

SHORT COMMUNICATIONS

**GOMPHUS (PHANOGOMPHUS) WESTFALLI SPEC. NOV. FROM THE  
GULF COAST OF FLORIDA (ANISOPTERA: GOMPHIDAE)**

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*Received September 16, 1986 | Accepted October 29, 1986*

*G. (Phanogomphus) westfalli* sp. n. (male holotype, female allotype: Ates Creek at Carr Lake dam site near Holt, Santa Rosa Co., Florida USA) is described from adult specimens and its affinities discussed. A brief taxonomic history of related species is given along with a summary of known biological information.

INTRODUCTION

The genus *Gomphus* Leach 1815 is represented throughout the northern hemisphere and reaches its greatest diversity in southern China and in the southeastern United States. *Phanogomphus* Carle & Cook is the dominant subgenus of American *Gomphus* with the following species reported from the southeast: *G. minutus* Rambur, *G. lividus* Selys, *G. exilis* Selys, *G. quadricolor* Walsh, *G. descriptus* Banks (as *G. mortimer* Needham), *G. australis* Needham, *G. cavillaris* Needham, *G. brimleyi* Muttkowski, *G. oklahomensis* Pritchard, *G. flavocaudatus* Walker, *G. hodgesi* Needham, *G. diminutus* Needham, and *G. sandrius* Tennessen. *Gomphus mortimer* was synonymized with *G. descriptus* by WESTFALL (1945), but an inability to rediscover it at the type locality and its nonconforming habitat preference suggest a mislabeling, in which case *G. descriptus* is incorrectly reported from the southeast (Dr M.J. Westfall, Jr, pers. comm., 1985). Of the remaining species *G. exilis*-*G. flavocaudatus* and *G. cavillaris*-*G. brimleyi* each form closely related allopatric species pairs which may actually represent subspecies. Unfortunately the latter species pair has

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been the subject of considerable taxonomic confusion because MUTTKOWSKI (1911) included two species in the type series of *G. brimleyi*.

The composite series was first suspected by Dr M.J. Westfall, Jr while comparing a specimen collected by Dr C.S. Brimley to the original description. Later his suspicions were confirmed by Mrs L.K. Gloyd who concluded that the holotype of *G. brimleyi* was similar to *G. cavillaris*, but that figures of the new Brimley specimen were similar to one of Muttkowski's paratypes. NEEDHAM (1950) then described *G. diminutus* from the Brimley specimen (collected 14 April 1927 at Aberdeen, North Carolina). With regard to the possible mislabeling of the *G. brimleyi* holotype, WESTFALL (1965) writes: "If while writing the description of *brimleyi* Muttkowski was critically examining one of the two specimens which Needham later named *diminutus*, it is difficult to see how he could have neglected describing the large medial projection of the superior appendage which sets *diminutus* males apart from *cavillaris* at once". Dr Needham was also sent a specimen determined as *G. brimleyi* from Alabama which Westfall also noted was not the true *G. brimleyi*; NEEDHAM (1950) described it as *G. hodgesi*.

In 1972 Dr O.S. Flint, Jr collected a *Phanogomphus* in the western panhandle of Florida which was tentatively referred to *G. diminutus* by Dr Westfall (pers. comm., 1981). In the following year the second author collected the floridian *G. diminutus* and in the field noted significant differences between the male cerci of these specimens and the photograph of the *G. diminutus* holotype in NEEDHAM & WESTFALL (1955: fig. 122). Later the first author noted these differences while comparing Flint's specimens to photographs of *G. diminutus* in the original description (NEEDHAM, 1950: figs 3 and 4; note that fig. 5 is incorrectly labeled as *G. hodgesi*), but decided to follow Westfall's tentative determination until specimens of the nominate form could be obtained. Consequently, the description and photographs in CARLE (1982: fig. 37.b) are of floridian material and are now referred to the new species. A specimen of the nominate form was eventually obtained in a small lot of dragonflies (collected by Dr B. Kondratieff) from near the Georgia-South Carolina border. This specimen, like a specimen collected by Mr Carl Cook in Tennessee, and several males collected by Mr Jerrell Daigle in Georgia, is the true *G. diminutus* of Needham. Although all three populations are separated from a cluster of populations known from the sandhills of North and South Carolina which includes the type locality, none show evidence of clinal variation which could eventually prove to include the new species.

