

**FIRST DESCRIPTION OF THE FEMALE OF *PARASIMULIUM STONEI*
PETERSON (DIPTERA: SIMULIIDAE), WITH NOTES AND A
DISCUSSION ON COLLECTION SITES**

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Abstract.—The female of *Parasimulium stonei* Peterson is described and illustrated for the first time and is distinguished from the female of *P. crosskeyi* Peterson. This is only the second species of the genus for which females are known. Notes and a discussion on the collection sites of both species are given.

A synoptic review of the genus *Parasimulium* Malloch was published by Peterson (1977). At that time, only eight specimens were known for the genus, all of which were males representing four species distributed in two subgenera. More recently, Wood and Borkent (1982) collected many additional males and a small number of females of *P. crosskeyi* Peterson, and added one more locality to the previous eight known collection sites. Since the publication of the latter paper, two females and one more male of *P. stonei* Peterson have been found. The female specimens are the first known for *P. stonei* and are described and illustrated below.

DESCRIPTION

Fig. 1

Female (preserved in alcohol).—General body color yellowish brown. Length: body, 1.82 mm; wing, 1.82 mm.

Head.—Dark brown, shiny; eye rather small, black; stemmatic bulla paler than rest of head capsule. Frons noticeably broader than clypeus, moderately covered with pale yellow setae; postocular setae pale yellow. Clypeus rather long and slender, nearly twice as long as wide, slightly paler than frons, sparsely covered with moderately long, dark setae. Antenna almost translucent, pale yellow, with pale yellowish pubescence that is longer than normal for family, and seemingly without short, stiff, coarse pubescence of other black flies; with 8 flagellomeres, all subequal in length and width except apical flagellomere slightly longer; pedicel distinctly longer and slightly wider than scape or individual flagellomeres. Palpus pale brownish yellow; third palpomere darkest, distinctly enlarged and somewhat

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globose, palpomeres 3 and 4 subequal in length, palpomere 5 somewhat longer. Sensory vesicle situated centrally in palpomere 3, slightly less than $\frac{1}{2}$ as long as palpomere, opening to exterior through a perpendicular pore that widens dorsally to $\frac{2}{3}$ length of vesicle. Mandible pale, weakly sclerotized, shorter but broader than lacinia, bluntly rounded apically, without serrations, one minute, nipple-like convexity present apically (this is difficult to accurately discern in available specimens). Lacinia pale, weakly sclerotized, somewhat cleaver-shaped but rather short, slender and pointed apically, with about 12–15 seta-like processes on apex and along margin. Proximal (dorsal) arms of cibarium relatively long and nearly uniform in width, somewhat truncate apically.

Thorax.—Yellowish brown dorsally, lobe of anteprenotum slightly darker than scutum; scutellum and postnotum darker yellowish brown, but median area of postnotum paler brown. Lobes of anteprenotum widely separated, connected by a very slender median rod-like strip that is situated under anterior margin of scutum; each lobe with a series of moderately long and stout yellow setae (there also are about 15 larger and conspicuous setal bases on each lobe that presumably held the longer, stouter black setae described by Wood and Borkent (1982) for *P. crosskeyi*; neither specimen at hand had any of these bristle-like setae). Postpronotal lobe small, weakly defined, slightly paler yellow than adjacent area of scutum, sparsely covered by yellow setae that are scarcely longer than sparse yellow setae of anterior portion of scutum; setae mid-dorsally on scutum yellow, but distinctly shorter than anterior marginal setae; prescutellar area of scutum with a sparse series of rather stout, yellow setae, in addition there is a series of large setal bases presumably from large, stout, black setae as described for *P. crosskeyi* by Wood and Borkent (1982). Dorsal margin of supra-alar declivity with a few moderately long, dark setae and with 3 or 4 shorter dark setae present anterodorsal to point where base of wing joins thorax. Scutellum sparsely covered with moderately long and stout, yellow setae, also present are a number of larger setal bases probably from large, stout, black setae as described by Wood and Borkent (1982) for *P. crosskeyi*. Postnotum shiny, brownish yellow, mottled with patches of darker brown. Pleuron brownish yellow, mottled with whitish yellow patches; anepisternal membrane white, specimens at hand each with a single tiny white seta at anterodorsal corner of membrane. Anepimeral tuft absent.

