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PHYLLOCYCLA BASIDENTA SPEC. NOV. AND *P. UNIFORMA* SPEC. NOV., NEW DRAGONFLIES FROM BOLOVIA AND PERU (ANISOPTERA: GOMPHIDAE)*

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P. basidenta sp. n. (holotype ♂: Bolivia, Santa Cruz Depto, 10 km E of Warnes, 17.40 S 63.00 W, deposited in FSCA, Gainesville, Florida) is described and figured. It is closely related to *P. malkini* Belle, but differs from all other known *Phyllocycla* by the presence of a basoventral tooth at 1/4 length of each male cercus. — *P. uniforma* sp. n. (holotype ♂: Peru, Puesto Guadalupe, deposited in FSCA) is described and figured. It is in the *P. volsella* (Calvert) group but has the least developed color pattern among known *Phyllocycla* spp. Its closest relative is *P. neotropica* Belle. Male mating adaptations in the genus are discussed.

INTRODUCTION

DAVIES & TOBIN (1985) listed 23 species of the exclusively Neotropical genus *Phyllocycla* Calvert. Of these, *P. calverti* (Kirby) was recognized as a *Phyllogomphoides* by GLOYD (1973). *Gomphoides hesperus,* described by CALVERT (1909) and said by him to belong to Selys' *Cyclophylla,* should be a *Phyllocycla* although DAVIES & TOBIN (1985) list it as an *Aphylla.* Two more *Phyllocycla* spp. are described below, bringing the total to 25 known species.

PHYLLOCYCLA BASIDENTA SPEC. NOV.

Figure 1 (A-D)

Material — **Holotype:** male adult, Bolivia, Santa Cruz Depto, 10 km East of Warnes, North of Santa Cruz, 17.40 S 63.00 W, 30 Dec. 1983, R. Wilkerson leg. Deposited Florida State Collection

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of Arthropods (FSCA), Gainesville, Florida, United States.

Etymology. — Named for the distinctive basoventral tooth on each male cercus.

Diagnosis. — A small *Phyllocycla* with the dark thoracic stripes well developed, a narrow lateral flange on abdominal segment 8, and simple cerci except for the basoventral tooth at ¼ length of each which is unique in the genus. Female unknown.

Male: Head. — Face prognathous. Labrum, mandibles, anteclypeus, sides of postclypeus, and dorsal surface of frons pale gray blue, rest of head brown. Labrum 2.0× wider than long, distance between antennal bases 2.4× sagittal length of frons dorsal surface, occiput trapezoidal with its anterior edge 0.6× as wide as its crest, ligula 1.4× wider than long.

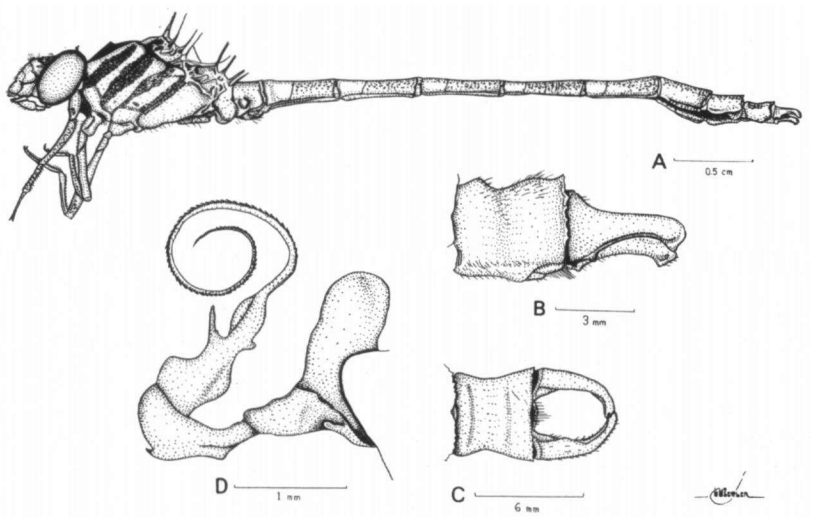

Fig. 1. *Phyllocycla basidenta* sp. n., holotype male: (A) Left lateral view; — (B) Left lateral view of abdominal segment 10 and cerci; — (C) Dorsal view of abdominal segment 10 and cerci; — (D) Right lateral view of penis.

