Redescription of *Simulium (Nevermannia) fontinale*
Radzivilovskaya (Diptera: Simuliidae) from Japan

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**Abstract:** *Simulium (Nevermannia) fontinale* Radzivilovskaya is redescribed on the basis of the reared adult females, males, pupal exuviae and mature larvae collected from Gifu Prefecture, Honshu, Japan. Several morphological characters of the specimens from Japan that differ from those from Russia and North America are noted.

Key words: *Nevermannia,* Simuliidae, *Simulium,* black fly, venum species-group, Japan

*Simulium (Nevermannia) fontinale* was originally described by Radzivilovskaya (1948) from Far East Russia, redescribed by Rubtsov (1956), and recently recorded from North America by Adler et al. (2004), who concluded that *S. (N.) decolletum* Adler and Currie described from Alberta and the Yukon, Canada (Adler and Currie, 1986), was a junior synonym of *S. (N.) fontinale* after studying a series of type specimens of the latter species.

Saito et al. (1996) recorded *S. (N.) fontinale* for the first time from Japan, based on pupal and larval specimens collected from Gifu Prefecture, Honshu. Recently we obtained adult females and males of this species reared from the pupae collected from Gifu Prefecture, and could confirm the identity of the species. Here we give a redescription of *S. (N.) fontinale* based on the specimens collected from Japan because no detailed description of this species in Japan is yet available, and because there are slight variations in certain features between the Japanese and Russian or North American specimens.

The terms for morphological features used here follow those of Takaoka (2003).

**Simulium (Nevermannia) fontinale**
Radzivilovskaya

**DESCRIPTION.** Female. Body length about 3.4 mm. **Head.** Slightly narrower than thorax. Frons brownish-black, whitish-gray pruinose, not shiny, moderately covered with whitish-yellow recumbent short hairs interspersed with several brown long hairs along lateral margins except median portion narrowly bare longitudinally; frontal ratio 1.7−2.1:1.0:2.2−2.8. Frons-head ratio 1.0:4.4−4.5. Fronto-ocular area (Fig. 1A) directed laterally and somewhat upwardly, deep, rounded apically. Clypeus brownish-black, whitish-gray pruinose, not shiny, moderately covered with whitish-yellow short hairs interspersed with many brown long curved hairs on lower 1/2. Labrum 0.64−0.71 times as long as clypeus. Antenna composed of scape, pedicel and 9 flagellomeres, dark brown; 1st flagellomere about 1.9 times as long as 2nd one. Maxillary palp composed of 5 segments, light to medium brown, proportional lengths of
Fig. 1. Female of Simulium (Nevermannia) fontinale. A, fronto-ocular area; B and C, 3rd maxillary palpal segments (B, lateral view; C, front view); D, basitarsus and 2nd tarsal segment of hind leg (outer view); E, claw; F, 8th sternite and ovipositor valves in situ (ventral view); G, genital fork (ventral view); H and I, paraprocts and cerci (H, ventral view; I, lateral view); J, spermatheca (lateral view). Scale bars. 0.08 mm for D; 0.04 mm for A; 0.02 mm for B, C and F–J; 0.01 mm for E.

3rd, 4th, and 5th segments 1.0 : 0.9 : 2.0; sensory vesicle (Fig. 1B, C) enlarged, ellipsoidal, 0.42–0.46 times as long as 3rd segment, and with small opening. Maxillary lacinia with 9–11 inner and 14 or 15 outer teeth. Mandible with 21–23 inner and 10–12 outer teeth. Cibarium smooth. **Thorax.** Scutum blackish-brown to black, shiny at certain angle of light, without any longitudinal vittae, densely covered with yellow recumbent short hairs inter-spersed with yellow long upright hairs on pre-scutellar area. Scutellum medium brown, covered with yellow short and long hairs. Postnotum medium to dark brown, shiny at certain angle of light, whitish-gray pruinose, bare. Pleural membrane bare. Katepisternum dark brown, longer than deep, shiny, whitish-gray pruinose, and bare. **Legs.** Fore leg: coxa medium brown; trochanter and femur light to medium brown except apical cap of femur dark.
brown; tibia medium brown except basal tip and apical cap dark brown; tarsus brownish-black; basitarsus somewhat dilated, 8.3 times as long as its greatest width. Midleg: coxa medium brown except posterior surface dark brown; trochanter, femur and tibia light to medium brown except apical caps of femur and tibia dark brown; tarsus brownish-black. Hind leg: coxa medium brown; trochanter, femur and tibia light to medium brown except apical cap of femur and basal tip and apical cap of tibia dark brown; basitarsus medium brown; rest of tarsus dark brown except basal 1/2 of 2nd segment light brown; basitarsus (Fig. 1D) slender, parallel-sided, 6.50 times as long as wide, and 0.72 and 0.67 times as wide as tibia and femur, respectively; calcipala well developed, 1.2 times as long as wide; pedisulcus well developed at basal 1/3 of 2nd tarsal segment. Claws (Fig. 1E) each with large basal tooth 0.5 times as long as claw. All coxae, trochanters, femora and tibiae densely covered with whitish-yellow short hairs, as well as usual dark hairs at least on outer and posterior surfaces. 

