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(DIPTERA: DIOPSIDAE) FROM INDIA WITH A KEY TO THE ALLIED SPECIES

AND NOTE ON ITS HABITAT

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TAXONOMIC STATUS AND ADDITIONAL DESCRIPTION OF WHITE'S STALKED-EYED FLY *CYRTODIOPSIS WHITEI* (CURRAN, 1936) (DIPTERA: DIOPSIDAE) FROM INDIA WITH A KEY TO THE ALLIED SPECIES AND NOTE ON ITS HABITAT

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Abstract: Systematics and ecology of *Cyrtodiopsis whitei* (Curran, 1936), initially described in brief from a tropical dry deciduous forest in eastern India as *Diopsis whitei*, remained obscure for want of the type specimens. Recent collections of male and female specimens of this species from a new locality in the northeastern part of India, the country of the type locality, has allowed a fresh appraisal of its morphology, taxonomic position and habitat ecology in the background of several studies done on Diopsidae. Herein are included some new characters, hitherto unknown in the species of *Cyrtodiopsis*, a taxonomic key to the separation of four species, considered monophyletic under the genus, and a note on the habitat of the species.

Keywords: *Cyrtodiopsis*, *Diopsis*, habitat, monophyletic, new characters, systematics, taxonomic key.

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INTRODUCTION

Worldwide, Stalked-eyed Flies of the family Diopsidae Bilberg, 1820 are known by 189 species from 12 genera (Roskov et al. 2015). These include reports of eight species in five genera from India (Mitra et al. 2014). Baker et al. (2001), Meier & Baker (2002), and Földvári et al. (2007) considered species of *Teleopsis* Rondani, 1875 and *Cyrtodiopsis* Frey, 1928 to be congeneric based on molecular affinity provided by partial nucleotide alignments of three mitochondrial and three nuclear genes. Feijen (2011), however, disputed the single clade phylogenetic hypothesis by Baker et al. (2001) and preferred *Teleopsis* and *Cyrtodiopsis* to be paraphyletic and that is being widely followed in diopsid taxonomy and biology till date (Roskov et al. 2015).

The original description of *Cyrtodiopsis whitei* under the genus *Diopsis* by Curran from India in 1936 had inadequate morphometrical details and illustrations of diagnostic characters. The whereabouts of the type specimens (male holotype and a female allotype) collected on 2 May 1935 and originally deposited in the American Museum of Natural History (New York) is uncertain, and Shillito (1940) based his study of the species on a single specimen by the identical name collected on 21 October 1920 from a location in 'Jungle of Assam', northeastern India. Földvári et al. (2007), based on laboratory culture specimens from Malaysia, provided another brief description of the species without sufficient illustration of diagnostic characters, and without reference to the original description provided by Curran (1936). It is, therefore, doubtful if the Malaysian specimens are really *C. whitei*. Extensive uses of laboratory-reared *C. whitei* in behavioral (Lorch et al. 1993; Wilkinson et al. 1998; Al-Khairulla et al. 2003), physiological (Burkhardt & de la Motte 1983; Buschbeck & Hoy 2005) and genetic studies (Wilkinson et al. 1997; Wilkinson & Sanchez 2001) has made this species name well known as an experimental object for molecular and behavioral studies of stalked-eyed flies in general.

Therefore, in view of the recent collection of both the sexes of *C. whitei* from a new location in northeastern India, the country of the type locality, it became necessary to provide accurate description of the species based on biometric data and supported by photographs and line drawings which include descriptions of new morphological characters previously unnoticed in this species. Another objective of this study is to provide a better understanding of *C. whitei* in its area of distribution and its relation to other species so as to ensure its accurate identification and a better taxonomic appraisal

of the genus. To that end, an identification key to the known species of *Cyrtodiopsis*, sensu Feijen (2011), and a note on the habitat have also been provided.

METHODS AND MATERIALS

Live specimens of *C. whitei* were collected from the wild habitat using insect nets and these were transferred to killing jars. Biotic and abiotic features of the habitat of occurrence were recorded on each occasion of specimen collection. Dead and dry specimens were brought to the laboratory and kept in relaxation boxes for 36 hours to allow softening of external parts. Individual insects were spread to their natural posture and mounted on paper tips, pinned, labeled, and studied under Leica M205C zoom stereoscopic microscope fitted with Leica DFC295 digital camera. Biometry to the accuracy of 0.01mm and microphotographs were taken using Leica Application 3.8.0 version software. Images, so acquired, were transferred in Microsoft power point slides to write the names of characters. Abdomens of six males and a female were dissected for genitalia study. These were individually subjected to heating in glass vials at 60°C, first in 10% KOH solutions for 10 minutes for maceration, then for five minutes each at increasing concentrations of ethyl alcohol (70%, 80%, 90% and 99.99%) for dehydration. Dehydrated specimens were boiled for five minutes in the saturated solution of choral phenol for softening of cuticle and sclerotised structures (Feijen & Feijen 2011). Finally, the abdomens with the ventral side up were mounted individually on clean glass slides with the help of fine tip needles under the Carl Zeiss Stemi 2000-C microscope and studied under Carl Zeiss AXIO Lab.1 microscope under 10X and 40X objectives and for Camera Lucida drawings. Specimens of this study are deposited with identical accession numbers, as used in Tables 1 and 2, in the Insect Biodiversity Laboratory, Department of Zoology of Tripura University.