We name the new species in honor of Dr MINTER J. WESTFALL, Jr in light of his many contributions to the odonatological community.

### *GOMPHUS (PHANOGOMPHUS) WESTFALLI* SPEC. NOV.

Figure 1

Material examined. — Holotype male: United States: Florida, Santa Rosa Co., Black Water

State Forest, Ates Creek at Carr Lake dam site near state fish hatchery at Holt, 18-IV-1986, F.L. Carle, deposited Florida State Collection of Arthropods (FSCA), Gainesville, Florida, U.S.A. — **Allotype female:** same as for holotype. — **Paratypes:** same data as for holotype, 25 males, 3 females; same locality as holotype, 1 female, 10-III-1972, O.S. Flint, Jr; 2 males, 14-III-1973, M.L. May; 1 male, 1 female, 16-III-1973, M.L. May; 8 males, 3 females, 15-III-1974, M.J. Westfall, Jr; Black Water State forest, Riley Spring Branch near Florida A&M field station at Holt, 3 males, 3 females, 10-III-1972, O.S. Flint, Jr; 3 males, 3 females, 17-III-1974, M.J. Westfall, Jr; 4 males, 1 female, 5-IV-1975, M.L. May; 1 male, 10-IV-1981, J.J. Daigle; marshy pond near Riley Spring Branch, 1 male, 1 female, 5-IV-1975, M.L. May; forest stream 1/2 mile SW of Riley Spring Branch, 1 male, 5-IV-1975, M.L. May; Big Cold Water Creek at Highway 191, 2 males, 2 females, 28-III-1976, S.W. Dunkle; 1 female, 23-III-1979, M.J. Westfall, Jr. Representative paratypes deposited at the FSCA; U.S. National Museum of Natural History; E.B. Williamson Collection, University of Michigan, Ann Arbor; Museum of Comparative Zoology, Harvard University; and at the American Museum of Natural History.

**MALE** — Measurements (in mm): total length 39.9-45.0; — abdomen including cerci 29.0-34.0; — cerci 1.1-1.3; — hind femora 6.1-7.3; — hind wings 21.5-24.5; — pterostigmata 2.6-2.7/3.0-3.2.

**Head.** — Labium and maxillae yellow, light brown distally; bases of mandibles yellow with apices brown; labrum yellow with proximal margin narrowly brown; postgenae and genae yellow; anteclypeus light greenish yellow; postclypeus yellow; frons yellow with fronto-clypeal sulcus and basal 1/4-1/3 of dorsal surface dark brown (dorsal band typically produced medially); postfrons ("vertex") and antennae dark brown and black, postocellar ridge extended to lateral margins of postfrons and slightly concave medially; distance between compound eyes 1.15-1.30 mm; occiput yellow with well developed transverse ridge, anterior surface ca twice as long at base as distance along midline, and posterior surface concave in posterodorsal view; posterior surface of head predominantly dark brown above lateral sinuosity of compound eyes and predominantly yellow below sinuosity.

**Thorax.** — Prothorax mostly brown, anterior lobe yellow with basal portion brown, middle lobe brown with geminate median and large lateral yellow spots, posterior lobe brown. Pterothorax brown with yellow stripes, with pterothoracic tergum yellow margined with brown; mesothoracic middorsal carina yellow to level of bifurcation and narrowly confluent with yellow collar below; mesothoracic collar stripe yellow, and narrowly if at all, confluent across midline; dorsal mesanepisternal yellow stripes divergent anteriorly, separated from antealar carina above and confluent with yellow collar below, upper ends of mesanepisternal pale stripes separated by ca. maximum width of stripe; lateral mesanepisternal yellow stripes each narrow with upper end not fused to dorsal stripe and with lower portion gradually convergent toward mesanepimeral yellow stripe (intervening brown area wedged-shaped); mesokatepisterna yellow with inverted "C"-shaped brown area above middle; mesanepimeral yellow stripes separated from metanepisternal yellow stripes by brown band which reaches metathoracic spiracles, spiracles ringed with brown; metanepisternal stripes bright yellow and

