarsus* sp. 1" Butler 1980b; life history and production ecology.

Type material. Holotype: 1 associated Pex+adult ♂ (on two slides, in Euparal), USA, Alaska, Barrow, IBP site Pond J, 23.VI.1977, leg. M. Butler (USNM). – Paratypes (all from USA, Alaska; slide-mounted in Euparal or balsam): 10 adult ♂♂ on one slide, 3 adult ♀♀ on one slide, as holotype except 25.VI.1977 (USNM); 4 adult ♂♂ on one slide, Prudhoe Bay, Loon Pond (70°23'N, 148°31'W), 28.VI.1979 (ZSM); 2 adult ♂♂, 2 adult ♀♀, Alaska, Barrow, Pond J, 3.VII.1972, leg. D. A. Bierle, slides No. CH236.10 to 13 (CNC); 1 adult ♀, as previous except 4.VII.1972, slide No. CH249.1 (CNC).

Diagnosis. *Tanytarsus aquavolans*, spec. nov. is easily recognized by the unique hypopygium in combination with several pronounced morphological reductions. The male antennal flagellum is shortened and bears short setae; both sexes have short palps, legs and wings. The rarity of setae in the wing cells is characteristic. Important diagnostic characters of the male hypopygium include its generally robust form, lack of median setae on the anal tergite, lack of microtrichia or (usually) spine groups between anal point crests, lack of a digitus, and division of the superior volsella into two distinct portions with the proximo-dorsal surface bearing microtrichia. Among described Holarctic *Tanytarsus*, the new species is most similar to members of the *lugens*- or *gregarius* groups (after Reiss & Fittkau 1971), but shows too many deviating characters for group placement to be productive at this time.

Etymology. The name reflects the pelagic swarming behavior of this surface-mating species.

Description

Adult male.

Size. Total length 2.5 mm (2.4-2.7, n=5).

Coloration. Greenish-brown in life. Alcohol-preserved specimens light brown with chestnut-brown scutal bands (separated), postnotum, and preepisternum. Abdomen, legs, and scutellum uniformly light brown.

Head. Frontal tubercle large, conical (length 21-46 μm, n=7). Palpomere lengths 2-5 (in μm) 48, 93, 73, 116 (n=8).

Antenna (Fig. 1c). Highly reduced relative to generic standard. Distal flagellomeres fused so that only 9-12 segments can be distinguished, thus AR cannot be measured consistently. Total length of flagellum 0.47 mm (0.43-0.51, n=8). Length of longest flagellar seta 130 μm.

Wing (Fig. 1d). Length 1.48 mm (1.41-1.67, n=16), VR=0.96 (0.94-0.98, n=8). Setae present on veins R_1, R_{4+5}, Cu, and An; absent from cells except occasionally at distal margin of r_{4+5}.

Legs. Segment lengths (in μm; n=1) and proportions:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR
p_1	750	550	600	270	210	150	120	1.12 (1.08-1.23, n=15)
p_2	720	600	250	160	120	80	80	0.41 (0.38-0.42, n=12)
p_3	790	690	360	220	200	110	100	0.52 (0.49-0.53, n=12)

Foreleg lacking beard, bearing single tibial spur (length 26 μm). Mid and hind tibia with two combs, each bearing a single spur. Pulvilli present.

Hypopygium (Figs 1a,b). Of generally robust appearance. Anal tergite lacking lateral teeth and median setae. Anal tergal bands V-shaped, not parallel or connected. Anal point broad, with anal point crests reaching to the rounded tip. No microtrichia, and generally no spine groups between crests (1 specimen in 24 examined had a single spine between crests, 24 μm anterior of anal point tip). Each side of anal point bearing 8-10 setae. Superior volsella with two distinct portions (Figs 1a,b): basal portion inflated, entire dorsal surface densely covered with microtrichia and supporting 6-12 dorsal and lateral setae; distal portion lacking microtrichia, but with 7-12 median, dorsal and lateral setae. Digitus lacking. Median volsella projecting postero-ventrally and bearing many subulate and foliate lamellae (Figs 1a,b). Inferior volsella completely covered with microtrichia, distal ⅓ curving to dorsal and bearing long, curved setae (Fig. 1b).

