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OPHIOGOMPHUS SUSBEHCHA SPEC. NOV. FROM NORTH CENTRAL UNITED STATES (ANISOPTERA: GOMPHIDAE)

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The new sp. is described and diagnostic characters for adults and larvae are illustrated (holotype ♂, allotype ♀: Wisconsin, Burnett Co., Saint Croix River, resp. 6 & 23-VI-1991; deposited at NMNH, Washington, D.C.). Placement within the genus is problematic since it shares characters with the subgenera *Ophionuroides* Carle and *Ophionurus* Carle. Larvae are known only from large, rapid rivers with pristine water quality. Adult emergence is highly synchronized and takes place in late May.

INTRODUCTION

O. susbehcha spec. nov. was first discovered by WAS at the Saint Croix River, Burnett County, Wisconsin on 18 June 1989, when eight exuviae were collected. Final instar larvae were collected in November 1989, and May 1990, and reared to adults. Reared adults were compared with field adults collected in May-June, 1990 and 1991. All specimens were conspecific and belong to a previously undescribed species of *Ophiogomphus*.

OPHIOGOMPHUS SUSBEHCHA SPEC. NOV.

Figures 1-4

Material. – **Holotype** ♂: UNITED STATES. Wisconsin: Burnett Co., Saint Croix River, County O Boat Landing, T.37N.-R.20W., Section 20, 6-VI-1991, TEV coll. [NMNH]. – **Allotype** ♀: same data as holotype except, Sand Rock Cliff, T.38N.-R.19W. Sec. 7, 23-VI-1991, T.W. Donnelly coll. [NMNH]. – **Paratypes** (15 ♂, 16 ♀): same data as holotype, 1 ♂ [NMNH]; – same locality as holotype, 18-VI-1990, WAS, TEV, A.A. Smith (AAS), I.A. Smith (IAS) colls, 1 ♂ [MM]; – same locality as holotype, 15-VI-1991, TEV coll, 1 ♂, 1 ♀ [UMMZ]; – same data as allotype, 1

