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New distributional records of Tabanidae (Insecta: Diptera) from different geo-climatic regions of West Bengal, India

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Abstract

Eight species namely *Chrysops designatus* Ricardo, 1911; *Hybomitra subcallosa* (Ricardo, 1911); *Tabanus dorsiger* Wiedemann, 1821; *Tabanus (Tabanus) biannularis* Philip, 1960; *Tabanus (Tabanus) optatus* Walker, 1856; *Haematopota inconspicua* Ricardo, 1911; *Haematopota sikkimensis* Stone & Philip, 1974 and *Haematopota tessellata* Ricardo, 1906; belonging to four genera viz., *Chrysops* Meigen, 1803; *Hybomitra* Enderlein, 1922; *Tabanus* Linnaeus, 1758 and *Haematopota* Meigen, 1803; of subfamilies Chrysopsinae and Tabaninae, are recorded for the first time from the state of West Bengal, are listed, keyed, and discussed with distribution pattern wherever deemed necessary, along with morphology and methodology in aid of understanding the flies of family Tabanidae.

Keywords: Taxonomy, Tabanidae, new records, West Bengal

Introduction

Tabanids are one of the representative groups of brachyceran insects under order Diptera and family Tabanidae as they have two wings, haltere, sickle shaped antennae, pulvilliform empodium and their 4th and 5th radial veins terminate on opposite side of the wing.

Males and females of the species are sexually dimorphic and show striking differences in the arrangement of eyes, which is used as differentiating characters. They are largely seen in warm days with low wind speed. Their abundance remains very high during monsoon (Ahmed, 2005) [1]. Their preferred habitat seemed to be bushy areas or grassland near aquatic body. Females are often found nearby their hosts, mostly seen in and around cattle in village areas. Adults generally take rest on tree trunks after feeding. They are all diurnal in habit and found to breed near aquatic bodies (Datta, 1985) [5].

Tabanidae are mainly known for their noxious bite followed by annoying sensation. Their haematophagy make them economically important as a serious pest of domestic and wild lives. Several viral, bacterial and protozoan diseases are reported to be transmitted by around 20 species of vector tabanids from India. Among all other diseases, Trypanosomiasis (locally called 'Surra') is one of the most prevalent protozoan diseases in Indian sub-regions and causes serious threats to livestock and wild animal mortality.

Trypanosomiasis is a disease characterized by high fever, skin lesion, anaemia, and weight loss. The disease is mainly prevalent in cattle, horse, camel and other domestic animals and transmitted by several vector species of tabanid flies (Baldacchino *et al.*, 2014) [2]. The disease was originated from Africa and *Trypanosoma evansi* Steel, 1885 was the first mammalian trypanosome to be described in 1880 by Griffith Evans in blood of Indian equines. First case study of trypanosomiasis in India was described in camel by Basu and Menon (1952) [3]. There are several case studies of trypanosomiasis transmission in cattle and other live stocks. Investigation of the death of 13 tigers including 12 white tigers in Nandan Kanan Zoo, Orissa was found to be caused by trypanosomiasis transmission and several vector species were also found from the study area (Vcer, 2002) [13]. First case report of trypanosomiasis in human was reported in 2005 in a farmer from Nagpur, Maharashtra (Joshi *et al.* 2005) [7]. A recent outbreak of this disease was reported in cattle of Ludhiana, Punjab (Singh *et al.* 2012) [12]. Several serological test and lymph examination using Haematocrit Centrifuge Technique (HCT) or Dark Ground buffy coat (DG) technique were used earlier for disease diagnosis (Paris *et al.* 1982) [11].

Varying sensitivity of the test and failure to detect trypanosomes if number of parasites were too low depict limitation of parasitological diagnosis. However antigen ELISA was shown to have high diagnostic sensitivity (Nantulya, 1990) [10]. Trypanosomiasis was distributed mainly in Neotropical, Ethiopian, Oriental, Palearctic region, evident from distribution map found in the literature review (Desquesnes *et al.* 2013) [6]. Use of drugs *viz.* Quinapyramine sulphate (sub cutaneous dose) at 3-5 mg / kg body weight would be effective to kill trypanosomes in blood tissues while the use of antricyde prosalt (1.5 parts quinapyramine sulphate and 1 part quinapyramine chloride) resulted in prophylactic effect and that lasts for 3 months. Diminazene was found to be very effective especially in case of buffaloes.

Despite high economic importance of tabanids as pests and disease vectors, taxonomic studies on the family Tabanidae are not sufficiently advanced, and the family is considered one of the least studied in Diptera (Mackerras *et al.*, 2008) [8] and neglected as subject of interest (Desquesnes *et al.*, 2013) [6]. It was imperative to survey at this juncture and investigate the occurrence of any new species of Tabanidae especially those of potential vector for Surra disease and the status of the already reported ones from West Bengal for designing quarantine plan in future. However their taxonomy and distribution pattern in diverse geo-morphological regions *viz.* hilly region, plain land, arid region and coastal region across the West Bengal need to be investigated to get a complete scenario of their systematics and distribution.