Legs whitish yellow, distalmost tarsomere slightly darkened, about apical $\frac{1}{2}$ of mid and hind femora, in dorsal view, appearing brownish and corresponding in position with brown of abdominal tergites 3 and 4, this brownish tinge much less evident in lateral view; legs generally covered with pale whitish yellow setae, anteroventral surface of each femur with 1 to several longer dark setae, and posterior margin of basal $\frac{1}{2}$ of hind tibia with 2 to 3 long, dark setae and several shorter, more distal, black setae; distal $\frac{1}{4}$ or slightly more of posterior surface of hind tibia with a patch of short, yellow setae that can be seen, in lateral view, as a slight bulge on inner posterior surface; basal $\frac{1}{2}$ of first hind tarsomere with a similar nearly contiguous patch of short, yellow setae. Hind femur only slightly longer than tibia; hind basal tarsomere 6 times as long as wide, and slightly longer than combined lengths of tarsomeres 2–5. Tarsal claw simple at base, relatively long, slender and rather straight, slightly curved near tip; empodium plumose.

Wing essentially as described for male by Peterson (1977, 1981) except about proximal $\frac{1}{2}$ of stem vein with short yellow to yellow and black bicolored setae,

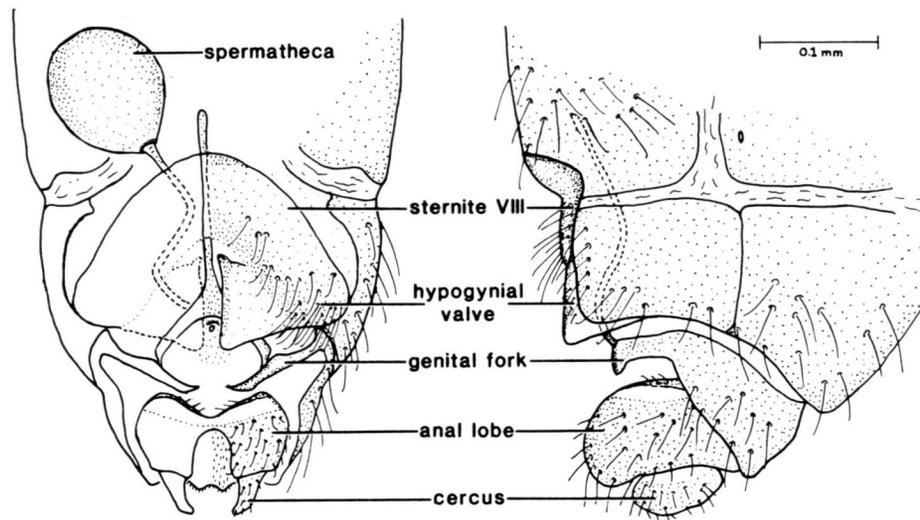


Fig. 1. Female terminalia of *Parasimulium stonei* Peterson. Left side showing ventral view. Right side showing left lateral view.

and distal $\frac{1}{2}$ with about 6 very much longer, black, coarse, stiff, bristle-like setae that readily abrade; alar lobe and calypter fringed with fine, pale yellow setae. Halter whitish yellow, with a slight brownish tinge on stem near base.