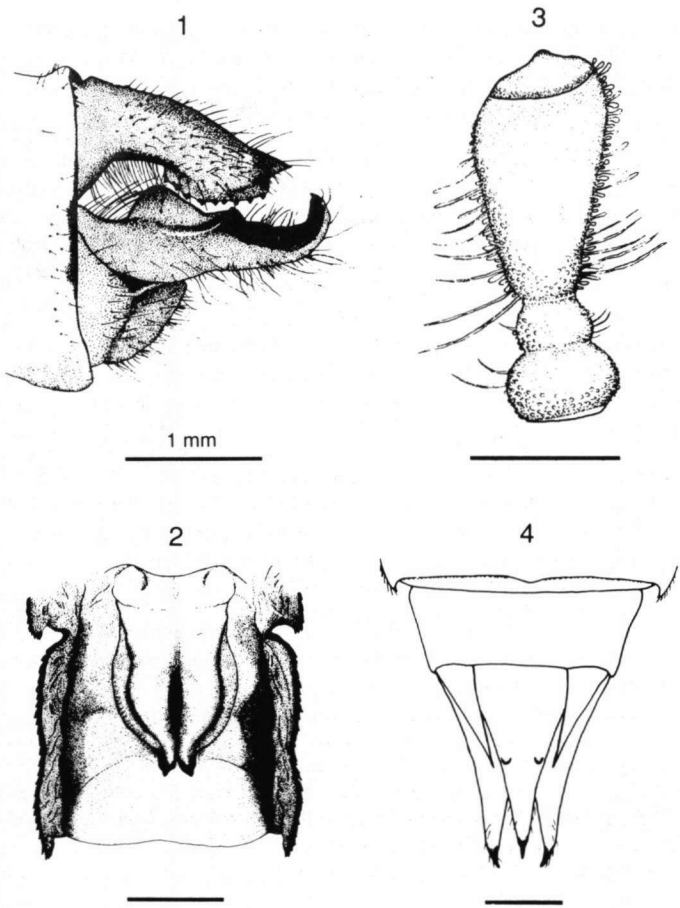
♀ [MM]; – same locality as allotype, 7-VI-1991, WAS, TEV, B.W. Smith (BWS) colls, 2 ♂, 1 ♀ [ROM], 2 ♂ [IBUM], 1 ♂ [UMMZ]; – 22-VI-1991, M.J. Westfall, Jr (MJW) coll, 1 ♀ [FSCA]; – E.D. Cashatt (EDC), J.R. Wiker (JRW), B.G. SIMS (BGS) colls, 1 ♂, 1 ♀ [ISM], 2 ♀ [NMNH]; – 23-VI-1991, MJW coll, 1 ♀ [FSCA]; – EDC, JRW, BGS colls, 1 ♂, 2 ♀ [ISM]; – 22/23-VI-1991, C. Cook coll, 1 ♂, 3 ♀ [FSCA]; – same data as holotype except, Benson Bluffs, T.37N.-R.20W. Sec. 8, 15-VI-1991, TEV coll, 2 ♂ [NMNH], 1 ♂, 1 ♀ [BMNH]; – 16-VI-1991, TEV coll, 1 ♀ [INHS]; – Norway Point Bottomlands State Natural Area, T.40N.-R.18W. Sec. 19, 8-VI-1991, TEV coll, 1 ♂ [INHS]; – Sand Rock Cliff Trail, T.38N.-R.20W. Sec. 13, 7-VI-1991, TEV coll, 1 ♀ [IBUM]. – **Larvae**: same locality as holotype, 12-V-1990, WAS, TEV, D.J. Heath colls, (1 final instar); – same data as holotype except, Soderbeck Boat Landing, T.39N.-R.19W. Sec. 31, 12-VI-1991, R.A. Lillie (RAL) coll, (1 ca F-2 instar); – Polk Co., Saint Croix River, Interstate Park, T.34N.-R.19W. Sec. 35, 8-IX-1990, WAS coll, (1 ca F-2 instar). – **Exuviae**: same locality as holotype, 18-VI-1989, WAS, C.C. Smith (CCS), BWS colls, (8 specimens); – 15-VII-1989, WAS, CCS, BWS colls, (8); – 27-V-1990, WAS, AAS, IAS colls, (147); – 30-V-1990, TEV coll, (19); – same locality as allotype, 24-VI-1990, WAS, G.A. Miller (GAM) colls, (46); – same data as holotype except, Benson Bluffs, T.37N.-R.20W. Sec. 4, 18-VI-1990, WAS, TEV colls, (4); Hwy 70 Boat Landing, T.38N.-R.20W. Sec. 24, 29-V-1990, TEV coll, (3); 19-VI-1990, WAS, CCS, BWS colls, (20); – Nelson Boat Landing, T.40N.-R.19W. Sec. 35, 30-V-1990, TEV coll, (6); – Norway Point Boat Landing, T.40N.-R.18W. Sec. 30, 30-V-1990, TEV coll, (1); – Soderbeck Boat Landing, T.39N.-R.19W. Sec. 31, 30-V-1990, TEV coll, (8); – 22-V-1991, RAL coll, (2); – 26-V-1991, WAS coll, (6); – Polk Co., Saint Croix River, Interstate Park, T.34N.-R.19W. Sec. 36, 25-V-1991, WAS coll, (3); – Sunrise Boat Landing, T.36N.-R.20W. Sec. 32, 31-V-1990, TEV coll, (3); – 19-VI-1990, WAS, CCS, BWS colls, (1); – Rusk Co., Chippewa River, 1 km E Bruce, T.34N.-R.7W. Sec. 5, 29-V-1991, GAM coll, (3); – 11-VI-1992, WAS coll, (4); – 25 km E Chetek, T.33N.-R.8W. Sec. 14, 11-VI-1992, WAS coll, (1); – Minnesota; Pine Co., Saint Croix River, Hwy 70 bridge, T.38N.-R.20W. Sec. 13, 13-VI-1990, TEV coll, (4).

Larvae and exuviae are not designated as paratypes. Holotype male, allotype female, some paratypes, larvae, and some exuviae are deposited at the United States National Museum of Natural History [NMNH], Washington, D.C., USA. Other paratypes and some exuviae are deposited in the Milwaukee Museum [MM], Milwaukee, Wisconsin, USA; University of Michigan Museum of Zoology [UMMZ], Ann Arbor, Michigan, USA; Royal Ontario Museum [ROM], Toronto, Ontario, Canada; Institut de Biologie, Université de Montréal [IBUM], Montréal Québec, Canada; Florida State Collection of Arthropods [FSCA], Gainesville, Florida, USA; Illinois State Museum [ISM], Springfield, Illinois, USA; Bell Museum of Natural History [BMNH], Minneapolis, Minnesota, USA; and Illinois Natural History Survey [INHS], Urbana, Illinois, USA.

Dimensions given to nearest 0.1 mm; structures < 10 mm measured with an ocular micrometer. Coloration of types as in live, mature adults. Total and abdominal lengths of adults and larvae include appendages. Ante- and postnodal crossvein numbers are of the costal series.