Materials and methods

(i) Study area

The present study area of West Bengal has been designed in such a way that it encompasses all the geo-climatic zones across the state. Tabanids were collected from plain land of gangetic plains (encompassing Howrah and Hooghly), hilly region (encompassing Darjeeling and Jalpaiguri districts), arid region (encompassing Bankura and Birbhum districts), coastal region (encompassing South 24 Paraganas and East Midnapore).

(ii) Field and laboratory techniques

Tabanid flies especially females were collected conveniently by hand picking method from cattle animals as they are usually used to exhibit the characteristic haematophagy and males were collected from tree trunks or on vegetation by sweeping with insect net in warm sunny weather or from lights at night. Traps especially malaise trap, canopy trap etc. can also be used as most effective method for catching large amount of tabanids in a short time with minimum effort. Larvae and pupae can be collected from moist ground, preferably near edges of aquatic bodies *i.e.* river, swamps, etc. and reared to get the adults in natural media after brought to laboratory.

After catching, adults were killed in killing jars as it contains benzene and it was pinned as early as possible for studying most of the characters that might be present at live condition. Then specimens were kept in special envelopes composed of blotting papers. Special care were also taken to pin the specimen through one side (preferably on left side of the thorax) and proper labelling for recording their localities, district and state of availability with date of collection and collector's name. Pinned specimens were preserved carefully by keeping them in wooden box with smashed naphthalene and cottons at hollow spaces in sides and cotton ball dipped in carbolic acid at bottom of the box. Then pinned specimens

were identified following a proper taxonomic key and all the diagnostic characters were noted and material examined was written following a specific format.

(iii) Morphology and terminology

All the subfamilies, tribe, genera and species of family Tabanidae are presented following the classification scheme of Berger and Thompson, 1981 [4] for convenience. All the terminologies used in the present study are taken from McAlpine, 1989 [9].

Tabanids exhibit considerable amount of inter-generic diversity in morphology but relatively less heterogeneity in interspecific level is helpful to identify a species. Some of these morphological characters are important for determining several species. Generalised characters are presented for understanding key and definition of 4 genera, *viz.* *Chrysops* Meigen, 1803; *Hybomitra* Enderlein, 1922; *Tabanus* Linnaeus, 1758; *Haematopota* Meigen, 1803; that are known to occur from West Bengal.

Results

A total of 31 species under 8 genera of family Tabanidae were collected during 2013-2015. Among them 8 species of tabanids under 4 genera were reported for the first time from the state of West Bengal. List of those newly recorded species of tabanids along with their taxonomic keys and diagnosis were given below.

List of species

1. *Chrysops designatus* Ricardo, 1911

1911. *Chrysops designata* Ricardo, *Rec. Indian Mus.*, 4: 383.
Type location: Sarah, Nepal; Jaulasal, Nainital district, India
Distribution: India (West Bengal: S 24 Paraganas; Assam, Arunachal Pradesh, Kashmir, UP, Uttarakhand)
Elsewhere: Myanmar, Nepal, Pakistan, China
Bio-geographical realms: Oriental region, Palearctic region

2. *Hybomitra subcallosa* (Ricardo, 1911)

Tabanus (Therioplectes) subcallosa Ricardo, 1911. *Rec. Indian Mus.* 4: 227.
1969.
Hybomitra subcallosa Chvala, *Acta. Entomol. Bohemoslov.*, 66: 49.
Type location: Mussoorie, Uttarakhand, India
Distribution: India (West Bengal: Darjeeling; HP, Punjab, UP, Uttarakhand)
Elsewhere: Nepal, Pakistan, Myanmar, China, Japan.
Bio-geographical realms: Oriental region, Palearctic region.

3. *Tabanus dorsiger* Wiedemann, 1821

Tabanus ochrophilus Lutz, 1914
Tabanus secundus Walker, 1848
Tabanus triceps Thunberg, 1827
1821. *Tabanus dorsiger*. Wiedemann, *Diptera Exotica, Kiliae*, pp. 43-50, 101.
Type location: Brazil
Distribution: India (West Bengal: E Midnapore; Hooghly; Maldah; S 24 Paraganas; Orissa)
Elsewhere: Mexico to Argentina, Trinidad
Bio-geographical realms: Neotropical region; Oriental region.

4. *Tabanus (Tabanus) biannularis* Philip, 1960

Tabanus bicinctus Ricardo, 1911
1960. *Tabanus biannularis* Philip, *Stud. Inst. Med. Res. Malaya*, 29: 12.

Type location: Kadras jungle, N Kanara, SW India
 Distribution: India (West Bengal: Darjeeling; Karnataka, Kerala, Uttarakhand)
 Elsewhere: Formosa, Malaysia, Vietnam
 Bio-geographical realms: Oriental region.

5. *Tabanus (Tabanus) optatus* Walker, 1856

Tabanus alboscutus Rondani, 1875
Tabanus equestris Wulp, 1885
 1856. *Tabanus optatus* Walker, *Proc. Linn. Soc. London*, **1**: 111.
 Type location: Borneo.
 Distribution: India (West Bengal: Howrah; Bihar, Orissa)
 Elsewhere: Bangladesh, Borneo, Java, Malaysia, Sumatra, New Guinea.
 Bio-geographical realms: Oriental region.