**Wing.** Length 3.0–3.2 mm. Costa with dark spinules and hairs except basal portion with patch of yellow hairs. Subcosta with dark hairs, except apical 1/5 to 1/3 bare. Hair tuft on stem vein yellow. Basal portion of radial vein fully haired. R₁ with dark spinules and hairs. R₂ with dark hairs only. Basal cell and basal median cell absent. 

**Abdomen.** Basal scale light brown, with fringe of yellow long hairs; dorsal surface of abdomen dark yellow to light yellowish-brown except tergites light to medium brown; tergite of 2nd segment densely covered with yellow short hairs; dorsal and dorsolateral surfaces of other segments sparsely to moderately covered with yellow short hairs as well as dark short to medium-long hairs; tergites 6–8 shiny at certain angle of light; ventral surface of 7th segment with large sternal plate medially. 

**Genitalia.** Sternite 8 (Fig. 1F) bare medially, and with 14–17 yellow and dark long hairs on each side. Ovipositor valves (Fig. 1F) roughly triangular, rounded medioposteriorly, thin, membranous, densely covered with microsetae interspersed with 5–7 yellow short fine setae; inner margin moderately sclerotized and narrowly darkened. Genital fork (Fig. 1G) of usual inverted-Y form, stem slender and well sclerotized; arms of moderate width and weakly sclerotized; each arm with short well-sclerotized ridge directed anteriorly and wide triangular weakly-sclerotized projection directed posteriorly. Paraproct (Fig. 1H, I) slightly produced ventrally beyond ventral margin of cercus, with ventral margin slightly extended as small protuberance on anterior 1/2, and covered with about 16 dark short to long hairs on outer and ventral surface; paraproct with 5 or 6 sensilla on moderately sclerotized anteromedian surface. Cercus (Fig. 1I) semicircular, with dark hairs. Spermatheca (Fig. 1J) small, ellipsoidal, 1.28–1.31 times as long as its greatest width, well sclerotized except small area at juncture with duct, with reticulate surface patterns; internal setae absent.

**Male.** Body length 3.3–3.5 mm. **Head.** As wide as thorax. Upper eye consisting of 22 vertical columns and 22 horizontal rows of large facets. Face brownish-black, thickly white pruinose. Clypeus brownish-black, whitish-gray pruinose, moderately covered with yellow and dark brown long hairs, except median portion widely bare. Antenna composed of scape, pedicel and 9 flagellomeres, dark brown; 1st flagellomere somewhat elongate, 1.9 times as long as 2nd one. Maxillary palp composed of 5 segments, light to medium brown, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 1.1 : 2.4; sensory vesicle (Fig. 2A) small, globular or ellipsoidal, 0.21 times as long as 3rd segment, with small opening. 

**Thorax.** Black, shiny narrowly along lateral margins and on prescutellar area at certain angle of light, densely covered with yellow short hairs. Other features as in female. 

**Legs.** Color and shape nearly the same as those of female, except hind basitarsus enlarged. Fore basitarsus very slightly dilated, 8.8 times as long as its greatest width. Hind basitarsus (Fig. 2B) expanded, spindle-shaped, 4.31 times as long as its greatest width, and 1.04 and 0.98 times as wide as greatest widths of tibia and femur, respectively; calchipala small, 1.2 times as wide as long, and 0.27 times as wide as greatest width of basitarsus; pedisulcus moderately developed at basal 1/3 of 2nd tarsal segment. 

**Wing.** As in female except length 2.9 mm, and subcosta with 1–3 dark hairs near base. 

**Abdomen.** Basal scale medium brown, with fringe of dark long hairs. Dorsal surface of abdomen dark ochreous, except tergites medium to dark brown, with yellow short and dark brown short to long hairs; all tergites not shiny. 

**Genitalia.** Coxite in ventral view (Fig. 2
Fig. 2. Male of Simulium (Nevermannia) fontinale. A, 3rd maxillary palpal segment with sensory vesicle (front view); B, basitarsus and 2nd tarsal segment of hind leg (outer view); C, coxites, styles, and ventral plate in situ (ventral view); D, coxite and style (lateral view); E, style (ventrolateral view); F, ventral plate and median sclerite (lateral view); G, ventral plate (end view); H, median sclerite (anterior view); I, paramere (left side; ventral view); J, aedeagal membrane and dorsal plate (dorsal view); K, 10th abdominal segment and cercus (lateral view). Scale bars. 0.08 mm for B; 0.02 mm for A and C–K.