Thorax. — Prothorax brown except for 3 green spots on middle lobe, a medial and 2 lateral. Synthorax green with dark brown stripes (Fig. 1A). Mesepisternal green stripes widen ventrally to cover collar. Antealar carinae and sinuses brown, interalar sclerites green. Distance between lateral end of antealar carina and lateral end of collar carina 1.3× length of collar carina. Dorsomedian carina below dorsal point 0.9× length of half the collar carina. Coxae apparently green, trochanters and most of each femur tan, distal femora and rest of legs dark brown. Foretibial keel ⅓ tibial length. Distal spine of hind femur ¼ as long as local diameter of femur, about 22 spines in anterior row, spines black-tipped.

Hind tibia with 11 spines on antero-flexor carina.

Wings. — Venation dark brown, pterostigma tan and 0.37× as long as distance between nodus and pterostigma. Anal triangle 4-celled and 1.8× as long (including tornal cell) as wide. Tornal angle slightly obtuse. Supratriangles, triangles, and forewing subtriangles 2-celled. Hindwing subtriangle 1-celled. Basal subcostal crossveins present. Arculus just distal to second antenodal crossvein in forewing, proximal to it in hindwing. Forewing antenodal crossveins 16-17, hindwing 12, the first and fifth thickened in all wings. Forewing postnodals 11-10, hindwing 10-11. Forewing with 6-7 paranal cells, 2 of them doubled to form marginal cells. Hindwing veins A1 and A2 slightly divergent, A2 and A3 slightly convergent. Anal loop 2-celled but ill-defined. Forewing distal pleat (middle fork of Comstock/Needham notation) at 0.57× distance between distal angle of triangle and posterior end of subnodus. One cubitoanal crossvein proximal to subtriangle, in forewing 1/5 as long as posterior side of subtriangle. All wings with 5 crossveins posterior to pterostigma.

Abdomen. — Mostly dark brown, segment 1 discolored but probably brown dorsally, green laterally. Segment 2 green mid-dorsally, on auricles, and possibly elsewhere, segments 3-6 each with green basal rings proximal to transverse carina, 7 with green basal ring plus a lateral streak posterior to transverse carina, 8 with a green mid-dorsal basal streak, sides of 8-9 rusty brown, 10 tan, dark brown dorsobasally. Segment 8 with a narrow black lateral flange widest (0.25 mm) and straight edged in the posterior half. Segment 9 black edged and slightly sinuate laterally (Fig. 1A). No denticles on edges of flanges, but lower surfaces roughened. Sternum of 10 1.1× wider than long with only a small part of posteroventral corner of tergite folded against sternum. Cerci dark brown, 1.2× as long as segment 10 in dorsal view, each cercus with a short blunt tooth-like flange on inside curve near tip, small notch between distal end of flange and cercal tip in dorsal view (Fig. 1C). Each cercus wedge-shaped in cross-section, ventral edge keeled with a tooth at extreme base and another at 1/4 length of cercus (Fig. 1B). Anterior lamina of abdominal segment 2 transversely ridged, emarginate medially. Anterior hamule directed posteriorly, its tip a blunt slightly hooked fingernail-like flange. Posterior hamule with a prominent shoulder in both lateral and anterior views, its tip blunt and directed medially. Penis guard with a deep V-shaped medial notch. Penis hood in lateral view parallel-sided and bluntly rounded (Fig. 1D), in posterior view with a deep circular cleft which lacks a medial tooth. Second segment of penis in ventral view 1.8× as long as wide, third segment 0.7× as long as wide. Penis tipped with 2 long coiled serrated flagella.

Measurements (in mm). — Total length including cerci 48.0, abdomen 38.0, hindwing 26.5, forewing pterostigma 3.4, hind femur 5.0.