RESULTS

Order Diptera

Infra order Muscomorpha

Super family Diopsoidea

Family Diopsidae Bilberg, 1820

Genus *Cyrtodiopsis* Frey, 1928

Diagnosis: Thorax with a pair of infra-alar spines, supra-alar spines absent, scutellar spines slightly to

Table 1. Morphometry* of *C. whitei***

Characters	Male 1 (4004)	Male 2 (4005)	Male 3 (4006)	Male 4 (4007)	Male 5 (4008)	Male 6 (4009)	Range (min.– max.)	Female 1 (4010)
Body length	5.58	5.69	5.12	5.59	5.34	4.56	4.56–5.69	6.49
Eye span	6.95	7.52	4.95	6.57	5.72	3.98	3.98–7.52	5.83
Eye stalk length	3.47	3.71	2.47	3.29	2.81	1.99	2.47–3.71	3.03
Eye stalk middle width	0.13	0.14	0.10	0.13	0.12	0.12	0.10–0.14	0.13
Inner vertical bristle	0.58	0.66	0.59	0.62	0.51	0.54	0.51–0.66	0.64
Outer vertical bristle	0.37	0.37	0.35	0.37	0.25	0.32	0.25–0.39	0.39
Antenna 1 st segment	0.10	0.07	0.08	0.08	0.08	0.07	0.07–0.10	0.09
Antenna 2 nd Segment	0.15	0.15	0.19	0.16	broken	0.16	0.15–0.20	0.20
Antenna 3 rd Segment	0.09	0.10	0.09	0.10	broken	0.12	0.09–0.14	0.14
Antenna length	0.34	0.32	0.36	0.34	broken	0.35	0.32–0.43	0.43
Arista length	0.82	0.70	0.90	0.81	broken	0.74	0.70–0.90	0.82
Longest hair: head dorsum with bifid apices	0.18	0.125	0.15	0.18	0.10	0.13	0.10–0.23	0.23
Longest hair: base of eye stalk	0.14	0.14	0.12	0.14	0.12	0.12	0.12–0.16	0.16
Longest hair: near IVB	0.07	0.10	0.08	0.10	0.10	0.08	0.07–0.10	0.10
Longest hair: near antennal base	0.07	0.07	0.08	0.06	0.08	0.08	0.06–0.08	0.06
Longest hair: thorax dorsum	0.32	0.38	0.27	0.33	0.28	0.25	0.27–0.39	0.39
Scutellum length	0.23	0.23	0.18	0.25	0.23	0.18	0.18–0.32	0.32
Scutellum width	0.57	0.61	0.48	0.55	0.48	0.44	0.44–0.61	0.61
Infra-alar spine length	0.29	0.31	0.25	0.32	0.29	0.24	0.24–0.35	0.35
Scutellar spine length	1.02	1.08	0.80	1.0	0.99	0.69	0.69–1.12	1.12
Longest hair: scutellar spine	0.30	0.35	0.28	0.32	0.26	0.27	0.26–0.35	0.32
Basal diameter of scutellar spine	0.13	0.13	0.11	0.13	0.11	0.19	0.11–0.19	0.16
Fore coxa length	0.84	0.85	0.68	0.83	0.78	broken	0.78–0.86	0.86
Fore femora length	1.70	1.81	1.43	1.66	1.58	broken	1.43–1.81	1.79
Fore femora maximum width	0.37	0.41	0.30	0.35	0.33	broken	0.33–0.37	0.36
Longest hair: Fore femora	0.31	0.32	0.27	0.29	0.25	broken	0.25–0.29	0.29
First tarsal segment length	0.66	0.68	0.66	0.72	0.74	0.68	0.66–0.74	0.68
Last tarsal segment length	0.10	0.10	0.10	0.10	0.12	0.10	0.10–0.12	0.10
Wing length	4.09	4.30	3.84	4.14	3.84	3.16	3.16–4.56	4.56

*All measurements in mm. **Specimens are provided with respective accession/ reference numbers in parenthesis.

strongly curved outward, hairy, and each spine with a terminal bristle; fore femora conspicuously constricted on inner side at apex with incrassate surface; a tubercle is present at the base of inner margins of fore tibia that seems to fit into the constricted apex of fore femora when the fly is in rest.

Taxonomic status of the genus: Frey (1928) proposed *Cyrtodiopsis* from a collection of the Stalk-eyed Flies of Philippines on the basis of a distinct “peg and hollow structure of forelegs in certain males” with *dalmanni* (Weidmann) as the type species. Shillito (1940) provided the first illustrated account of the family with a key to the

identification of eight genera with particular reference to five species of the genus *Cyrtodiopsis*. Shillito (1940) distinguished *Cyrtodiopsis* from its nearest taxonomic relative *Teleopsis* in the wings without an alula, the thorax with infra-alar spines but without supra-alar spines, scutellar spines strongly curved, hairy and with a terminal long bristle and, most important, fore femora with constricted apex ventrally and fore tibia with rounded tubercles present at the base of the ventral side. Földvári et al. (2007) added a new species *Teleopsis thaii*, which is considered to be a *Cyrtodiopsis* species in the present work.