Adult female.

Size. Total length 2.1 mm (1.7-2.8, n=5).

Coloration. Same as male.

Antenna as in Fig. 1c.

Wing (Fig. 1d). Length 1.50 mm (1.33-1.65, n=9). VR=0.91 (0.86-0.94, n=6). Shape and setation similar to male.

Legs. Segment lengths (in μm; n=1) and proportions:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR
p_1	630	500	580	260	200	130	100	1.15 (1.13-1.16, n=6)
p_2	660	600	250	150	110	80	80	0.42 (0.40-0.45, n=6)
p_3	790	720	380	220	210	100	90	0.52 (0.41-0.55, n=6)

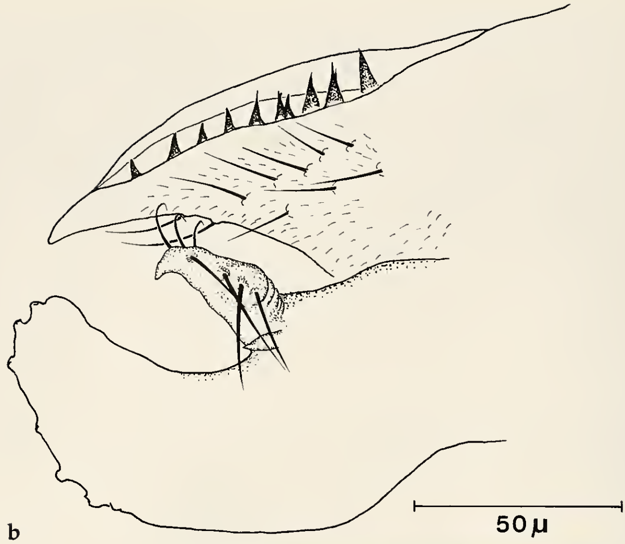
Fig. 2a. *Tanytarsus nearcticus*, spec. nov.; adult male. Hypopygium, dorsal (scale: 100 µm).

Tanytarsus nearcticus, spec. nov.

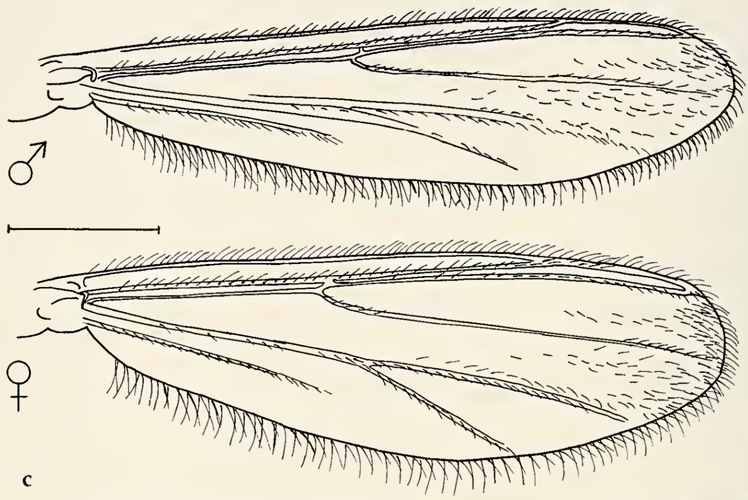
Fig. 2

"*Tanytarsus inaequalis*" Butler 1980a; Butler et al. 1980; ecology and phenology.
"*Tanytarsus* sp. 2" Butler 1980b; life history and production ecology.