C) rectangular, 2.4 times as long as wide. Style in ventral view (Fig. 2C) boot-shaped, about 0.8 times as long as coxite, and with single apical spine; style in lateral view (Fig. 2D) nearly rectangular, though dorsal margin somewhat concave; style in ventrolateral view (Fig. 2E) gradually narrowed from base to basal 2/3, then sharply tapered toward apex. Ventral plate in ventral view (Fig. 2C) transverse, plate-like, about 1.7 times as wide as long, with anterior margin convex and posterior margin slightly to moderately concave medially, and
Fig. 3. Pupa and mature larva of *Simulium (Nevermannia) fontinale*. A–D, pupa; E and F, mature larva. A, frons and part of face (right half); B, gill filaments (right side; lateral view); C, terminal hooks (end view); D, cocoon (dorsal view); E, mandible; F, hypostoma. Scales. 0.5 mm for D; 0.2 mm for B; 0.05 mm for A; 0.02 mm for C and F; 0.01 mm for E.
setose medially on posterior 2/3 of ventral surface; arms well sclerotized, slender, slightly shorter than body of ventral plate, and moderately divergent; ventral plate in lateral view (Fig. 2F) with anteroventral portion somewhat produced ventrally and with arm stout, tapered toward apex, slightly curved dorsally; ventral plate in end view (Fig. 2G) gently rounded ventrally, and setose medially on posterior surface. Median sclerite in lateral view (Fig. 2F) arising just before anterior margin of ventral plate, and in anterior view (Fig. 2H) narrow, nearly parallel-sided, and forked apically. Paramere in ventral view (Fig. 2I) narrow, with 1 long parameral hook. Aedeagal membrane (Fig. 2J) sparsely or moderately covered with microsetae, and dorsal plate (Fig. 2J) T-shaped, wide, thin, moderately sclerotized. Abdominal segment 10 in lateral view (Fig. 2K) with 2–4 hairs on ventral surface and 1–6 hairs on lateral surface on each side. Cercus in lateral view (Fig. 2K) low, rounded, and with 12–18 hairs.

**Pupa.** Body length 3.5–3.9 mm. **Head.** Integument (Fig. 3A) yellowish-brown, moderately covered with tubercles of various sizes and shapes; antennal sheath almost bare; frons with 2 short slender trichomes on each side; face with 1 medium-long slender trichome on each side, which is much longer and thicker than those of frons. **Thorax.** Integument yellowish-brown, moderately covered with tubercles of various sizes and shapes, and on each side with 2 short slender simple trichomes medio-dorsally, 2 slender simple trichomes (1 medium-long and 1 short) anterolaterally, 1 medium-long slender simple trichome postero-laterally, and 3 slender simple trichomes (1 medium-long, 2 short) ventrolaterally. Gill (Fig. 3B) with 4 slender thread-like filaments, arranged in dorsal and ventral pairs arising from short basal common stalk; stalk of dorsal pair short, nearly as long as but somewhat thicker than that of ventral pair, and slightly shorter than basal common stalk; filaments of dorsal pair (2.5–3.5 mm long) slightly longer and thicker than those of ventral pair; all filaments light to medium grayish-brown, gradually tapered toward apex, furnished with annular ridges and furrows, and densely covered with minute tubercles on outer surface. **Abdomen.** Dorsally, segments 1 and 2 weakly sclerotized and grayish-brown almost entirely, other segments also weakly sclerotized and partially grayish-brown; segments 1 and 2 entirely covered with small tubercles; segment 1 with 1 medium-long slender simple seta on each side; segment 2 with 1 short simple seta and 5 short dark spinous setae on each side; segments 3 and 4, each with 4 dark stout hooks and 1 short spinous seta on each side; segment 5 bare; segments 6–8 each with spine-combs and comb-like groups of minute spines lying transversely along anterior margin on each side; segment 9 with pair of cone-shaped terminal hooks (Fig. 3C), and comb-like groups of minute spines lying transversely along anterior margin on each side. Ventrally, segments 3–8 nearly transparent and segment 9 weakly sclerotized and light yellowish-brown; segment 3 with 3 very short simple setae on each side; segment 4 with 2 simple dark hooklets (slightly shorter and smaller than those on segments 5–7) and 2 short simple setae on each side; segment 5 with 2 bident dark hooks and a few short simple setae on each side; segments 6 and 7 each with 1 bident dark inner hook and 1 simple dark outer hook, and a few short simple setae on each side; segments 4–8 with comb-like groups of minute spines. Segment 9 without grapnel-shaped hooklets on each lateral side. **Cocoon.** (Fig. 3D). Simple, wall-pocket-shaped, sometimes nearly circular in dorsal view, tightly woven, with anterior margin thickly woven and broadly excavated, and extending ventrolaterally; floor woven on posterior 1/2; individual threads visible or not; 4.0–4.5 mm long by 3.0–3.3 mm wide.