***Cyrtodiopsis whitei* (Curran, 1936) (Images 1–5; Figs. 1–5)**

= *Diopsis whitei* Curran, 1936, *Am. Mus. Nov.* 833: 1–2

= *Teleopsis whitei* (Curran, 1936) in Földvári, M., A. Pomiankowski, S. Cotton & M. Carr (2007) *Zootaxa* 1620: 37–51.

Materials examined: TU/Dipt/Diop-4004, TU/Dipt/Diop-4005, TU/Dipt/Diop-4006, 3 males, 12.viii.2013, Sakaibari, Dhalai District, Tripura, 24.10995°N & 91.90888°E, decomposing organic mass floating in shallow waters of Gomti; TU/Dipt/Diop-4007, TU/Dipt/Diop-4008, TU/Dipt/Diop-4009, 3 males and 1 female, 30.vii.2015, coll. D.K. Sinha.

Habitat: The habitat of *C. whitei* in the Dhalai District of Tripura province is an evergreen primary virgin forest of low hills of 'Longtharai' (local name meaning 'deep valley') and is the catchment area of two rivers, each of which traverses through valleys forming wide and narrow to very narrow streams lined by rocky banks and verticals. Stalk-eyed flies were found to be active in the sunshine hours in decomposing mixed vegetation dominated with banana leaves that was either floating in streams or in organic mass formed near the bank of stream. Atmospheric temperature and humidity of the habitat at the collection sites were recorded to be 24.2–25.6 °C and 74–77 %, respectively, and that of the microhabitat within 10cm of aerial distance of the collection points were found to be 21.4–22.8 °C and 81–84 %, respectively.

Description of additional characters

Male: Length 4.56–5.69 mm; coloration generally brownish, head with antennae yellowish-brown to brown, thorax shining brown, scutellum darker than pre-scutellum or scutum; coxae and femora reddish-brown, tibiae and bases of tarsi reddish-brown to deep brown; wings pale brown with outer margins dark; abdomen with basal three segments pale brown and distal segments dark brown (Image 1). Head (Images 2,3; Fig. 1): sub-triangular, dorsum of central part yellowish brown (Image 2), conspicuously raised and bears three ocelli, one bigger in the front and two smaller on sides, with a pair of deep brown bristles having pointed apices (Fig. 1), about 0.14–0.18 mm long; frons brownish, humped, projected forward, with a dorsal curved deep brown band and a distinct mid-suture, face concolorous with dorsum of head, slightly protruding, bear several long blackish bristles with pointed apices, 1–2 of these with bifid apices, about 0.20–0.24 mm long; vertex yellowish brown to brown, narrower in front, broader at base and



Image 1. *Cyrtodiopsis whitei*: Paper point-mounted male specimen.



Image 2. *Cyrtodiopsis whitei*: Head with one side of the eye stalk showing details; IVB = inner vertical bristle, OVB = outer vertical bristle. © Basant Kumar Agarwala

with rounded edges, bearing long hairs of bifid apices on the posterior edges (Image 3a); eye stalks yellowish-brown, smooth, bears a row of sparse, thin hairs, facing outward, with pointed apices, curved gently to strongly, these gradually decrease in lengths from the origin of stalks in the central part of the head to the bases of antennae (Image 2), the longest ones at the base of eye stalk 0.12–0.14 mm long, 0.07–0.10 mm long in the middle of eye stalks, and 0.06–0.08 mm long at the bases of antennae, thus the longest ones at the base of eye stalk, on average, are 1.50–2.33 times longer than the shortest ones near the base of antenna; inner vertical bristles (IVB) and outer vertical bristles (OVB) at low tubercles, 0.51–0.66 mm and 0.25–0.37 mm long, respectively (Table 1), and these 4.31–5.90 times