Abdomen.—Segments 1 and 2 entirely whitish yellow except for a small tubercle-like brown spot below middle of posterior margin of pleural membrane of segment 2; tergite 1 (basal scale) slightly smaller and yellow fringe more sparse and shorter than in other female black flies; tergites 3–9 sclerotized and distinguishable from pleural membrane and sternites; tergites 3–6 brown, tergites 7, 9 and 10 paler brown, mottled with whitish yellow patches, tergite 8 paler whitish yellow; tergites 2–7 with sparse, short, yellow setae dorsocentrally, and with longer, sparse, dark setae laterally; tergites 8 and 9 with mixed short, yellow and dark setae. Sternites 3–5 whitish yellow, remaining sternites brown. Terminalia as in Fig. 1. Anal lobe with a short, slender, dorsal portion, and an enlarged ventral portion that projects nearly horizontally beneath cercus, ventroapical margin broadly rounded; moderately covered with short setae. Cercus relatively small, about twice as wide as long, hind margin curved and rounded ventroapically; moderately covered with short setae. Cercus not noticeably hidden or concealed in concavity of anal lobe in specimens at hand. Sternite 8 broadly U- or V-shaped, its central portion sclerotized, shiny, and bare, each side narrowly bare laterodorsally along anterior margin, posterior $\frac{1}{2}$ or slightly more with both short and longer setae. Posterior margins of hypogynial valves slightly oblique or subtruncate, weakly sclerotized, pale and narrowly bare; inner margins of valves nearly straight, folding inwardly, weakly sclerotized, pale and bare; valves narrowly separated from each other; each moderately covered by setulae. Genital fork (sternite 9) with stem about twice as long as arms, slender, nearly straight and moderately heavily sclerotized; each arm slender basally, expanding distally into a rather narrow, rectangular plate with a posteromedial curved process that is pointed apically and heavily sclerotized along inner margin, tips of processes of

Table 1. Characters separating females of *Parasimulium crosskeyi* and *P. stonei*.

<i>crosskeyi</i>	<i>stonei</i>
—Frontal and postocular setae dark, scarcely paler than dark integument.	—Frontal and postocular setae pale yellow, contrasting with dark integument.
—Lobes of antepronotum dark brown.	—Lobes of antepronotum paler brownish yellow.
—Pleuron yellow except for triangular pale brown spot on mesepimeron.	—Pleuron brownish yellow, mottled with whitish yellow patches. Anterodorsal angle of anepisternal membrane with a single tiny white seta.
—Mid femur entirely pale yellow.	—Mid femur, in dorsal view, with about apical ½ appearing brownish.
—Tergites and sternites weakly sclerotized, scarcely distinguishable from adjacent pleural membrane.	—Tergites 3–9 and, at least, sternites 6–8 sclerotized and distinguishable from adjacent pleural membrane.
—Slender curved medial process of each arm of genital fork apparently not heavily sclerotized along inner margin, the tips of the two processes almost meeting at midline behind opening of spermathecal duct (Figs. 4 and 5 in Wood and Borkent (1982)).	—Slender curved medial process of each arm of genital fork heavily sclerotized along inner margin, the tips of the two processes rather broadly separated medially behind opening of spermathecal duct (Fig. 1).

both arms rather widely separated medially; each arm broadly united with tergite 9 dorsolaterally. Spermatheca nearly spherical, moderately sclerotized, with a small, clear, circular area at junction with spermathecal duct.

REMARKS

Since only two alcohol preserved females of *P. stonei* are known, it is difficult to distinguish them reliably from females of *P. crosskeyi*. On careful perusal of the description of *P. crosskeyi* given by Wood and Borkent (1982), and by comparisons of actual specimens, several differences are apparent. These differences are listed in Table 1. The features of the genital fork are probably the best characters for separating these species.

DESCRIPTION OF COLLECTION SITES

Parasimulium stonei has been collected at five North American localities. The species was originally found by A. L. Melander at Viento, Oregon, on July 1, 1917. The male holotype is from the Bolling Park area, Humboldt Co., in northern California, and one male is known from Mt. Hood, Oregon. Three adults were found in emergence trap samples collected in 1982 from Mack Creek and Grasshopper Creek on the west side of the Cascade Mountains of Lane Co., Oregon. These are third order streams with similar altitude (800–900 m), aspect (north facing watersheds), gradient (about 10%), and substrates (primarily boulder-cobble). The latter two sites differ most noticeably in riparian vegetation. Mack Creek flows through an old-growth coniferous forest with Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) (Pinaceae) dominating the canopy. Streamside vegetation includes red alder (*Alnus rubra* Bong.) (Betulaceae), bigleaf maple (*Acer macrophyllum* Pursh) (Aceraceae), and devilsclub (*Oplopanax horridus* (J. E. Smith) Torr. & Gray ex Miq.) (Araliaceae). Grasshopper Creek is located in an area that was clear-cut in 1976. Riparian vegetation is dominated by mountain alder (*Alnus incana* (L.) Moench), vine

maple (*Acer circinatum* Pursh), willow (*Salix* (L.) sp.) (Salicaceae), and numerous herbaceous species including an abundance of coltsfoot (*Petasites frigidus* (L.) Fr.) (Compositae).