Etymology. – Lakota Sioux, n., *susbehcha* – "dragonfly".

MALE. – Head. – Labium yellow-white, movable hooks and endhooks dark brown; maxillae and mandibles yellow-white proximally, brown and orange-brown distally, respectively; labrum yellow-white, edged with dark brown distally; genae and anteclypeus yellow-white; frons green, proximal 1/4 brown dorsally; vertex dark brown with posteromedial greenish marking, antennae brown (distal 1/2 of basal segment brown-white), ocelli clear, postocellar ridge bilobed; occiput green, crest slightly convex and densely fringed with long setae; compound eyes gray-blue; postgenae predominantly brown dorsally, yellow ventrally. Labial setae light brown, others black.



Figs. 1-4. *Ophiogomphus susbehcha* spec. nov.: (1) lateral view of male terminalia; – (2) ventral view of female vulvar lamina; – (3) dorsal view of left larval antenna; – (4) dorsal view of male larval anal pyramid.

T h o r a x. – **Prothorax**: Notum yellow-brown with lateral and paired medial yellow markings, episterna yellow, epimera brown, sternum light yellow-brown, setae dark brown. – **Synthorax**: Pleura predominantly bright green, marked with dark brown bands as follows: middorsal band confluent with antealar carinae, extending to near anterior margin; antehumeral bands extending 7/10 distance toward wing bases; meso- (humeral) and metapleural bands confluent with dorsolateral carinae and anapleural and paracoxal sutures, respectively; intersegmental bands broadly interrupted medially between ca dorsal 1/6 and ventral 1/2. Middor-

sal and dorsolateral carinae, antealar sinuses, and spiracular margins dark brown; katepisterna light brown; ventral surface of metanepimera gray. Nota green; mesosternum brown-yellow, meta- and poststernum gray. Setae brown dorsally and laterally, gray ventrally. – **Wings**: Venation and pterostigmata dark brown, costa yellow ventrally, membrane hyaline. Antenodal crossveins 10-16/7-10; postnodal crossveins 8-13/8-12; triangles, sub- and supratriangles without crossveins; anal loop cells 2-4; anal triangle cells 4-7. – **Legs**: Coxae and trochanters yellow-green; femora dark brown, infused with yellow-green ventrally and proximally; tibiae, tarsi, and armature black; protibial keels yellow, ca 1/7 tibial length.

A b d o m e n. – Tergum 1 yellow dorsally, dark brown dorsolaterally, gray laterally. Tergum 2 dark brown with middorsal longitudinal yellow marking extending posteriorly to posterior transverse carina, marking constricted at supplementary transverse carina and posterior 1/3; auricles green with black tubercles posteriorly; small brown marking posterior to each auricle; large ventral gray marking anterior to posterior transverse carina. Terga 3-7 dark brown with middorsal lanceolate yellow marking broadest at anterior margin, constricted at supplementary transverse carina, and extending toward posterior margin ca 6/7, 3/4, 2/3, 5/8, and 3/5 length, respectively; lateral longitudinal gray marking extending from anterior margin ca 2/3 toward posterior margin, interrupted by supplementary transverse carina, tergum 7 lateral marking posterior to supplementary transverse carina yellow. Terga 8 and 9 dark brown with middorsal yellow marking for anterior 1/2 and 1/3, respectively; lateral yellow markings infused with brown medially. Tergum 10 yellow, anterior margin brown dorsally. Pleural membrane, where visible, gray. Sterna colored as follows: 1 light brown, 3-7 dark brown, 8 and 9 yellow-brown, 10 yellow. – **Terminalia** (Fig. 1): Yellow, distal 1/2 of epiproct dark brown dorsolaterally, setae dark brown. Cerci with lateral margins subparallel, mesal margins divergent, ventrally with proximal ca 2/5 constricted, distal ca 3/5 subcarinate and armed with black tubercles, apices acuminate. Epiproct with large, gibbose protuberance anterior to each ramus dorsally; prominent dorsolateral tooth posterior to each protuberance; cleft variable, rami slightly to strongly convergent; apices abruptly curved dorsally, capped with terminal black tubercle. – **Secondary genitalia**: Dark brown, proximal 1/2 of posterior hamuli yellow-white, setae light brown. Anterior hamuli bifurcate distally; in lateral view anterior process slender, curved toward apex of broader posterior process; enclosed gap oval. Posterior hamuli with ca distal 1/2 attenuated, compressed, and directed anteromedially; apices spathulate.