and 2.10–3.38 times the middle width of eye stalks, respectively (Table 2); eye span 3.98–7.52 mm long and 0.87–1.32 times the body length; antennae light brown, 3-segmented (Image 2), 0.32–0.36 mm long, the shortest basal segment with a dark bristle on inner side, called scape, 0.07–0.10 mm long, the middle segment, called pedicel, 0.15–0.19 mm long (Table 1) and about 2–3 times longer than the basal segment (Table 2), bear 2–3 dark bristles, and the third and last segment, called first flagellomere, nearly bulbous, densely covered with small hairs, 0.09–0.12 mm long, about twice the length of the middle segment, and bears a thick, long bristle-like structure with pointed apex on a raised base, called arista (Fig. 2), 0.70–0.90 mm long (Table 1), and 1.30–1.52 times and 1.89–2.57 times the lengths of IVB and OVB, respectively (Table 2). Thorax (Image 3): collar glossy brown, V-shaped, scutum glossy brown, bi-lobed, smooth; scutellum shorter than wide, 0.18–0.25 mm long and 0.44–0.61 mm wide, with dorsum broad, glossy brown, densely pollinose in the centre of pronotum and mesonotum (Image 3b), bears many short thin hairs with pointed apices only and a few long and prominent hairs with pointed or bifid apices, the longest ones about 0.25–0.39 mm long; infra-alar spines yellowish, short, dorso-ventrally flattened, and with blunt apices (Image 3c), these about 0.24–0.32 mm long (Table 1); scutellar spines dark, slightly curved inward, 0.69–1.12 mm long, 3.75–4.73 times the length of scutellum, each spine bears on its inner side 2–3 small hairs with pointed apices and 3–4 longer hairs with bifid apices (Image 3d), the longest ones about 0.26–0.35 mm long, and a long apical bristle, about 0.44–0.49 mm long (Table 1). Wings (Image 4): 3.16–4.30 mm long, bases of fore wings leathery, rest membranous, dorsal surface densely covered with minute hairs; four distinct pale brown to brown bands present from base to the apex, the basal-most band paler than the other three bands, covers anal cell, discal cell, radial cell and subcostal-radial cell from lower to upper parts of the wing; the second band from the wing base broadest and darkest between R_{2+3} and R_{4+5} , and pale between costa and R_1 ; the sub-apical third band brownish, irregular, widest in the middle or radial-medial cell, and the fourth apical-most band narrowest, pale brown to brown in different specimens, extending from R_{2+3} to M_{1+2} from the apex and projects slightly to prominently towards the subapical band in the median cell; subapical and apical bands separated by three pale spots from apex to base of wings, with the median semi-circular hazy spot in comparison to pale but distinct anterior and posterior circular spots; hind wings leathery, stump-like with a short stalk and attached to the raised

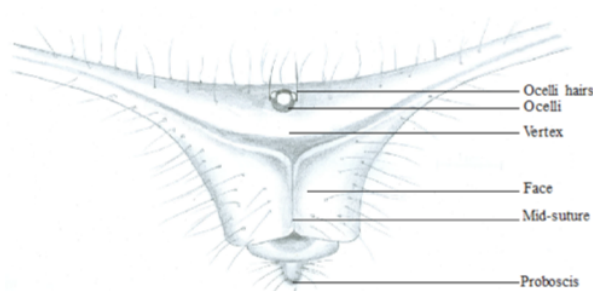


Figure 1. *Cyrtodiopsis whitei*: Frons of head showing ocelli, paired hairs on both sides of ocelli, face and proboscis.

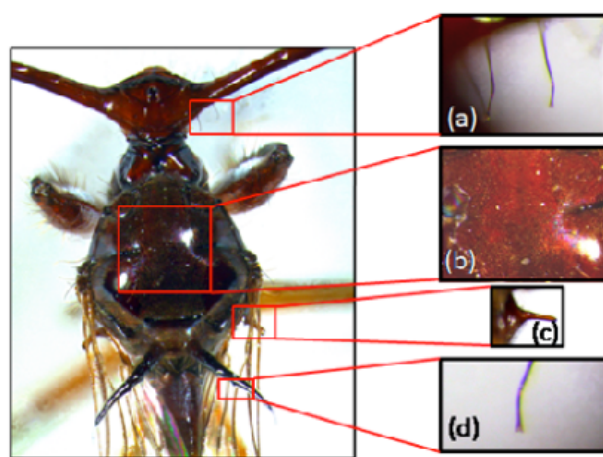


Image 3. *Cyrtodiopsis whitei*: Head and thorax showing (a) characteristic hairs with bifid apices on the rear part of vertex, (b) pollinose mesonotum, (c) infra-alar spine, (d) a long hair with bifid apex on scutellar spine. © Basant Kumar Agarwala

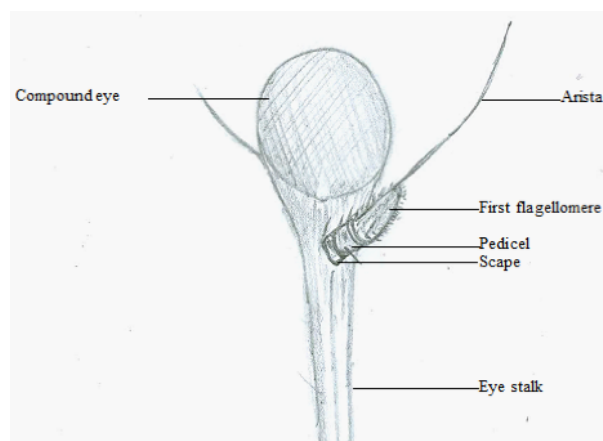


Figure 2. *Cyrtodiopsis whitei*: Eye stalk showing three segments of antenna and a long bristle, arista, arising from the third segment.

bases. Legs: conspicuously hairy, longer hairs with bifid apices; fore coxae 0.78–0.85 mm long, swollen in the middle; fore femora much wider (0.33–0.37 mm) than