Remarks. — *Phyllocycla malkini* Belle is similar to *basidenta*, but the male cerci are more slender and lack the basoventral tooth at 1/4 the cercal length, the penis guard has only a shallow v-notch, the hook of the posterior hamule is pointed, the anal loop is normally 1-celled, the labrum is brown with pale lateral spots, and the dorsal surface of the frons is brown instead of gray blue

medially. The basal part of the cercal ventral keel is 0.15× the length of the cerci, compared with 0.25× in *basidenta*. Some other *Phyllocycla* have cerci similar to those of *basidenta*, but none has a basoventral cercal tooth at ¼ length, and each has some character or combination of the following: wide lateral flanges on abdominal segment 8, deeply cleft anterior lamina of abdominal segment 2, no basoventral cercal carina, hindwing veins A2 and A3 divergent, dorsomedial or submedial cercal teeth present.

P. anduzei (Needham) was collected at the same place and date as the holotype of *P. basidenta*.

PHYLLOCYCLA UNIFORMA SPEC. NOV.

Figure 2 (A-C)

Material — **Holotype**: male adult, Peru, Puesto Guadalupe in coastal Peru, 18 March 1951, E.S. Ross & Michelbacher leg., deposited FSCA.

Etymology. — Named for the nearly uniform green color, without notable dark markings.

Diagnosis. — The only known *Phyllocycla* which lacks definite thoracic stripes. The male cerci are also characteristically shaped; they are of the *P. volsella* (Calvert) type but the tips are blunt and slightly bifid in lateral view. Female unknown.

Male: Head. — Face prognathous, unmarked pale blue gray including dorsal frons. Vertex and occiput yellow olive green. Labium and rear of head tan. Antennal scape yellow green, pedicel and flagellum brown. Labrum 2.0× wider than long, distance between antennal bases 2.1× mid-sagittal length of frons dorsal surface, occiput trapezoidal with its anterior edge 0.6 as wide as its crest, ligula 1.1× wider than long.

Thorax. — Prothorax and synthorax yellow olive green, except for dark wide antehumeral and narrow humeral smudges, and yellow collar and dorsomedian carina. Distance between lateral end of antealar carina and lateral end of collar carina 1.3× length of collar carina. Dorsomedian carina below 0.9× length of half the collar carina. Coxae yellow olive green; femora tan, darker distally, except yellow green underside of fore femur. Tibiae and tarsi dark brown. Foretibial keel 0.3× tibial length. Distal spine of hind femur ⅓ as long as local diameter of femur, about 17 spines in anterior row, spines black.

Wings. — Venation dark brown except dull yellow costa and tan pterostigma. Anal triangle 4-celled and 1.9× as long (including tornal cell) as wide. Tornal angle slightly obtuse. Supratriangles, triangles, and forewing subtriangles 2-celled. Hindwing subtriangle 1-celled. Basal subcostal crossveins present. Arculus proximal to second antenodal crossvein in all wings. Forewing antenodals 15-14, hindwing 11-10, the first and fifth thickened in all wings. Postnodal crossveins 9 in all wings. Forewings with 6 paranal cells, 2-3 of them doubled to form marginal cells. Hindwing veins A1, A2, and A3 nearly parallel. Forewing distal pleat at 0.54× distance between distal angle of triangle and posterior end of subnodus. One cubitoanal crossvein proximal to subtriangle, in forewing ⅕ as long as

posterior side of subtriangle. Pterostigma 0.5× as long as distance between nodus and pterostigma; 6 crossveins posterior to it in forewings, 5 in hindwings.