D i m e n s i o n s (in mm). – Total length 49.9-51.9; – Abdomen 36.0-38.0; – hindwing 26.5--29.0; – pterostigmata (fw) 2.7-3.3, (hw) 3.0-3.6; – cerci 1.4-1.6; – epiproct 1.8-2.0.

FEMALE. – Coloration similar to that of male; differences otherwise noted.

H e a d. – Prominent postoccipital horns present.

T h o r a x. – **Wings**: Antenodal crossveins 11-15/6-11; postnodal crossveins 8-13/8-13; anal loop cells 2-5. – **Legs**: Femora with pale areas more extensive.

A b d o m e n. – Middorsal and lateral pale markings more extensive; auricles vestigial, tubercles absent; terga 3-6 lateral markings posterior to supplementary transverse carina yellow; epiproct yellow; sternum 2 dark brown, 8-9 predominantly yellow. – **Genitalia** (Fig. 2): Vulvar lamina yellow; length ca 3/5 of sternum 9; base moderately tumid; cleft ca 1/2 length; lobes approximated basally for ca 6/7 length; apices dark brown, slightly divergent.

D i m e n s i o n s (in mm). – Total length 48.3-52.0; – abdomen 35.0-38.3; – hindwing 28.9--32.0; – pterostigmata (fw) 3.1-3.7, (hw) 3.6-4.3; – vulvar lamina length 1.9-2.1; – vulvar lamina basal width 1.2-1.4.

LARVA. – Description from one final instar larva and 25 exuviae; all specimens preserved in alcohol. Exuviae data given parenthetically. Color light brown unless otherwise noted.

H e a d. – Prementum widest at ca 1/2 length, narrowing gradually distally; ligula evenly convex with border of spiniform setae and 24 (20-24) rectangular denticles, width 2.9 (2.6-3.3) times length; first segment of labial palps rounded distally, mesal margins linear to slightly concave with 14 (11-16) subquadrate teeth; folded labium extends to posterior 1/2 of metacoxae. Antennal segment length ratio ca 17:11:48:10 (Fig. 3); 1 and 2 cylindrical; 3 depressed, spathulate, lateral margin broadly convex, mesal margin linear, margins convergent distally and fringed with setae; 4 papillate, lateral and mesal margins continuous with those of 3, proximal width ca 3/4 (2/3-3/4) greatest width of 3.

T h o r a x. – Wing pads divergent, extending to posterior margin of tergum 4; metafemur extending posteriorly to sternum 4.

A b d o m e n (Fig. 4). – Long ovoid, depressed, length ca twice width, widest at segment 5 or 6, dorsum moderately granular. Dorsal hooks greatly reduced; segment 2 with hook elongate, erect; 3 robust, depressed; 4-9 vestigial, in lateral view reduced to shallow mound-like prominences becoming progressively lower on 4, 5 and 6, then higher on 7, 8 and 9; in dorsal view, 9th hook usually visible as a protrusion of tergite's posterior margin. Lateral spines on segments 7-9, relative lengths ca 6:7:5. Cerci slender, apices dark brown, ca twice middorsal length of tergum 10; epiproct with distal 2/5 predominantly light brown-yellow, apex dark brown and slightly decurved, male epiproctal tubercles at ca 1/2 length; paraprocts with distal 3/5 predominantly light brown-yellow, apices dark brown, ca distal 1/5 incurvate.

D i m e n s i o n s (in mm). – Total lengths 27.8 (28.4-31.9); – head width 5.7 (5.4-6.1); – abdomen length 18.5 (19.5-21.9); – tergum 5 width 8.6 (6.9-8.7); – tergum 6 width 8.5 (6.8-8.4); – forewing pad 7.3 (6.3-7.3); – hindwing pad 6.8 (5.9-7.2); – metafemur 5.0 (4.6-5.4); – prementum length 3.5 (3.4-3.7); – prementum width 2.8 (2.6-3.0); – ligula width 1.0 (0.8-1.1); – epiproct 2.7 (2.5-2.9); – cerci 1.6 (1.4-1.6); – paraprocts 2.4 (2.1-2.5).

DIAGNOSIS AND TAXONOMIC AFFINITIES

O. susbehcha sp. n. adults can be differentiated from other known Nearctic *Ophiogomphus* as follows: tergum 10 yellow, except extreme anterior margin; intersegmental brown bands present but interrupted medially; and tibiae black.

Also, the male terminalia, notably the dorsal gibbose epiproctal protuberances (Fig. 1), and female vulvar lamina (Fig. 2) are distinctive. Final instar larvae can be distinguished from other Nearctic *Ophiogomphus* as follows: antennal segment 4 papillate, proximal width greater than 2/3 greatest width of 3 (Fig. 3); middorsal hooks on abdominal segments 3-9 reduced; and terminal appendages distinctive (Fig. 4).