6. *Haematopota inconspicua* Ricardo, 1911

1911. *Haematopota inconspicua* Ricardo, *Rec. Indian Mus.*, **4**: 358.
 Type location: Igatpuri, Mumbai, India
 Distribution: India (West Bengal: Darjeeling; Karnataka, Maharashtra)
 Elsewhere: Nil.
 Bio-geographical realms: Oriental region.

7. *Haematopota sikkimensis* Stone & Philip, 1974

1974. *Haematopota sikkimensis* Stone & Philip, *U. S. Dep. Agric. Res. Serv. Tech. Bull.*, **1489**: 174.
 Type location: Mangang, Sikkim, India
 Distribution: India (West Bengal: Darjeeling; Sikkim)
 Elsewhere: Nil.
 Bio-geographical realms: Oriental region.

8. *Haematopota tessellata* Ricardo, 1906

1906. *Haematopota tessellata* Ricardo, *Ann. Mag. Nat. Hist.*, **(7)**18: 120.
 Type location: Hot wells, Trincomalee, Sri Lanka
 Distribution: India (West Bengal: Maldah; Chattisgarh)
 Elsewhere: Sri Lanka.
 Bio-geographical realms: Oriental region.

Systematic account

Family: Tabanidae

Key to the subfamily

- Hind tibiae with paired apical spurs mostly, vertex with well-developed functional ocelli. Caudal ends of spermathecal ducts of female without cup like expansion.....Chrysopsinae

Vertex with rudimentary or no ocelli, hind tibiae without apical spurs. Caudal ends of spermathecal ducts of female with cup like expansion..... Tabaninae

Sub family Chrysopsinae

Tribe: Chrysopsini

Genus: *Chrysops* Meigen

Key to the tribes of sub family Tabaninae

- Frons in females much longer than wide, frontal callus usually longitudinal when present, flagellum with large basal plate and 4 annuli; wing hyaline or dusty; basicosta in wing with strong setae.....Tabanini
- Frons in females wider than long, frontal callus transverse, antennae long and slender, flagellum with narrow base and 3 annuli; pictured wing pattern with pale markings, basicosta with thin setae.....Haematopotini

Tribe: Tabanini

Key to the genus

- Eyes bare.....2
 Eyes hairy.....*Hybomitra* Enderlain
- Antennal style with 4 annulations, frons with prominent callus.....*Tabanus* Linnaeus

Key to the species of Genus *Tabanus* Linnaeus

- Fore head with two separate calli, first one usually transverse, second smaller and irregular.....2
 Fore head with one square, narrow or oblong callus with linear extension towards vertex. Species with one or more stripes usually continuous on abdomen. Frontal callus with spindle shaped linear extension.....3
 Fore head with oblong almost triangular callus with long linear extension towards vertex. Wings with brown cross band. Abdomen reddish, darker at apex with small white median spot.....*T. optatus*
- Scutellum white haired, abdomen black with 2 white haired bands*T. biannularis*
- Abdomen with median stripe complete, broad on 2nd tergite, lateral stripes in form of irregular spots appearing as steps.....*T. dorsiger*

Key to the species of genus *Haematopota* Meigen

- Wings with single apical band.....2
 Wings with double apical band.....3
 Wings with apical markings or spots not in form of bands...4
- Wings pale brown, apical band short single, not reaching from outer to inner wing border, 3 rosettes distinct, stigma and veins reddish brown.....*H. inconspicua*
- Wings brown with yellowish brown veins and appendix, apical band double, both branches united at base, diverging later.....*H. tessellata*
- Wings brown with patterned usual small spots, apical band narrow in form of three isolated spots, just crossing vein R4, no light spots on posterior margin of wing.....*H. sikkimensis*

Diagnosis of newly recorded species of family Tabanidae from West Bengal

Subfamily Chrysopsinae

Diagnosis: Abdominal tergite IX divided. Style of male gonocoxite bluntly ended. Antennae with 3-4 flagellomeres. Caudal ends of spermathecal ducts with simple tubes. Hind tibiae mostly with pair of apical spurs.

Tribe Chrysopsini

Diagnosis: Scape much elongated than broad, flagellomere narrow without dorsal angle. Eyes bare with spots or variegated dark markings, rarely with bands. Posterior margin of cells open.

Genus *Chrysops* Meigen, 1803

1803. *Chrysops* Meigen, *Mag. Insekten Kude*, **2**: 267.
 Type species: *Tabanus caecutiens* Linnaeus 1761
 Diagnosis: Varies from small to moderately long in size (5.5-12.5 mm in length), usually bright yellow to black coloured species. Callus usually transverse with three functional ocelli. Scape and pedicel much longer and scape in most often swollen. Proboscis long. Wings infuscated in irregular fashion or with dark cross band, Sc vein bare, r5 and m2 cells open widely. Abdomen with specific yellow and black patterns or yellowish or dark stripes, spots or triangles.

1. *Chrysops designatus* Ricardo, 1911

1911. *Chrysops designata* Ricardo, *Rec. Indian Mus.*, 4: 383.
 1927. *Chrysops designatus* Senior-white, *Cat. Indian Insects*, 12: 61.
 Type locality: Nepal
 Material examined: 1♀, collected from cow, 22°22'55.8" N, 88°56'39.7" E, 4.6 m, Bhandarkhali, S 24 Paragana, 08.vi.2013, Coll. T. Naiya

Diagnosis:

Head: Large yellow stripes in the centre of yellowish face with glossy blackish tubercles. Lower part of cheeks black with yellow hairs. Palpi yellowish to reddish with few yellow pubescence. Scape reddish yellow, scape and pedicel with black pubescence. Forehead with yellow pubescence. Frontal callus glossy, dark brown, oblique, not reaching eyes.