Type material. Holotype: 1 individually associated Lex+Pex+adult ♂ (on 1 slide, in Euparal), USA, Alaska, Barrow, IBP site Pond X, 27.VII.1976, leg. M. Butler (USNM). – Paratypes (all slide-mounted in Euparal or balsam). CANADA: adult ♂, labeled "Chesterfield NWT 9-VIII-1950 J. R. Vockeroth CNC 9"; ♂ hypopygium, labeled "Coral Harbour Southampton Is. 20-VII-1948 G. E. Shewell CNC 573-1136" (CNC); USA (Barrow, Alaska, leg. M. Butler): 1 Pex+adult ♂ (on 2 slides), Pond G, 17.VII.1976; 1 Lex+Pex+adult ♀ (on 1 slide), as holotype except Pond G; 1 adult ♂, Pond Q, 14.VII.1977; at USNM. 1 Lex+Pex+adult ♂ (on 1 slide), Pond X, 14.VII.1976; 1 Lex+Pex+adult ♀ (on 1 slide), Pond G, 27.VII.1976 (ZSM); 1 adult ♂, Barrow, Pond J, 10.VII.1972, No. CH230.4; 1 adult ♂, 3 adult ♀♀, 11.VII.1972, No. CH450.1 to 3 and CH231.1, leg. D. A. Bierle (CNC); 15 adult ♂♂ on 12 slides (No. 563-102, 104, 162, 171, 174, 179, 187, 200, 202, 203, 204), Cape Thompson, Ogotoruk Cr., pond 4, CI-583 #6064, 4.VIII.1961, leg. J. J. Davis (CNC).



b



c

Fig. 2b-c. *Tanytarsus nearcticus*, spec. nov.; adult male. **b.** Anal point, superior and inferior volsella, median aspect (scale: 100 μm). **c.** Male and female wings (scale: 50 μm).

Diagnosis. *Tanytarsus nearcticus*, spec. nov. is very similar to *T. inaequalis* (Goetghebuer), and the two may be considered sister-species. Adult male *T. nearcticus* from four locations in arctic Alaska and Canada differ from *inaequalis* material from several German lakes (Großer Plöner See, Stechlinsee, Chiemsee) by the following characters:

The most notable difference is in the antennal ratio: *T. nearcticus* = 0.60-0.79, *inaequalis* = 1.54-1.73 (Reiss & Fittkau 1971). *T. nearcticus* is slightly smaller, with WL=1.8-2.2 mm, *inaequalis* WL=2.5-3.0 mm.

Fore leg ratio: *T. nearcticus* = 1.53-1.69, *inaequalis* = 1.93-2.0 (Reiss & Fittkau 1971).

Hypopygium: See *T. inaequalis* figures in Reiss & Fittkau (1971) and Pinder (1978). In both species, usually 3 long, straight setae project from the median margin of the superior volsella. Most *inaequalis* specimens have a gap between the basal and the two more distal setae, usually with the proximal seta originating farther ventral than the other two. In *T. nearcticus*, the 3 setae are usually in a close, evenly-spaced group, often with the central seta inserting dorsally of the other two. The broad, smooth, spatulate tip of the anal point in *T. nearcticus* contrasts with the narrower tip of *inaequalis*, which usually shows some ventral granulation. The sum of these differences is considered sufficient for species separation, in analogy to similar such "dual species" pairs of which one member shows surface mating adaptations (Wülker 1959).

Etymology. The name should not be taken to imply restriction of the species to North America. It seems likely that *T. nearcticus* will also be found in the northern Palaearctic when similar habitats are investigated there.

Description

Adult male.

Size. Total length 2.7 mm (2.5-2.9, n=7).

Coloration. Light green in life. Alcohol-preserved specimens translucent yellow with chestnut-brown scutal bands (separated), posterior pronotum, and preepisternum.

Head. Frontal tubercle finger-like; length 14-23 µm, width 8-12 µm (n=6). Palpomere lengths 2-5 (in µm) 46, 139, 121, 175 (n=7).

Antenna. AR 0.72 (0.60-0.79, n=12).

Wing (Fig. 2c). Length 1.99 (1.71-2.16, n=10). VR=0.87 (0.86-0.90, n=6). Setae on veins R_{4+5} and M_{1+2}, and in cells r_{4+5} and m_{1+2}.

Legs. Segment lengths (in µm; n=1) and proportions:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR
p_1	1010	650	990	510	460	320	160	1.57 (1.51-1.65, n=9)
p_2	960	870	410	280	220	160	120	0.47 (0.44-0.50, n=11)
p_3	1100	1070	650	410	360	230	130	0.60 (0.56-0.62, n=12)

Foreleg lacking beard; fore tibia bearing single spur (length 28 µm). Mid and hind tibia with two combs each bearing a long spur. Pulvilli present.