**Mature larva.** Body length 6.5–7.6 mm. Body color grayish-creamy. Cephalic apotome (Fig. 4A–C) whitish-yellow except area between posterior margin and posterolateral head spots medium to dark brown (though in some specimens this darkened area widely extending forward, thus covering posterior 1/2 of mediolateral spots and posterior one of mediolongitudinal spots, as shown in Fig. 4C); head spots medium to dark brown though anterior one of posterolateral spots and anterior one of mediolateral spots light brown in most specimens or completely pale in a few specimens (Fig. 4B). Lateral surface of head capsule (Fig. 4D) mostly yellowish, with eyebrow darkened and also wide area along posterior margin darkened, and with 1 or rarely 2 dark spots below eye-spot region. Ventral surface of head capsule (Fig. 4E, F) yellowish to dark yellow, with transverse area along posterior...
margin darkened, and with light brown elongate spot on each side of postgenal cleft. Cervical sclerites (Fig. 4A–C) composed of 2 rod-like small pieces, not fused to occiput, widely separated from each other. Antenna composed of 3 segments and apical sensillum, much longer than stem of labral fan; proportional lengths of 1st, 2nd, and 3rd segments 1.0:1.0–1.1:0.5. Labral fan with about 40 rays. Mandible (Fig. 3E) with 1st comb-tooth longest, followed by 3rd one, which is longer than 2nd; mandibular serrations composed of 1 large tooth and 3 or 4 small teeth including supernumerary ones; large tooth at obtuse angle to the mandible on apical side. Hypostoma (Fig. 3F) with a row of 9 apical teeth, median tooth slightly longer than corner teeth, and 3 intermediate teeth on each side shortest (only 2 intermediate teeth present on right side in 1 larva, and 4 intermediate teeth on left side in another larva, thus totalling 8 and 10 apical teeth in these 2 larvae); lateral margins smooth, except near apex serrated; hypostomal bristles 4–6 in row, nearly parallel to or slightly diverging from lateral margin on each side (1 or 2 additional bristles present out of row in some larvae). Postgenal cleft (Fig. 4E, F) small, 0.66–0.75 times as long as postgenal bridge. Thoracic and abdominal cuticles almost bare, except dorsal surface of a few posterior abdominal segments sparsely to moderately covered with colorless minute setae and small areas on both sides of anal sclerite covered with colorless short setae. Rectal scales absent. Rectal papilla compound, each of 3 lobes with 11–14 finger-like secondary lobules ventrally. Anal sclerite X-shaped, anterior arms 0.7 times as long as posterior ones; accessory sclerites absent. Ventral tubercles present ventrolaterally. Posterior cirquelet of hooks with about 80 rows of up to 15 hooks per row.

SPECIMENS EXAMINED. 13 females, 6 males (all reared from pupae), 20 pupae and 9 mature larvae, collected from a slow-flowing stream (width 1–2 m, water temperature 8°C, partially shaded, altitude 1,500 m), Abodaira, Joho Village, Yoshiki District, Gifu Prefecture, Honshu, Japan, 4. IX. 2006, by K. Saito.

REMARKS. The specimens of S. (N.) fontinale from Japan are morphologically similar to those from Russia [redescribed...
by Rubtsov (1956)], except in the following characters (those of Russian specimens are shown in parentheses): female paraproct in lateral view only slightly produced ventrally (Fig. 1I) (conspicuously produced ventrally), female cercus in lateral view rounded posteriorly (Fig. 1I) (subquadrate) and the basal common stalk of the pupal gill nearly as long as or slightly longer than those of dorsal and ventral pairs of filaments (Fig. 3B) (much shorter). There are also differences in the female and male genitalia between the Japanese and Canadian specimens. In Canadian specimens, the female genital fork has a posteromedia! projection less produced on each arm and the male ventral plate has its arms nearly parallel-sided, according to the illustrations given under S. decolletum (Adler and Currie, 1986). These differences might be intraspecific variation since this species is widely distributed in Far East Russia, Alaska (USA), and Canada.

This species, assigned to the vernum species-group, is characterized by the female genital fork with a short projection directed forward and a distinct triangular one directed posteromedially on each arm (Fig. 1G), the pupal head and thorax moderately covered with somewhat large round tubercles (Fig. 3A), pupal gill filaments directed downward basally (Fig. 3B) and the simple round cocoon with an anterior margin broadly excavated (Fig. 3D). The combination of these three pupal characters mentioned above easily separates this species from the other 11 species of the vernum species-group so far reported from Japan (Takaoka and Saito, 2007).

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References