Thorax: Thorax dark brown with broad median stripe, composed of greyish yellow tomentum, divided into two by narrow brown line and sides with bright yellow pubescence. Scutellum greyish yellow with dark pubescence in the centre.

Abdomen: Abdomen with yellowish pubescence dense on apical tergites, light yellow on first two tergites, rests bright yellow. Black narrow band on posterior border of first tergite widening in centre forming broad median spot reaching anterior margin with concave sides. V-shaped black spot meeting on anterior margin of second abdominal tergite and on third abdominal tergite V-shaped black spot becomes broader and not reaching anterior margin. Sides and posterior border have black bands. 2 small black triangular spots on 4th abdominal terga on anterior margin.

Legs: Legs reddish yellow, coxae, femora and apical joints of tarsi blackish.

Wings: Wings hyaline with brown at fore border reaching apex. Presence of brown cross band which reaches anal cell. Apical spot narrow, reaching to centre of apices of wing.

Distribution: India (West Bengal: S 24 Paraganas; Arunachal Pradesh, Assam, Kashmir, UP, Uttarakhand)

Elsewhere: Myanmar, Nepal, Pakistan, China

Remarks: This species primarily occurs in North-West part of oriental region. This species is recorded for the first time from the state of West Bengal.

Subfamily Tabaninae

Diagnosis: Hind tibia without apical spurs. Style of gonocoxite truncate by a shallow incision. Caudal ends of spermathecal ducts of female with cup like expansion. Antennae with 3-4 flagellomeres. Cell r5 mostly closed, m3 always open.

Tribe Tabanini

Diagnosis: Basicosta densely setulose except in some palearctic species. Antennae usually short and stout. Basal flagellomere with well-developed dorsal angle. Flagellum with 4 flagellomeres.

Genus *Hybomitra* Enderlein, 1922

1922. *Hybomitra* Enderlein, *Mitt. Zool. Mus. Berl.* 10: 347.

Type species: *Hybomitra solox* Enderlein, 1922.

Diagnosis: Medium sized fly; vertex with ocellar tubercle; eyes with dense pubescence and 3 green or purple band in live condition; basal and median callus usually broad; body blackish to dark greyish often with orangish side markings in at least 2 to 3 anterior abdominal segments.

2. *Hybomitra subcallosa* (Ricardo, 1911)

1911. *Tabanus subcallosus* Ricardo, *Rec. Indian Mus.*, 4: 227.
 1969. *Hybomitra subcallosa* Chvala, *Acta. Entomol.*

Bohemoslov., 66: 49.

Type locality: Mussoorie, India

Material examined: 1♀, collected from cow, 27°01'52.2" N, 88°41'39.8" E, 894 m, Lower phaperkheta Darjeeling, 29.v.2015, Coll. R.S. Mridha

Diagnosis:

Head: Face greyish tomentose with white pubescence, palpi pale yellow, stout and tapering, grey tomentose on dorsal side, thickly covered with white pubescence intermixed with black hairs. Scape & pedicel yellowish and black pubescent, flagellum reddish. Subcallus brownish and convex. Forehead covered with brown tomentum, frontal callus dark brownish to blackish, border irregular at apex, median callus small, irregular and blackish. Eyes with hairs.

Thorax: Thorax appeared black and grey tomentose with black pubescence.

Abdomen: Abdomen black with white haired bands at dorsum and white band becomes broader at venter.

Legs: Legs black, tibiae whitish at basal two thirds and black at apex. Pubescence at back side of femora and coxae.

Wings: Wings hyaline, stigma whitish. Scutellum black with grey tomentum.

Distribution: India (West Bengal: Darjeeling; Himachal Pradesh, Uttar Pradesh, Uttarakhand.

Elsewhere: None

Remarks: This is a rare species in West Bengal, found above 700 m altitudes of hilly regions of Darjeeling district and most of them were collected from Buffalo. This species is recorded for the first time from the state of West Bengal.

Genus *Tabanus* Linnaeus, 1758

1758. *Tabanus* Linnaeus, *Syst. Nat. Ed.*, 10: 601.

Type species: *Tabanus bovinus* Linnaeus, 1758

Diagnosis: Robust flies with colourful eyes in live condition; vertex without prominent ocellar tubercle; in males entirely pollinose when present; eyes bare.

3. *Tabanus dorsiger* Wiedemann, 1821

1821. *Tabanus dorsiger*. Wiedemann, *Diptera Exotica, Kiliae*, pp. 43-50, 101.