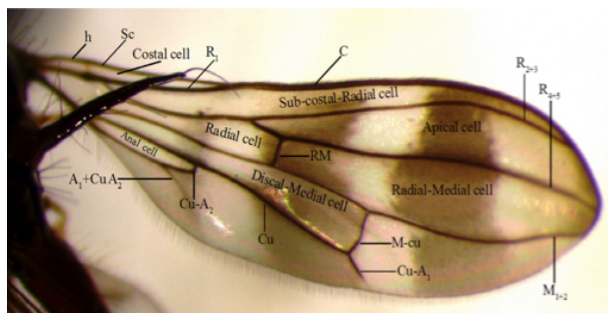


Image 4. *Cyrtodiopsis whitei*: Forewings - h = humerus vein, Sc = subcosta, C = costa, R_1 , R_{2+3} , R_{4+5} = radial veins, M_{1+2} = medial veins, M-Cu = medial-cubitus vein, Cu = cubitus vein, Cu- A_1 = Cubitus-anal vein, Cu- A_2 = cubitus and anal 2 veins, A_1 +Cu A_2 = anal1 and cubitus 2 veins. © Basant Kumar Agarwala

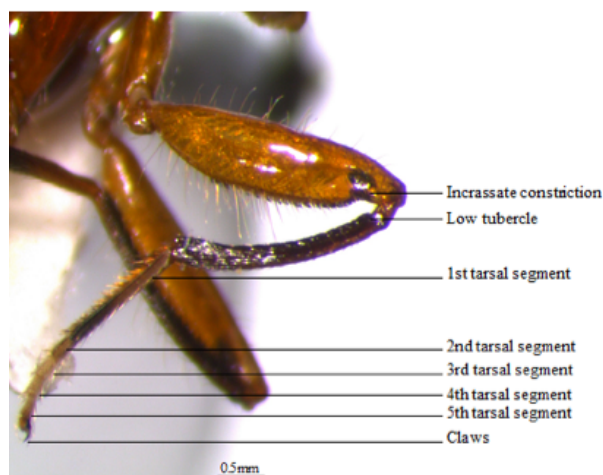


Image 5. *Cyrtodiopsis whitei*: Foreleg showing apical incrassate constriction in femur, low tubercle on inner base of tibia, 5 segments of tarsi, and a pair of claws. © Basant Kumar Agarwala

mid- (0.13–0.16 mm) and hind femora (0.10–0.12 mm), basal $\frac{1}{4}$ part of inner margins smooth, rest $\frac{3}{4}$ margins incrassate, with a shallow constriction near the joint with tibia (Image 5); fore tibia with a low, rounded and dark tubercle in the apex that seems to fit in the constricted part of the fore femur on each side when the fly is in rest; tibiae dark, sparsely hairy on margins; tarsi 5-segmented, first segment the darkest and the longest, 0.66–0.74 mm long, densely hairy on posterior margins, next four segments paler, decreasingly smaller in sizes, the apical-most segment the smallest, 0.10–0.12 mm long, about 6.16–7.20 times the first tarsal segment, bear two dark, curved divergent claws. Abdomen black, clavate shaped (Image 1), first three segments fused, fuscus, with sparse long and thin hairs having pointed apices, tergites mildly pollinose, fourth, fifth and sixth segments with distinct inter-segmental sutures, wider than first three segments, gently deflexed ventrally, tergites and pleurites with hairs all over, segments 7 to 10 narrow to very narrow, condensed, covered with microtrichia and a few sparsely distributed long hairs; sub-anal plate triangular, heart-shaped; cerci club-shaped, apically rounded, about twice the length at base. Genitalia (Figs. 3–5): In ventral view, epandrium rounded with sclerotised and smooth margins, with 18 pairs of long setae counted when mounted in slide; surstyli pale, broad basally with thin margins but brown, bulbous apically, bulbous ends sclerotised and proximate in the middle, covered with microtrichia, with four pairs of long setae, two pairs originate from the inner margins of the base and other two pairs originate from the outer margins of bulbous apex (Fig. 3); cerci

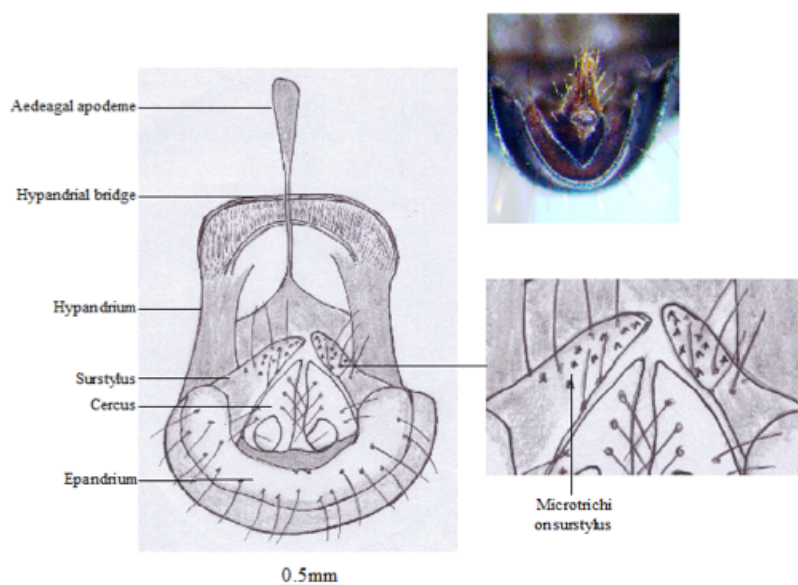


Figure 3. *Cyrtodiopsis whitei*: Structure of male genitalia - dorsal view showing magnified surstyli covered with long hairs and microtrichi; inset is the actual photograph.