Hypopygium (Figs 2a,b). Anal tergite lacking lateral teeth and median setae. Anal tergal bands V-shaped, meeting weakly. Anal crests arise near confluence of anal tergal bands and converge with margin of anal tergite anterior to tip anal of point. Sensillar pit (Spies 1998) with 6-13 (n=9) spine groups (= sensilla basiconica) and small, erect microtrichia; a few spine groups may also be present anterior to the sensillar pit proper. Tip of anal point spatulate and devoid of punctation, granulation, or microtrichia. Each side of anal point bearing 7-10 setae. Superior volsella inversely drop-shaped with tip projecting ventrally; bearing 3-4 long, straight setae projecting medially from inner margin, plus 6-9 smaller dorsal and lateral setae (Figs 2a,b). Digitus a small finger arising from medial side of base of superior volsella (Figs 2a,b). Median volsella projecting postero-ventrally, bearing 6-8 foliate lamellae and numerous bristle-like setae (Fig. 2a). Inferior volsella completely covered with microtrichia, distal ⅓ bearing long, curved setae and curving to dorsal; distal-median margin in dorsal aspect usually with convex or angular projection, giving the volsella a club-shaped appearance.

Adult female.

Size. Total length 2.2 mm (1.8-2.4, n=7).

Coloration. Same as male.

Wing (Fig. 2c). Length 2.19 (2.00-2.54, n=6). Relatively broader than in male.

Legs. Segment lengths (in mm; n=1) and proportions:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR
p_1	790	510	860	450	360	250	130	1.62 (1.53-1.69, n=4)
p_2	820	750	380	240	190	120	100	0.51 (0.49-0.53, n=4)
p_3	940	960	610	400	320	190	120	0.65 (0.64-0.66, n=4)

Ecology, behavior, and phenology

In the shallow tundra ponds at Barrow, Alaska, *Tanytarsus aquavolans* was most abundant in the fibrous, peaty sediments of the emergent *Carex* zone near the pond margins. *T. nearcticus* was common in the softer, depositional sediments toward the pond centers (Butler 1980b, Butler et al. 1980). Both species were semivoltine in one pond where populations were studied in detail. Adults of both species are pelagic swarmers, a phenomenon reported for a number of high-latitude, winter-emerging, or marine chironomids (see Armitage 1995). Of the two species, *T. aquavolans* shows the more pronounced modification of palps, wings, legs, male antennae, and hypopygium), but the male antenna of *T. nearcticus* also shows reduction compared to related species. Similar modifications have been described for many, taxonomically diverse chironomid species (e.g. Wülker 1959). These parallel developments are generally considered adaptations to pelagic swarming or surface mating, or reductions of structures no longer beneficial under strong selection pressure against flight, for example in habitats subjected to persistent high winds.

Butler (1980a) reported *T. aquavolans* among the earliest, and *T. nearcticus* as the very last species to appear during the 3-4 week chironomid emergence season at the Barrow tundra ponds. Highly synchronous emergence (5-6 days per species) means that congeners are temporally isolated within each pond. Not only is reproductive isolation thus assured, but interference competition with other pelagic-swarming midges for the limited water surface is minimized by this temporal succession of emergence periods (Butler 1980a,b).

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This paper is dedicated to Dr. Friedrich Reiss, for his valuable coaching during my initial efforts in chironomid systematics 20 years ago. As a teacher, Frieder was challenging but supportive, and his commitment to quality work on the Chironomidae remains an inspiration. His views on research specialization are a lesson still being learned; had I heeded his advice and kept a narrower focus, this paper might have appeared some 18 years sooner. My time at the Zoologische Staatssammlung, during which I was helped and encouraged by Dr. E. J. Fittkau, the ZSM staff, and L. Säwedal, was supported by a NATO Postdoctoral Fellowship in Science. Field work in Alaska was made possible by grants to J. E. Hobbie from the U.S. Department of Energy. I thank Dr. J. E. Sublette for the loan of those *Tanytarsus* specimens not collected by myself.

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