Type locality: Indian subcontinent

Material examined: 3♀♀, collected from cow, 22°02'29.0" N, 87°59'02.4" E, 16 m, Anantapur, East Midnapore, 27.viii.2013, Coll. A. Maity; 1♀, collected from cow, 22°22'55.8" N, 88°56'39.7" E, 4.6 m, Bhandarkhali, S 24 Paraganas, 08.vi.2013, Coll. Tufan Naiya; 1♀, collected from cow, 22°53'26.8" N, 88°00'50.2" E, 16 m, Bhonjipur, Hooghly, 25.iii.2014, Coll. A. Naskar; 1♀, collected from cow, 25°05'28.2" N, 88°08'08.2" E, 70 m, Kaluadighi, Maldah, 12.vi.2014, S. Hazra; 1♀, collected from cow, 25°05'28.2" N, 88°08'08.2" E, 70 m, Kaluadighi, Maldah, 12.vi.2014, A. Naskar; 1♀, collected from cow, 25°05'28.2" N, 88°08'08.2" E, 70 m, Kaluadighi, Maldah, 12.vi.2014, J. Sengupta; 2♀♀, collected from cow, 24°52'45.6" N, 88°08'22.3" E, 49 m, Bekidurgapur, Maldah, 13.vi.2014, S. Hazra; 1♀, collected from cow, 24°52'45.6" N, 88°08'22.3" E, 49 m, Bekidurgapur, Maldah, 13.vi.2014, A. Naskar

Diagnosis: Adult fly is usually larger (14–16 mm in length) than the other two trivittate flies, *T. striatus* and *T. tenens*.

Head: Fore head slightly divergent above, frontal callus narrowly separated from eye margins and median callus spindle-shaped and narrowly joined to dorsal extension of frontal callus.

Thorax: Thoracic stripes are distinct.

Abdomen: Abdomen trivittate, mid dorsal stripe complete and broad on tergum II, sub lateral pale stripes noticeably step-

like; venter uniform with grey tomentum and light pilose.

Legs: Fore femur and fore tibia are uniformly orange to orangy brown in colour but are darkened apically.

Wings: The male has a yellow tinted costal cell on the wing.

Distribution: India (West Bengal: East Midnapre, Hooghly, Maldah, S 24 Paraganas; Orissa)

Elsewhere: Mexico to Argentina, Trinidad

Remarks: This species is previously known to us as *Tabanus triceps* Thunberg, 1827, later the species was synonymised under *Tabanus dorsiger* Wiedemann, 1821 due to basically same character of callus in fore head and abdominal pattern with sub lateral stripes step like in both species. This species is recorded for the first time from the state of West Bengal.

4. *Tabanus (Tabanus) biannularis* Philip, 1960

1960. *Tabanus biannularis* Philip, *Stud. Inst. Med. Res. Malaya*, 29: 12.

Type locality: Kadras jungle, N Kanara, SW India

Material examined: 1♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 27.v.2015, Coll. A. Maity.

Diagnosis:

Head: Face covered with pale tomentum and long white hairs. A dark brown band extend between eyes and base of antennae with black pubescence. Beared white. Palpi stout ending in acute point, appears as light grey from outside, covered densely with white tomentum and short black pubescence. Antennae reddish, scape and pedicel with black pubescence. Flagellum with small tooth crowned with black hairs, apical annuli dark. Fore head covered with grey tomentum. Two calli dark brown, frontal callus irregularly square separated from sub callus by narrow interval. Median callus is elongated and narrower. Fore head is brownish at vertex. Thorax: Thorax black covered with grey tomentum and white pubescence. Scutellum covered with grey tomentum and dense white pubescence.

Abdomen: Narrow fringes of white hairs forming bands in fifth and sixth abdominal tergite. Second abdominal tergite is covered with white pubescence.

Legs: Tibiae white, black at their apices. Fore coxae and fore tibiae with long white hairs and white pubescence respectively.

Wings: Wings tinged brown on anterior margin as far as third vein, veins and pterostigma brown, costal border yellow.

Distribution: India (West Bengal: Darjeeling; Karnataka, Kerala, Uttarakhand)

Elsewhere: Formosa, Malaysia, Vietnam

Remarks: This species shows little variation in extension of brown tinge coloration on anterior margin of wing in several specimens. This species is recorded for the first time from the state of West Bengal.

5. *Tabanus (Tabanus) optatus* Walker, 1856

1856. *Tabanus optatus* Walker, *Proc. Linn. Soc. London*, 1: 111.

Type locality: Borneo

Material examined: 1♀, collected from cow, 22°31'24.0" N, 88°11'41.0" E, 10.9 m, Nalpur, Howrah, 11.v.2014, Coll. S. Hazra;

Diagnosis:

Head: Face yellowish white. Palpi pale yellow. Antennae ochraceous, flagellum infuscated and with tooth on its upper side. Frontal callus almost triangular in shape with long linear extension up to middle of fore head.

Thorax: Thorax, scutellum and abdomen dark brownish to rufous. Thorax with indistinct stripes and greyish yellow hairs

at sides. Hind margin of scutellum greyish.

Abdomen: Abdomen rufous, last two abdominal tergites blackish and posterior margin yellowish on every abdominal tergite.

Legs: Legs fulvous, fore femora with greyish white hairs and dark pubescence.

Wings: Wings at base yellowish brown, broad brownish cross band in middle which issues pterostigma and embraces discal cell but not reaching posterior margin, costal cell yellow.