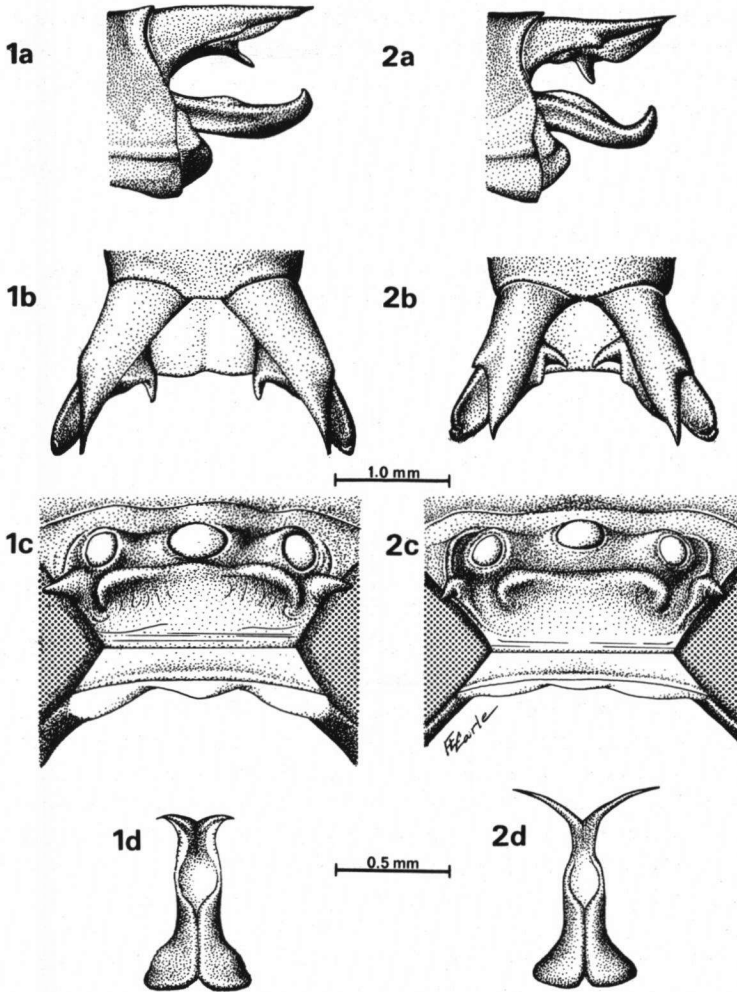
entire, metakatepisterna yellow with upper 1/3 brown; metanepimera laterally yellow, anterior margin brown along metapleural sulci; dorsolateral carina brown, antealar yellow margined with brown; thoracic sternum pale yellow with ventral surface of metanepimera tinged with brown.

Legs. — Coxae yellow; trochanters, femora, tibia, and tarsi predominantly brown; ventral surface of femora light brown or pale yellow; tibia with external surface and patellae pale yellow; prothoracic tibial keels tan and ca 1/3 as long as fore tibia; tarsal claws tan.

Wings. — Venation brown, costa and ventral surface of pterostigmata pale yellow, dorsal surface of pterostigmata tan; basal subcostal crossveins absent; antenodal crossveins 9-12, 9-11/6-8, 5-8; postnodal crossveins 6-10/6-9, crossveins under pterostigmata 3-4/3-5; bridge crossveins 4-6/3-5; triangles, subtriangles, and supratrangles without crossveins; outer side of fore wing triangle not distinctly angulated near middle; fore wing trigonal interspace typically with 1-4 through cells; gaff 0.6-1.1 times as long as inner side of triangle; anal field of fore wing with 4-7 cells not contiguous with anal vein.