The relative size of antennal segment 4 and reduced middorsal hooks of the larva are most similar to those of *O. anomalus* Harvey and *O. howei* Bromley, respectively. CARLE (1986, 1992) places these species in the subgenus *Ophionuroides* Carle. Epiproctal rami of adult male *O. susbehcha* have prominent dorsolateral processes. Based upon this character, *O. susbehcha* is referable to the subgenus *Ophionurus* Carle. Posterior hamuli of *Ophionuroides, Ophionurus,* and *O. susbehcha* have elongate hook-like apices. If this character state is synapomorphic, then *Ophionuroides* and *Ophionurus* are paraphyletic. Thus, if these subgenera are valid, they may require further definition.

BIOLOGY

O. susbehcha sp. n. is presently known from 11 sites on the Saint Croix River, Wisconsin and Minnesota. Ten of these are distributed over ca 50 river km. A hydroelectric dam and its accompanying impoundment separate the other known site, Interstate Park, by ca 30 river km. It is also known from two sites on the Chippewa River, Wisconsin. These sites are separated by ca 20 river km.

The following limnological data are available for the Saint Croix River, Burnett County, Wisconsin: average width - 161 m; average substrate composition - 60% gravel, 20% rock, 10% sand, and 10% muck (BLACKMAN, et al., 1966). Range and [means] for select water quality parameters recorded from the Saint Croix River near Danbury, Burnett County, Wisconsin, between 1975 and 1983 are: flow (m^3/sec) 7.6-140.5 [44.3]; specific conductance (μmhos) 60-175 [115.4]; dissolved oxygen (mg/l) 6.5-12.7 [10.7]; pH 6.1-8.5 [7.5]; alkalinity (mg/l $CaCO_3$) 21-75 [53.8]; and suspended sediment (mg/l) 0-50 [10.56] (GRACZYK, 1986).

At the type locality, larvae were found in water of at least 1 m depth and only where the current was so swift that collectors had extreme difficulty remaining in place. Substrate yielding *O. susbehcha* larvae consisted predominantly of cobble in sand and gravel with frequent large boulders. Other larval odonates present in this microhabitat include *O. howei* and *O. rupinsulensis* (Walsh). Adjacent areas with either shallower water, slower current, or different substrates yielded no *O. susbehcha*. Other breeding Anisoptera (n = 2,895 exuviae) present at *O. susbehcha* sites include: *Basiaeschna janata* (Say), *Boyeria vinosa* (Say), *Dromogomphus spinosus* Selys, *Gomphus (Gomphurus) fraternus* (Say), *G. (Gomphurus) lineatifrons* Calvert, *G. (Gomphurus) vastus* Walsh, *G. (Gomphurus) ventricosus* Walsh, *G. (Gomphus) adelphus* Selys, *G. (Gomphus) viridifrons*

Hine, *G. (Phanogomphus) quadricolor* Walsh, *Hagenius brevistylus* Selys, *O. anomalus, Stylurus amnicola* (Walsh), *S. notatus* (Rambur), *S. spiniceps* (Walsh), *Macromia illinoiensis* Walsh, *Epitheca (Tetragoneuria) canis* MacLachlan, *E. (Tetragoneuria) cynosura* (Say), *E. (Epicordulia) princeps* Hagen, *Neurocordulia molesta* (Walsh), *N. yamaskanensis* (Provancher), and *Libellula (Plathemis) lydia* Drury. *O. howei, G. (Gomphurus) lineatifrons*, and *G. (Gomphus) viridifrons* were first reported from Wisconsin by TENNESSEN (1988).

During June and July, 1989, Anisoptera exuviae were systematically collected from the type locality. Sixteen of the 642 exuviae collected were *O. susbehcha*. A mass emergence of *O. susbehcha* was observed at this site by WAS on 26 and 27 May, 1990. Exuviae and tenerals were intensively collected at this time (*O. susbehcha* 147, *O. anomalus* 4, *B. janata* 4). None of the other 17 breeding Anisoptera known from this site had begun emergence. Water temperature at 1800h CDT on 26 May was 14.7°C. During 1991 *O. susbehcha* emergence had begun by 22 May. The sex ratio for *O. susbehcha*, based on exuviae from all sites, is apparently 1:1 (146 ♂ : 151 ♀). Adults were most often observed in fields adjacent to the Saint Croix River where they fed on small dipterans.

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