Distribution: India (West Bengal: Howrah; Bihar, Orissa)

Elsewhere: Bangladesh, Borneo, Java, Malaysia, Sumatra, New Guinea.

Remarks: This species is only collected from Howrah district of West Bengal. Eyes in live condition with three bluish green bands. This species is recorded for the first time from the state of West Bengal.

Tribe Haematopotini

Diagnosis: Fore head broad usually with paired dark velvety spots above the wide and glossy callus. Antennae usually long and narrow. Scape cylindrical, longer than wide. Basal flagellomere cylindrical with under developed or rounded dorsal angle and with 3 flagellomeres. Characteristic dappled wing. Vein R4 usually with strong appendix.

Genus *Haematopota* Meigen, 1803

1803. *Haematopota* Meigen, *Magazin Insekt Kunde*, 2: 67.

Type species: *Tabanus pluvialis* Linnaeus, 1758.

Diagnosis: Generally small and slender flies of brownish to blackish grey in colour; eyes with several wavy bands in live condition; frons with velvety black spot on each side above the frontal callus and often a mid-frontal spot above these; picture wing pattern i.e. dark wing with pattern of pale spots; mid tibiae and hind tibiae often with pale rings.

6. *Haematopota inconspicua* Ricardo, 1911

1911. *Haematopota inconspicua* Ricardo, *Rec. Indian Mus.* 4: 358.

Type locality: Igatpuri, Mumbai, India.

Material examined: 2♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 24.v.2015, Coll. A. Maity; 4♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 28.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 29.v.2015, Coll. R.S. Mridha; 1♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 21.v.2015, Coll. R.S. Mridha; 5♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 5♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 23.v.2015, Coll. A. Maity; 3♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 27.v.2015, Coll. R.S. Mridha; 2♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 24.v.2015, Coll. R.S. Mridha; 5♀♀, collected from cow, 27°01'33.2" N, 88°41'47.4" E, 867 m, Ambiok basti side, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 1♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 24.v.2015, Coll. A. Maity; 2♀♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 27.v.2015, Coll. R.S. Mridha; 2♀♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 27.v.2015, Coll. A. Maity; 5♀♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 2

♀♀, collected from cow, 27°03'02.3" N, 88°40'48.4" E, 1599 m, Neora valley national park buffer zone, Darjeeling, 21.v.2015, Coll. A. Maity; 1 ♀, collected from cow, 27°03'02.3" N, 88°40'48.4" E, 1599 m, Neora valley national park buffer zone, Darjeeling, 21.v.2015, Coll. R.S. Mridha; 5♀♀, collected from cow, 27°02'32.8" N, 88°41'32.8" E, 1103 m, Kuapani roadside 2, Darjeeling, 23.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°02'34.2" N, 88°41'42.0" E, 1110 m, Kuapani road side 1, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 2♀♀, collected from cow, 27°02'58.0" N, 88°40'51.9" E, 1522 m, Kuapani, Darjeeling, 21.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°02'58.0" N, 88°40'51.9" E, 1522 m, Kuapani, Darjeeling, 21.v.2015, Coll. R.S. Mridha; 1♀, collected from cow, 27°05'34.9" N, 88°42'05.4" E, 2345 m, Chowdaphari, Darjeeling, 22.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°04'52.3" N, 88°40'21.7" E, 2209 m, Rachila, Darjeeling, 22.v.2015, Coll. R.S. Mridha;

Diagnosis:

Head: Face grey, white pubescent, blackish brown band between eyes and antennae. Palpi reddish yellow with pale pubescence. Antennae reddish yellow, cylindrical scape & small pedicel with black pubescence, first annulations little dilated and broader in comparison to rest at apex of slender flagellum. Forehead greyish yellow with prominent dark brown large round spots. Frontal callus narrow black.

Thorax: Thorax brown with 3 greyish yellow stripes and fore border greyish, underside grey.

Abdomen: Abdomen reddish brown with grey segmentations with short ferruginous pubescence.

Legs: 2 rings on middle and posterior tibiae, basal joints of middle and posterior tarsi yellow. Wings: Wings pale brown, apical band short single, not reaching from outer to inner wing border, 3 rosettes distinct, stigma and veins reddish brown.

Distribution: India (West Bengal: Darjeeling; Arunachal Pradesh, Himachal Pradesh, Maharashtra, Meghalaya)

Elsewhere: China, Thailand and Vietnam.

Remarks: The species described above was reported for the first time from the state of West Bengal. The species is presumed to be common in hot summer days.

7. *Haematopota sikkimensis* Stone & Philip, 1974

1974. *Haematopota sikkimensis* Stone & Philip, *U. S. Dep. Agric. Res. Serv. Tech. Bull.*, 1489: 174.