Abdomen. — Brownish black marked with yellow and white; segments 1 and 2 mostly brown with dorsomedian yellow stripe and yellow lateral area extended to just above level of auricle; dorsomedian stripe constricted at antecostal suture, and segment 2 with brown area extended ventrally posterior to auricle and with small brown area anteroventral to auricle; auricles yellow with 15-30 denticles, intersegmental conjunctiva of segments 1-6 brown, that of 7-9 tan; lateral margins of terga 3-6 narrowly white; acrotergites 3-8 with small lateral yellow spots, spots extended posterodorsally on 8; terga 3-8 with elongate middorsal yellow spots (extended narrowly to apex on terga 3-4, 5, or 6), middorsal spot of tergum 7 ca 7/10 length of tergum and that of 8 a basal spot; terga 9 and 10 brown dorsally; terga 7, 8, and 10 with posterolateral triangular yellow areas, tergum 9 with lateral yellow bands; terminalia brown, cerci each with dorsomedian, lateral, and ventroapical carina, and with a posteroventrally directed spine near middle (Figs 1a, 1b); cercal spine not separated from ventroapical carina by notch; cerci each with vestigial lateral tooth and acute apex; epiproct divaricate, attenuate, slightly longer than cerci, and without subapical dorsal pits (Fig. 1a).

Genitalia. — Anterior hamuli each tan with dark brown apex, lateral apical lobe with 2 long and 1 or 2 short posteromedially directed spines, medial lobe subapical and strongly appressed, with distal end of posterior ridge fused to lateral lobe near middle of hamulus; posterior hamuli each tan with brown shoulder and anteriorly directed endhook, shoulders ridgeline and contiguous medially, each shoulder also with large proximal concavity, distal portion of each hamulus elongate and slightly tapered toward apex so that width at base of end hook is ca 3 times length of endhook. Penis brown, filament and membranes translucent or white; segment 1 with raised pyramidal hood with thick lateral flanges, with posterior margin in lateral view erect, penile receiver wide-trough-



Figs 1-2. *Gomphus (Phanogomphus) westfalli* sp. n. (Fig. 1), and *G.(P.) diminutus* Needham (Fig. 2): (a) lateral view of male terminalia, — (b) dorsal view of male terminalia, — (c) dorsal view of female head, and — (d) ventral view of fourth penile segment.

like with squared "U"-shaped apex; segment 2 "L"-shaped and gradually widened distally, ca 1.1 mm long, and with penile spine absent; segment 3 ca 1.5 mm long excluding prepuce, ca 0.7 mm wide near apex and strongly narrowed toward base, apical sclerites brown distally, and prepuce projected posteriorly above segment 4; segment 4 ca 1.0 mm long with flagella wide basally and divided into two short tails apically (Fig. 1d).

**FEMALE** — Measurements (in mm): total length 39.0-45.0; — abdomen including cerci 28.0-34.0; — cerci 0.8-1.1; — hind femora 6.0-7.1; — hind wings 22.0-25.0; — pterostigmata 2.8-3.1/3.0-3.5.

**Head.** — Colored as in male with yellow more extensive; postocellar ridge ending behind lateral ocelli near base of lateral spines (Fig. 1c), lateral horns of postfrons large and directed laterally or dorsolaterally, distance between compound eyes 1.3-1.5 mm, posterolateral surfaces of occiput merged gradually into posterior surface of head (Fig. 1c), posterior surface of occiput with well developed medial lobe.

**Thorax.** — Prothorax and pterothorax colored as in male with yellow more extensive.

**Legs.** — Colored as in male, inner spines of hind tibia longer than in male.

**Wings.** — Venation brown, costa yellow, pterostigmata tan, antenodal crossveins 10-12, 9-12/6-9, 5-9, postnodal crossveins 7-10/6-9, triangles, subtriangles, and supratrangles without crossveins; gaff 2/3 to as long as inner side of triangle, bridge crossveins 3-7/3-6; crossveins under pterostigmata 3-5/3-5.

**Abdomen.** — Dark brown with lateral and medial greenish yellow stripes, segment 1 yellow with submedial rectangular brown areas, segment 2 with broad lateral and dorsal yellow stripes, auricles yellow and without denticles; terga 3-7 with full-length lanceolate dorsal spots, and slightly undulate lateral stripes extended from anterior edge of segment to near posterior carina, lateral stripes widest anteriorly and often divided by narrow brown line along antecostal suture, terga 3-7 with ventrolateral margin and lateral carina white, tergum 8 blackish brown with small midbasal yellow triangular spot, and with lower half yellow, tergum 9 blackish brown dorsally with lower half yellow, tergum 10 blackish brown with middorsal yellow spot on posterior margin, sterna 1 and 2 predominantly yellow, sterna 3-7 brown (distal swelling on 7 yellow), sterna 9 and 10 yellow with diffuse medial brown band (lateral carina of 10 also yellow), terminalia yellow with cerci margined with brown.