Table 2. Ratio of bivariate characters of *C. whitei**

Ratio of Characters	Male1 (4004)	Male 2 (4005)	Male 3 (4006)	Male 4 (4007)	Male 5 (4008)	Male 6 (4009)	Range (min.-max.)	Female (4010)
Eye span/ body length	1.24	1.32	0.97	1.18	1.07	0.87	0.87–1.32	0.90
Inner vertical bristle/Eye stalk middle width	4.46	4.71	5.90	4.31	4.58	5.75	4.31–5.90	5.09
Outer vertical bristle/Eye stalk middle width	2.79	2.54	3.38	2.80	2.10	2.69	2.54–3.28	3.08
Arista length/Inner vertical bristle	1.41	1.06	1.52	1.30	broken	1.36	1.30–1.52	1.30
Arista length/Outer vertical bristle	2.20	1.89	2.57	2.21	broken	2.28	1.89–2.57	2.14
Scutellum: length/ width	0.41	0.37	0.37	0.47	0.49	0.41	0.37–0.52	0.52
Scutellar spine length/ Scutellum length	4.45	4.73	4.54	3.93	4.25	3.89	3.75–4.73	3.75
Longest hair at base of eye stalk/ longest hair at base of antennae	2.0	2.0	1.50	2.33	2.0	1.50	1.50–2.67	2.67
First tarsal segment/last tarsal segment	6.60	6.80	6.60	7.20	6.16	6.80	6.16–7.20	6.80

*Specimens are provided with respective accession numbers in parentheses.

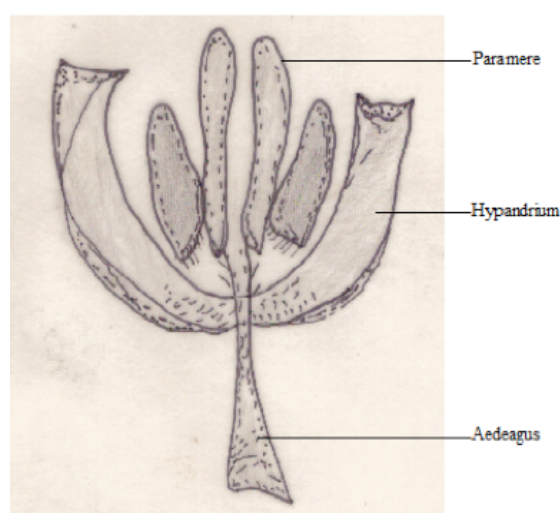


Figure 4. *Cyrtodiopsis whitei*: Male genitalia - ventral view of hypandrium and associated structures.

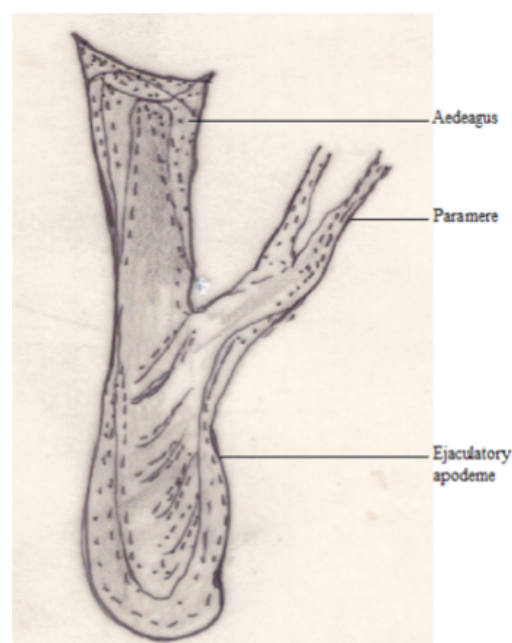


Figure 5. *Cyrtodiopsis whitei*: Male genitalia - lateral view of aedeagus and aedeagal apodeme.

large, with broad base and nearly conical apices, about twice as long as broad at the base, with thin margins and five pairs of hairs, two pairs of smaller hairs projected outwards and three pairs of longer ones projected inwards; hypandrium flat brown, with smooth margins, hypandrial bridge glabrous, in ventral view smooth, pale brown, bridge brown, with rough surface (Fig. 4); aedeagal apodeme elongated, brown, connected basally to hypandrium, in lateral view aedeagus with somewhat rounded end, sclerotic, and with a well developed ejaculatory apodeme (Fig. 5).

Female: The single female in the collection is similar to males except in longer body (6.49mm), longer OVB (0.39mm), longer antennae (0.43mm), longer hairs on head and eye stalks (Table 1), longer scutellum (0.32mm)

and scutellar spines (1.12mm), fore coxae, fore femora and wings (Table 1). Genitalia parts were damaged in course of slide mounting.