Abdomen. — Segments 1 and 2 yellow olive green, most of remainder brown, yellower laterally on 3 and basal to transverse carinae on 4-7. Segment 8 yellow laterally with an arcuate black flange on each side (Fig. 2C), flange denticulate along edge of posterior half, yellow at extreme posterior end, and widest (0.4 mm) at 3/4 its length. Segment 9 yellow laterally with a narrow (0.2 mm) yellow slightly sinuate nondenticulate flange. Segment 10 brown, sternum yellower and 1.4× wider than long. Posterolateral corners of tergite 10 not folded ventrally. Cerci brown, 1.8× as long as segment 10 in dorsal view, the posterodorsal edge of each rolled inward to form an oblique medial flange (Fig. 2B); anterior end of flange appears as a blunt dorsal tooth at 0.7× length of cercus in lateral view. Each cercal tip ends in 2 blunt teeth, the proximal one shorter (Fig. 2A). Basal 0.7 of each cercus slightly keeled both dorsally and ventrally. Secondary genitalia similar to those of *P. anduzei* (and *neotropica* Belle), but notch of penis hood has a medial tooth in posterior view. Edge of anterior lamina broadly concave, tips of anterior hamules curved dorsally, posterior hamules green and bluntly pointed, penis hood brown, penis guard with a small v-shaped medial notch.

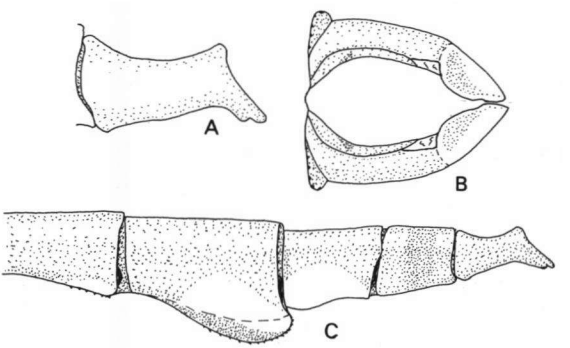

Fig. 2. *Phyllocycla uniforma* sp. n., holotype male: (A) Left lateral view of cerci; — (B) Dorsal view of cerci; — (C) Left lateral view of abdominal segments 8-10 and cerci.

Measurements (in mm). — Total length including cerci 47.0, abdomen 36.0, hindwing 28.0, forewing pterostigma 4.3, hind femur 5.0.

Remarks. — *P. uniforma* has the least developed color pattern among known *Phyllocycla* spp. *P. pallida* Belle has a reduced thoracic pattern consisting of pale brown antehumeral and humeral stripes, but the male cerci are forcipate as in *basidenta*. The shape of the male cerci shows that *P. uniforma* belongs to the *volsella* group of BELLE (1977), including *anduzei, armata* Belle, *neotropica, titschacki* (Schmidt), and *volsella*. These species differ from *uniforma* by having well developed thoracic stripes, sharply pointed male cerci, and ventral tergal margins of segment 9 black. *P. neotropica*, known only from Surinam, is most similar to *uniforma* in its morphology, but in addition to the differences cited above, males have the flange of segment 8 widest at its posterior end and the tips of the cerci divaricate or parallel in dorsal view. Males of other species in the *volsella* group have the flange of segment 8 with few or no denticles, the ventral tergal margin of 9 convex for nearly its full length, and hindwing veins A2 and A3 convergent.

Mr A.E. Michelbacher has supplied additional data on the type locality. Puesto Guadalupe must lie in a river valley on the Pan American Highway on the west coast of Peru between Lima and Chiclayo. This locality is in west central Peru in Lima, Ancash, or La Libertad Departments.

Phyllocycla basidenta and *P. uniforma* are classified with reasonable ease into the Gomphoidea, Gomphidae, Lindeniinae, and Gomphoidini of CARLE (1986). However, in *uniforma* the pterostigma is longer than the distance between the costal braces (primary antenodal crossveins) and thus does not fit the key to Gomphoidea for this character. In both *basidenta* and *uniforma* the distance between the lateral end of the antealar carina and the lateral end of the collar carina is 1.3× the length of the collar carina, not within the 1.7-2.2× range given in the diagnosis for Gomphoidini.