**Genitalia.** — Vulvar lamina yellow, ca 3/5 length of sternum 9, 1.9-2.4 times as long as wide, and 1.6-1.9 mm long, apical cleft extended ca 3/5 distance to base.

**REMARKS** — *Gomphus westfalli* sp. n. and *G. diminutus* comprise a closely related species pair. Both species may be distinguished from other *Phanogomphus* by the elongate posterior hamuli and vulvar lamina. *Gomphus westfalli* will not key out using the keys provided in NEEDHAM & WESTFALL (1955). For example, couplet 7 for *G. diminutus* states "Midlateral and femoral brown stripes of thorax and area between covered by single wide brown band. . .", whereas these brown stripes are separated by a narrow bright yellow stripe in *G. westfalli*. Study of several *G. diminutus* has revealed that the metanepisternal midregion is actually diffuse yellow at emergence and then becomes brown at maturity, the diffuse yellow area being reduced to a small dorsal spot and an area adjacent to the spiracle. Also in *G. westfalli* the base color of the legs and abdomen is dark brown, the middorsal abdominal yellow spots are narrow-lanceolate (spot on tergum 7 6-9 times as long as wide), and the lower 2/3 of the metakatepisterna are yellow; in *G. diminutus* the base color of legs and abdomen is brown (tergum 10 yellowish brown), the middorsal abdominal yellow spots are

wide-lanceolate (spot on tergum 7 4-5 times as long as wide), and the metakatepisterna are brown.

The male terminalia of *G. westfalli* are in some respects intermediate in structure between *G. diminutus* and *G. australis*. However, *G. westfalli* differs from both related species in that the lateral cercal spines are vestigial (Figs 1a, 2a). The male cerci of *G. westfalli* further differ from those of *G. diminutus* in that they lack the postspinal lobe (Figs 1b, 2b), and have the inner cercal spines directed posteroventrally instead of medioventrally. The male epiproct is straighter and more attenuate in *G. westfalli*, the rami being nearly straight and 4-5 times as long as wide, opposed to strongly upcurved apically and 3-4 times as long as wide in *G. diminutus*. In *G. westfalli* the medial lobe of the anterior hamuli is more strongly appressed and fused than in *G. diminutus* (see description). The penis of *G. westfalli* differs primarily in that the flagellar base is widened laterally by translucent borders and the flagella are very short (Figs 1d, 2d). In addition, the apex of the penile receiver is "U"-shaped in *G. westfalli* and "V"-shaped in *G. diminutus*.

Females may be distinguished by the shape of the posterior surface of the occiput (Figs 1c, 2c). In *G. westfalli* the posterolateral occipital surfaces merge gradually into the posterior surface of the head and the posteromedial lobe is well developed, while in *G. diminutus* the transition between posterolateral occipital surfaces and the posterior surface of the head is abrupt with the posteromedial lobe vestigial or absent. In addition, the lateral horns of the postfrons are directed laterally or dorsolaterally and the bases of the lateral horns are nearly contiguous with the postocellar ridge in *G. westfalli* while in *G. diminutus* the lateral horns are directed posterolaterally and the bases of the lateral horns are separated from the postocellar ridge by a wide flat area (Figs 1c, 2c). The vulvar lamina is more elongate in *G. westfalli* being about twice as long as wide and divided for ca 3/5 its length, whereas it is about 1.6 times as long as wide in *G. diminutus* and divided for ca 3/4 length. Abdominal segment 10 also differs in females of the two species, in *G. westfalli* it is about 1.3 times as long as wide ventrally, dark brown dorsally with a small posteromedial yellow spot, and bright yellow ventrally; in *G. diminutus* segment 10 is about 1.2 times as long as wide ventrally, brown dorsally with a large medial yellow area, and yellowish brown ventrally.