Taxonomic status: Curran (1936) described *Diopsis whitei* from a tropical dry deciduous forest in Jharkhand in eastern India. That description lacked illustrations or drawings of distinguishing characters of the species. Shillito (1940) transferred the species to *Cyrtodiopsis* because of the presence of characteristic apical incrassate constriction in fore femora and low rounded tubercles in the fore tibia. Since then six males and one female specimen of this species from a tropical evergreen forest

in northeastern parts of India have become available from the country of its type locality. These show strong similarities with *C. whitei* in the structure of wings, the pollinose pattern of the scutellum, and general description of body parts sensu Curran (1936) and Shillito (1940). Hans Feijen (pers. comm. 10.07.2015) found our specimens to show similarity with the single *C. whitei* specimen in his possession from Meghalaya in northeastern India. Detail examination of specimens used in this study, however, warranted description of new characters not described earlier; these include some of the hairs present on dorsal surfaces of head, thorax, scutellar spines and on femora and tibiae with bifid apices, presence of a row of progressively gently to strongly curved frontal hairs of decreasing lengths from the base of the eyestalk to the base of antenna, and in the structure of male genitalia which were not adequately described. None of existing literature on Diopsidae mention the occurrence of hairs with bifid apices and curved frontal hairs of eye stalks that were noted in specimens of *C. whitei* of this study. It is possible that earlier workers might have missed these characters in *whitei* or other taxa of Diopsidae, therefore, it may be premature to conclude that these characters are unique to *C. whitei* or that the sample of this study might represent a new population of a distinct species. The author was not able to access the type specimens of *whitei* or specimens of other species of Diopsidae from valid sources. Therefore, at this point, the specimens of

this study from moist evergreen forests of northeastern India are considered to represent possibly a part of widely distributed populations of *whitei* complex in its geographic range extending from the dry deciduous forest of eastern India (Jharkhand, the type locality) to moist evergreen forest in northeastern India, and, possibly, further east in Southeast Asia (Malaysia included), and it is assumed that populations of *whitei* might show habitat/area-specific variations and this position may be maintained until such time future study reveals more information.

DISCUSSION AND CONCLUSIONS

Feijen (2011) considered *Cyrtodiopsis* to be a weakly defined genus from the oriental region due to inclusion of several unrelated species at different times but preferred its distinct identity sensu Shillito (1940) in view of distinctive morphological attributes (chiefly in having prominent incrassate constrictions on apex of fore femora and low tubercles on the inner bases of fore tibiae) absent in the species of other genera under the family. Earlier, cladistic study using mitochondrial genes made by Baker et al. (2001), Meier & Baker (2002) and Földvári et al. (2007) revealed phylogenetic relationship between *Teleopsis* and *Cyrtodiopsis* but molecular distinctions between the two genera based on four marker genes, particularly between *T. thaii* and

Key to the identification of species of *Cyrtodiopsis*

1. IVB on high tubercles, the tubercles about 0.75 times the middle width of eye stalks; infra-alar spines roundish; forewings with sub-apical band darker and wider than the apical bands, with a nearly circular pale spot in the radial-medial cell (R_{4+5}), completely isolated from other cells *currani*
 IVB on low tubercles, the tubercles at most 0.40 times the middle width of eye stalks; infra-alar spines dorso-ventrally flattened with rounded tips; forewings with sub-apical bands pale to pale brown, with or without a spot in the radial-medial cell (R_{4+5}), not completely separated from other spots or cells 2
2. Thorax shining yellow, not pollinose; forewings with sub-apical bands narrow to wide, completely separated from the middle band *dalmanni*
 Thorax shining glossy yellow or brown, distinctly pollinose in mid-dorsum; forewings with or without a median pale spot between sub-apical and middle bands 3
3. Eye span, on average, 11.18mm long, 1.39 times the body length; scutellar spines up to 5.0 times the scutellar length *thaii*
 Eye span, on average, less than 8.0mm long, up to 1.25 times the body length; scutellar spines 3.50–4.0 times but never more than 4.30 times the scutellar length; pronotum and mesonotum pollinose, shining brown pleurally *whitei* complex
- (i) OVB up to 1.35 times and IVB up to 4.50 times as long as the width of eye stalks in the middle; eye span about 7.93mm long and 1.25 times the body length; cerci of male genitalia with several long, dispersed setae along their surface; habitat: laboratory culture specimens sourced from primary tropical rainforest in Malaysia (based on description from Földvári et al. 2007) *whitei* from Malaysia
- (ii) OVB 2.10–3.78 times and IVB 4.31–5.91 times as long as the width of eye stalks in the middle; eye span 3.99–5.93 mm long (Table 1) and up to 1.08 times the body length (Table 2); cerci of male genitalia on each side bears 5 hairs, 2 smaller ones protected outwards and 3 longer ones projected inwards (based on actual specimens); habitat: tropical moist deciduous forest *whitei* from northeastern India

T. breviscopium, were not conclusive (Földvári et al. 2007). To date, the presence of sharp incrassate apical constriction in fore femora and corresponding rounded tubercles on the basal parts of the fore tibia are the most robust and unique characters to the species of *Cyrtodiopsis*. Also, supra-alar spines, characteristic of all *Teleopsis* species, are absent in *Cyrtodiopsis* species. The presence of several hairs with bifid or split tips on the body of *C. whitei* could possibly be another unique character of this genus till further study reveals its presence in other species of *Cyrtodiopsis* and possibly in other genera of Diopsidae.