A male of *P. stonei* was collected at Mack Creek on June 29, and a female on August 7. Both specimens were taken in a trap located in a fast riffle directly below a waterfall plunge pool. The stream current velocity exceeded 1 m/s throughout much of the sampled area. Water temperatures during this period ranged from 9°C to 14°C. A second female was collected at Grasshopper Creek on July 22. It was taken from a trap placed in a depositional zone about 115 m downstream from the clear-cut boundary. Above this was old-growth coniferous forest. The trap was situated in a pool adjacent to a fast riffle, but was protected from the current by several boulders. The water temperatures for July ranged from 9°C to 13°C.

DISCUSSION

The ecology of *Parasimulium* species is poorly known due, in part, to a lack of information about the immature stages. The only detailed account of adult bionomics was given by Wood and Borkent (1982). Their discussion pertained to *P. crosskeyi* and, primarily, the Wahkeena Creek site in the Columbia River gorge. There seems to be a tendency for *P. crosskeyi* to inhabit streams with waterfalls (e.g. Wahkeena, Eagle, Starvation creeks). The presence of a waterfall might reflect some ecological requirement, such as a marker for adult swarming behavior. The Mack Creek collection site is directly below a waterfall, but the height of the falls is much less than that of Wahkeena Falls, or others in the Columbia River gorge. However, if this feature serves only as a marker, the relative height may be inconsequential. Grasshopper Creek contains no waterfalls per se, but does have numerous high-gradient, cascading sections. The cascades of these sections might also serve as swarm markers.

It is difficult to explain why the immature stages of *Parasimulium* have not been found. Certainly, most habitats have been examined by a number of black-fly collectors. One habitat that may have been insufficiently explored is the hyporheic zone (i.e. the aquatic habitat in deep gravels beneath and lateral to the stream bed). At Wahkeena Creek the hyporheic zone is extensive, particularly along the reach where most of the adult *Parasimulium* have been collected. Mack and Grasshopper Creeks contain relatively little hyporheic habitat. Still, if immature stages inhabit this zone, its extent need not be great to support the seemingly low abundances of *Parasimulium* at these sites.

Parasimulium crosskeyi has been reported from Corvallis, which is about 145 km south-southeast of the Columbia River gorge. The Corvallis area is dramatically different from other *P. crosskeyi* sites, both topographically and floristically. Aquatic systems in the general vicinity of Corvallis are predominantly large, low-gradient rivers, with relatively high sediment loads. The specimen of *P. crosskeyi* taken by Melander, might actually have been collected in the nearby foothills of the Coast Range, where ecological conditions may approach those of other *Parasimulium* localities. An alternate explanation is that adult *Parasimulium* can travel long distances, a behavior observed in several other black fly taxa. As a final possibility, *Parasimulium* may inhabit larger stream systems, such as the Willamette and Columbia Rivers. The biota of these are poorly known, especially

in terms of the black fly fauna. More effort in collecting simuliids in these large rivers might prove rewarding.

Unlike the *P. crosskeyi* collection sites, Mack and Grasshopper creeks are far removed from any large, silty rivers. Our collections provide strong evidence that *P. stonei* inhabits relatively cold, clear, high-gradient streams. The teneral condition of our specimens further suggests that they emerged nearby. Future examination of these streams, and others, should concentrate on isolating the microhabitat of immature *Parasimulium*. Unfortunately, for the present, the enigmatic problem of where these stages occur remains unsolved.

ACKNOWLEDGMENTS

We are grateful to N. H. Anderson, Oregon State University, Corvallis, for his assistance and encouragement during the course of this investigation, and to P. H. Adler, Clemson University, Clemson, S.C., for reading and commenting on an early draft of the manuscript. This project was supported, in part, by NSF Grant BSR 8112455 (to Cummins et al.); this is Contribution No. 14 of the Riparian Grant.

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