Type locality: Mangang, Sikkim, India

Material examined: 8♀♀, collected from cow, 27°01'33.2" N, 88°41'47.4" E, 867 m, Ambiok basti side, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 12♀♀, collected from cow, 27°01'33.2" N, 88°41'47.4" E, 867 m, Ambiok basti side, Darjeeling, 23.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°05'01.0" N, 88°40'09.0" E, 2045 m, NVNP site 7, Darjeeling, 24.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 24.v.2015, Coll. A. Maity; 2♀♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 27.v.2015, Coll. R.S. Mridha; 3♀♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 27.v.2015, Coll. A. Maity; 6♀♀, collected from cow, 27°02'50.9" N, 88°41'05.0" E, 1409 m, Upper kuapani, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 1♀, collected from cow, 27°04'52.3" N, 88°40'21.7" E, 2209 m, Rachila, Darjeeling, 22.v.2015, Coll. A. Maity; 2 ♀♀, collected from cow, 27°03'02.3" N, 88°40'48.4" E, 1599 m, Neora valley national park buffer zone, Darjeeling, 21.v.2015, Coll. A. Maity; 12 ♀♀, collected from cow, 27°03'02.3" N,

88°40'48.4" E, 1599 m, Neora valley national park buffer zone, Darjeeling, 21.v.2015, Coll. R.S. Mridha; 8♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 21.v.2015, Coll. R.S. Mridha; 7♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 23.v.2015, Coll. R.S. Mridha; 2♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 21.v.2015, Coll. A. Maity; 3♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 24.v.2015, Coll. R.S. Mridha; 3♀♀, collected from cow, 27°02'10.8" N, 88°41'50.8" E, 990 m, Phaperkheti, Darjeeling, 23.v.2015, Coll. A. Maity; 11♀♀, collected from cow, 27°02'32.8" N, 88°41'32.8" E, 1103 m, Kuapani roadside 2, Darjeeling, 23.v.2015, Coll. A. Maity; 4♀♀, collected from cow, 27°02'34.2" N, 88°41'42.0" E, 1110 m, Kuapani road side 1, Darjeeling, 23.v.2015, Coll. A. Maity; 1♀, collected from cow, 27°01'21.8" N, 88°42'08.7" E, 799 m, Ambiok, Darjeeling, 21.v.2015, Coll. R.S. Mridha.

Diagnosis:

Head: Fore head greyish brown, mid frontal spot small, paired spots triangular, touching eyes and almost reaching callus. Callus yellowish brown, rugose centrally, strong inter antennal dark spot. Face greyish brown. Scape yellowish brown, cylindrical, pedicel with dorsal projection, flagellum dusky, long and slender. Palpi dark brown with dark hair.

Thorax: Thorax dark brown, pair of triangular spots on transverse suture, pair of crescentic spots anterior to scutellum.

Abdomen: Abdomen dark brown with narrow, light incisures.

Legs: Fore coxae light on basal half, light basal third of fore tibiae, basal two fifths of tibiae white.

Wings: Wings brown with patterned usual small spots, apical band narrow, just crossing vein R4, no light spots on posterior margin of wing.

Distribution: India (West Bengal: Darjeeling; Sikkim)

Elsewhere: Nil.

Remarks: This species is recorded for the first time from the state of West Bengal.

8. *Haematopota tessellata* Ricardo, 1906

1906. *Haematopota tessellata* Ricardo, *Ann. Mag. Nat. Hist.*, (7)18: 120.

Type locality: Hot wells, Trincomalee, Sri Lanka

Material examined: 1♀, collected from cow, 25°11'33.2" N, 88°11'08.2" E, 27 m, Bagsarai, Maldah, 12.vi.2014, Coll. D. Banerjee

Diagnosis:

Head: Face grey, trace of brown stripes between antennae and eyes. Frontal callus black and not reaching eyes, on posterior border ending in a point, anterior border straight. Black, large paired spots not reaching eyes. Fore head apparently grey. Antennae yellow, scape incrassate, shorter than flagellum which is dusky.

Thorax: Thorax brown with grey stripes.

Abdomen: Abdomen brown with white borders to segments, grey spots on posterior abdominal segments and faint grey median stripe.

Legs: Legs brown, femora light, mid and hind tibiae with rings, basal joints of mid and hind tarsi whitish.

Wings: Wings brown with yellowish brown veins and appendix, apical band double, both branches united at base, diverging later.

Distribution: India (West Bengal: Maldah; Chattisgarh)

Elsewhere: Sri Lanka.

Remarks: This species is recorded for the first time from the state of West Bengal.