## BIOLOGY

*Gomphus westfalli* inhabits clean acidic streams and small lakes of the Blackwater River drainage in north western Florida. The region is characterized by low sand-hills covered with pine forests, and aquatic habitats in which *Sphagnum* and other typically acid-adapted bog vegetation such as pitcher plants are prevalent. Nymphs of *G. westfalli* are found in the fine silts which overlie the sand bottoms of small streams and spring fed lakes. The known flight season extends from March 10 to April 18, but probably extends from late February until early May since many adults were in mature condition by March 14, and on April 18 many were present with some still in fresh condition. Adult emergence has been observed on March 16, and although we have no records of oviposition, a female specimen taken at Riley Spring Branch on March 17 has several eggs extruded beneath the vulvar lamina. Males commonly perch on the ground (or occasionally on low vegetation) near the waters edge, and females are most often encountered 10-20 m from stream-side on sand banks, on roads, or in forest openings. The specialized undulating flight pattern consisting of a series of 4 to 8 foot high concave loops observed in other *Phanogomphus* has also been observed in *G. westfalli*. However, unlike WALKER's (1958) description of this flight pattern

for *G. lividus*, the first author has observed it in both sexes of *Phanogomphus*. The only other gomphine collected at the type locality is *G. hodgei* which has a known flight season from April 3 to April 18 at the site. These dates and the maturity of the adults collected indicate that the flight season of *G. westfalli* begins at least two weeks earlier than that of *G. hodgei*. The known flight season of *G. hodgei* in Louisiana is from March 1 to April 16, indicating that the flight season of *G. westfalli* at yet undiscovered localities could begin in mid February. In contrast, *G. diminutus* inhabits sandy lakes and boggy ponds with the known flight season extending from April 5 to May 23 (WHITE et al., 1980). The distribution of this species pair resembles that of *G. parvidens* Currie-*G. geminatus* Carle, and *Ophiogomphus incurvatus* Carle-*Ophiogomphus* sp. A. Taken together the combined distributions are similar to that of several Odonata that have disjunct distributions, that is, in the inner coastal plain of the Carolinas and along the northern Gulf coast. These include: *Progomphus bellei* Knopf & Tennesen, *Stylurus townesi* Gloyd, *Gomphus brimleyi*, *Somatochlora calverti* Williamson & Gloyd, and *Enallagma davisii* Westfall. To what extent the distributional gap is real rather than the result of insufficient collecting in southern Georgia is unclear. The extent of morphological divergence between floridian and carolinian species pairs suggests that a genuine barrier separates or separated these populations. There is currently no obvious physiographic (FENNEMAN, 1938) or climatic discontinuity that would explain the separation, although geology through its influences on bottom substrates may be an important factor. The situation is further confused by the collection of *G. diminutus* from southeastern Tennessee in the Ridge and Valley physiographic province. Clearly, much more needs to be known of the habitat requirements of these species, and much more collecting in apparently suitable habitats is needed before a reasonable assessment of their true distribution and biogeography is possible.

DUNKLE & WESTFALL (1982) considered "*G. diminutus*" to be threatened in Florida, and BICK (1983) listed the species as rare in the United States. Reproductive isolation between the floridian and the more northern populations suggests that *G. westfalli*, in particular, is in greater jeopardy than previously believed; although the insect is locally abundant, the entire known range is encompassed within a radius of a few kilometers. It is hoped that further collecting in western Florida and southern Alabama will lead to discovery of additional populations, but at present the future of the species must be considered highly uncertain. This situation again serves to emphasize the importance of conservation efforts directed toward Odonata in the northern Gulf Coast region of the U.S. (BICK, 1983), and particularly the blackwater streams of the north-west Florida panhandle (DUNKLE & WESTFALL, 1982).



#### ACKNOWLEDGEMENTS

The authors thank the following persons for the loan of specimens: Mr CARL COOK, Dr O.S. FLINT, Jr, Mr JERRELL DAIGLE, Dr SIDNEY DUNKLE, Dr BORIS KONDRATIEFF, and Dr M.J. WESTFALL, Jr. — New Jersey Agricultural Experiment Station, Publication No. 0-08412-19-86, supported by state funds.

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