MALE MATING ADAPTATIONS IN *PHYLLOCYCLA*

In a few Gomphidae, including the New World *Phyllocycla, Aphylla, Cacoides, Melanocacus,* and *Archaeogomphus,* the male epiproct has become rudimentary and is not used to hold the female during tandem. According to CARLE (1986), the first 2 genera are placed in Gomphoidini, the next 2 in Lindeniini, and the last in Archaeogomphini. In these genera, the male primarily grips the female prothorax, a situation analogous to that in Zygoptera from which the Anisoptera were evolutionarily derived, but the tandem grip is different in each of the 3 tribes mentioned above and has been independently evolved in each. The tips of the male cerci in *Phyllocycla* apparently fit on or between the female's anterior and posterior lateral cervical sclerites. A patch of denticles on the proepisternum may guide the tips of the male cerci into position. The cervical sclerites and denticles are equally developed in both sexes, and vary little among species, and so do not seem to be reliable taxonomic characters. The inside curves of the male cerci are membranous, apparently allowing a more secure grip on the lateral edges of the anterior pronotal lobe (see *Aphylla* in next paragraph). Male abdominal tergites 7-9 often have sculptured and denticulated lateral edges which probably contact the vertex and face of the female during tandem.

Male *Aphylla* show much the same tandem grip adaptations as in *Phyllocycla,* but the posteroventral corners of tergite 10 press down on the crest of the female occiput during tandem. Since abdominal tergites 7-9 are not closely applied to the head of the female, their edges show little denticulation or sinuosity in male *Aphylla.* An examination of live male *Aphylla williamsoni* (Gloyd) showed that the inside curves of the cerci are indeed membranous. These membranes might be inflatable, but I was not able to cause them to inflate with pressure on the abdomen or with a water-filled hypodermic syringe. The membranes probably function as an adjustable socket for some projection on the prothorax of the female. The cerci of *A. williamsoni* were also interesting because the ventral carina which extends as the cercal tip is soft and flexible, even though it looks heavily sclerotized. It is likely that the tandem grip system of *Phyllocycla* evolved from an *Aphylla*-like system; the latter in turn evolved from a *Phyllogomphoides*-like system in which the males have a functional epiproct and forcipate cerci

without membranous areas.

In *Cacoides* and *Melanocacus* the denticulated medial edges of the male cerci apparently hold the sides of the female prothorax (see BELLE, 1986). The tandem grip system of male *Archaeogomphus* is quite different, involving projections from male tergite 10 which engage the female occipital foramen and posterior pronotal margin as explained by BELLE (1982, p. 40).

The penis in *Phyllocycla* has 2 long serrated flagella which probably remove sperm already present in a female before a male injects his own. The flagella are apparently cleaned of sperm by being pulled through the deep cleft in the hood of the penis. This cleft often has a medial tooth or radially arranged stiff setae which brush off sperm, as evidenced by what seemed to be dried semen on some specimens. This type of penis is more advanced than the *Aphylla* type which lacks flagella and a deeply cleft hood.

ACKNOWLEDGEMENTS

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REFERENCES

BELLE, J., 1977. A new species of Phyllocycla Calvert, 1948 from Brazil (Odonata: Gomphidae). *Ent. Ber., Amst.* 37: 6-7.

BELLE, J., 1982. A review of the genus Archaeogomphus Williamson (Odonata, Gomphidae). *Tijdschr. Ent.* 125: 37-56.

BELLE. J., 1986. New World Lindeniinae, with Melanocacus interioris gen. nov. et spec. nov. (Odonata: Gomphidae). *Ent. Ber., Amst.* 46: 97-102.

CALVERT, P.P., 1909. Contributions to a knowledge of the Odonata of the Neotropical region, exclusive of Mexico and Central America. *Ann. Carneg. Mus.* 6: 73-280.

CARLE, F.L., 1986. The classification, phylogeny and biogeography of the Gomphidae (Anisoptera). I. Classification. *Odonatologica* 15: 275-326.

DAVIES, D.A.L., & P. TOBIN, 1985. The dragonflies of the world: a systematic list of the extant species of Odonata, Vol. 2: Anisoptera. *Soc. Int. Odon. rapid Comm.* (Suppl.) 5: 1-151.

GLOYD, L.K., 1973. The status of the generic names Gomphoides, Neogomphoides, Progomphus, and Ammogomphus (Odonata: Gomphidae). *Occ. Pap. Mus. Zool. Univ. Mich.* 668: 1-7.