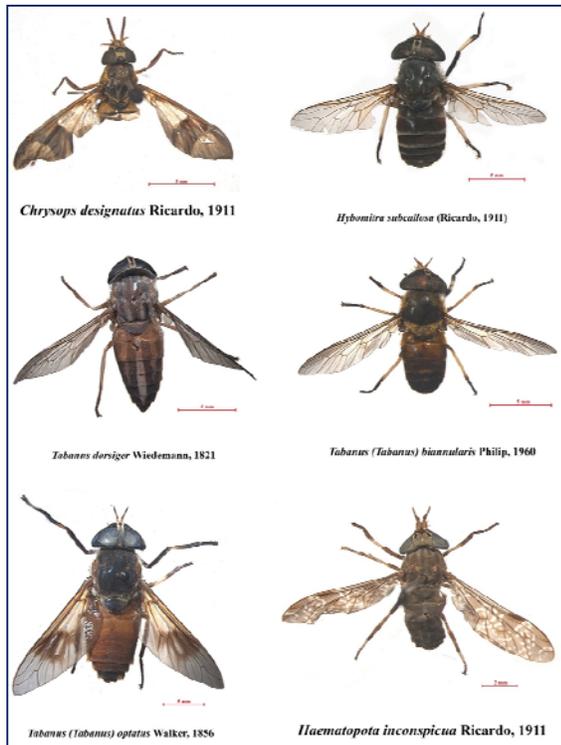
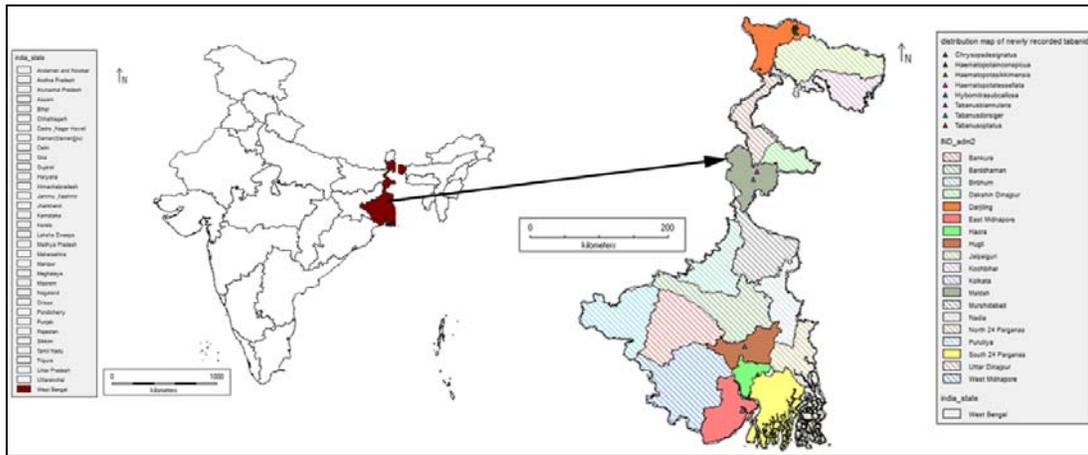


Fig 1: Habitus of newly recorded 6 tabanid species of West Bengal.

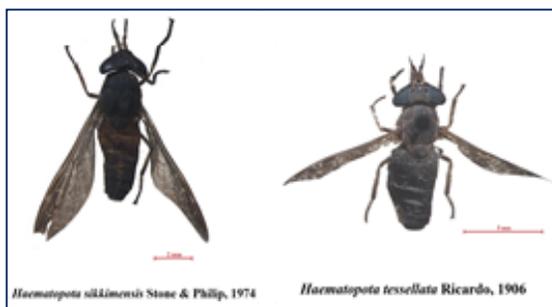


Fig 2; Habitus of newly recorded remaining 2 tabanid species of West Bengal.

Haematopota sikkimensis Stone & Philip, 1974; *Haematopota tessellata* Ricardo, 1906 were recorded for the first time from the state of West Bengal. The tabanid fauna are abundant throughout the study area and can be seen throughout the year with a little decline at higher elevations during winter. So far, in respect of qualitative richness of fauna, several tabanid species and even few genus endemic to the state of West Bengal. Of these, only few are far wide spread and nearly cosmopolitan in distribution.

Eight tabanid species under four genera exhibit new distributional record from the state of West Bengal. Among these newly recorded eight tabanid species, two species viz. *Hybomitra subcallosa* (Ricardo, 1911); *Haematopota sikkimensis* Stone & Philip, 1974 exhibit endemism to India. Surprisingly all these tabanid species exhibit wide distribution pattern throughout India and none of them are endemic to the state of West Bengal. On the other hand, seven tabanid species exhibit restricted distribution to only single district of West Bengal. *Chrysops designatus* Ricardo, 1911 are found only from S 24 Paraganas district of the state. Four tabanid species namely *Hybomitra subcallosa* (Ricardo, 1911); *Tabanus (Tabanus) biannularis* Philip, 1960; *Haematopota inconspicua* Ricardo, 1911 and *Haematopota sikkimensis* Stone & Philip, 1974 are reported to occur only from Darjeeling district of West Bengal. *Tabanus (Tabanus) optatus* Walker, 1856 is distributed only in Howrah district of West Bengal. *Haematopota tessellata* Ricardo, 1906 show its distribution restricted to Maldah district of West Bengal. Certain species occurring in West Bengal may immigrate at least to the neighbouring countries, such as Bangladesh, Nepal, Bhutan, Myanmar, Thailand, etc. or emigrate from those countries in the influence of allied topographic and climatic conditions. Indeed, nearly several species show discontinuous distribution, and this appears to be due to the need of thorough exploration of several area, unfavourable natural conditions in the area for survival and colonization, inaccessible area specially hilly mountain area, large part of Sundarban biosphere reserve, and border areas.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

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Discussion

Eight species under four genera namely *Chrysops designatus* Ricardo, 1911; *Hybomitra subcallosa* (Ricardo, 1911); *Tabanus dorsiger* Wiedemann, 1821; *Tabanus (Tabanus) biannularis* Philip, 1960; *Tabanus (Tabanus) optatus* Walker, 1856; *Haematopota inconspicua* Ricardo, 1911;

Quarters, M Block, New Alipore, Kolkata -700 053. The help of DFO and all the forest staffs, is also deeply acknowledged for providing us guidance, accommodation and necessary facilities.

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