Despite prominent differences in morphometry between the two populations of *whitei* from geographically isolated locations of India and Malaysia, as evident from the taxonomic key above, we do not describe these specimens as a new species, because both populations share fundamental similarities in characters of fore wings, pollinosity distribution in thorax, body coloration, and general structure of genitalia. The observed differences in morphometry and presence of some of the body hairs with bifid tips in *whitei* from northeast India, among others, might represent the influence of differences in environments of the two habitats separated by several hundred miles. This study has founded the basis of future study to ascertain the prevalence of these characters when more specimens become available from these or nearby areas and also from the original type locality.

REFERENCES

- Al-khairulla, H., D. Warburton & R.J. Knell (2003). Do the eyestalks of female diopsid flies have a function in intra-sexual aggressive encounters? *Journal of Insect Behavior* 16: 679–686.
- Baker, R.H., G. Wilkinson & R. DeSalle (2001). Phylogenetic utility of different types of molecular data used to infer evolutionary relationships among stalk-eyed flies (Diopsidae). *Systematic Biology* 50: 87–105; <http://doi.org/10.1080/10635150118679>
- Burkhardt, D. & I. de la Motte (1983). How stalk-eyed flies eye stalk-eyed flies: Observations and measurements of the eyes of *Cyrtodiopsis whitei* (Diopsidae, Diptera). *Journal of Comparative Physiology* 151: 407–421.
- Buschbeck, E.K. & R.R. Hoy (2005). The development of a long, coiled, optic nerve in the Stalk-eyed Fly *Cyrtodiopsis whitei*. *Cell Tissue Research* 321: 491–504; <http://doi.org/10.1007/s00441-005-1142-4>
- Curran, C.H. (1936). A new *Diopsis* from India, with notes on others (Diptera). *American Museum Novitates* 833: 1–2.
- Feijen, H.R. (2011). The genus *Teleopsis* Rondani (Diptera, Diopsidae): discussion of its taxonomic position and revision of the species occurring in the Philippines. *Zoologische Mededelingen* 85: 79–140.
- Feijen, H.R. & C. Feijen (2011). On the biogeographic range of the genus *Teleopsis* Rondani (Diptera: Diopsidae), with re-description of *Teleopsis sykesii* from India and description of a new species from Borneo. *Zoologische Mededelingen* 85: 141–159.
- Földvári, M., A. Pomiankowski, S. Cotton & M. Carr (2007). A morphological and molecular description of a new *Teleopsis* species (Diptera: Diopsidae) from Thailand. *Zootaxa* 1620: 37–51.
- Frey, R. (1928). Philippinische Dipteren.V. Fam. Diopsidae. *Notulae Entomologicae Helsingfors* 8: 69–77.
- Lorch, P.D., G.S. Wilkinson & P.R. Reillo (1993). Copulation duration and sperm precedence in the Stalk-eyed Fly *Cyrtodiopsis whitei* (Diptera: Diopsidae). *Behavioral Ecology and Sociobiology* 32(5): 303–311; <http://doi.org/10.1007/BF00183785>
- Meier, R. & R.H. Baker (2002). A cladistic analysis of Diopsidae (Diptera) based on morphological and DNA sequence data. *Insect Systematics and Evolution* 33: 325–336.
- Mitra, B., S. Roy & P. Parui (2014). A revised checklist of stalk-eyed flies (Diptera: Diopsidae) with first record of *Eurydiopsis brevispinus* Feijen from India. *Biosystematica* 8(1&2): 59–60.
- Roskov, Y., L. Abucay, T. Orrell, D. Nicolson, T. Kunze, C. Flann, N. Baill, P. Kirk, T. Bourgoin, R.E. De Walt, W. Decock & A. De Wever (eds) (2015). Species 2000 & ITIS Catalogue of Life, Accessed on 20.xi.2015; <http://www.catalogueoflife.org/col>
- Shillito, J.F. (1940). Studies on Diopsidae (Diptera). *Novitates Zoologicae London* 42: 147–163.
- Wilkinson, G.S., H. Kahler & R.H. Baker (1997). Evolution of female mating preferences in Stalk-eyed Flies. *Behavioral Ecology* 9: 525–533.
- Wilkinson, G.S., D.C. Presgraves & L. Crymes (1998). Male eye span in stalk-eyed flies indicates genetic quality by meiotic drive suppression. *Nature* 391: 276–279; <http://doi.org/10.1038/34640>
- Wilkinson, G.S. & M.I. Sanchez (2001). Sperm development, age and sex chromosome meiotic drive in the Stalk-eyed Fly *Cyrtodiopsis whitei*. *Heredity* 87: 17–24.





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