TAXONOMIC ACCOUNTS OF HORSE FLIES (DIPTERA: TABANIDAE) FROM ARID ZONE, PART OF CHOTANAGPUR PLATEAU, WEST BENGAL

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ABSTRACT: A total of eight tabanid species under four genera and single subfamily are found in arid zone of West Bengal. Among them single species namely *Tabanus dorsiger* Wiedemann, 1821 are reported for the first time from this region of West Bengal. Their taxonomic keys for identification and diagnostic accounts are discussed along with their distribution pattern where deemed necessary.

KEY WORDS: Tabanidae, Taxonomy, New record, Distribution, Arid zone, West Bengal

Tabanids are one of the representative groups of brachyceran sub order under order Diptera and family Tabanidae as they typical characters viz. 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). 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).

Tabnids are mainly known for their noxious bite followed by annoying sensation. Their haematophagy makes them economically important as a serious pest for 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.

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) and neglected as subject of interest (Desquesnes et al., 2013). It was imperative to survey at this juncture and investigate the occurrence of any new species or new record of Tabanidae in one of the interesting arid zone of West Bengal comprising of two eco regions namely Chotanagpur dry deciduous forest and lower most gangetic plains moist deciduous forest. Because unique assemblage of tabanid insect is expected from this region supported by arid eco-system. However their

taxonomy and distribution pattern in this arid 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

Arid Zone

Bankura: Bankura, an oldest locality in West Bengal once known as "Jungle Mahal" covered with long stretched forest area. The district covers a total forest area of 1450 sq. km., 21% of the total geographical area. The matter of pride is that Bankura is much more enriched with the wealth of forest than other districts of West Bengal scoring first in plantation of trees.

Climate of the district is characterized by extremities with temperature ranges between 39° to 42° C during summer and 7° to 14° C during winter.

Study area includes Bandarhati, Khatra and Panchal.

Birbhum: It is the northern most district of Burdwan sub division. Jharkhand lie at western border of district, whereas border in other direction is covered by Bardhaman and Murshidabad of West Bengal. Western part of Birbhum is topographically very unique in the sense it becomes part of chotanagpur plateau. This characteristic red or laterite soil of the region gradually merges with fertile farm land in the east. The district is situated between 23°32′30″ and 24°35′0″ north latitudes and 87°5′25″ and 88°1′40″ east longitudes. During summer temperature shoot well above 40° C and in winter it can drop around 10° C. It has an average annual rainfall of 1300 mm. Ajay, Mayurakhi, Kopai, Bakreshwar, Brahmani, Dwarka, Hinglo, Chapala, Bansloi and Pagla are major rivers that flow across the district.

Study area includes Kadhpur, Ballavpur, Bonerpukur danga and Pearson palli.

(ii) Sampling

A two year survey study from March 2013 to March 2015 was conducted by the team Diptera of Zoological Survey of India. Adult flies were collected using aerial net sweeps around the dense forest patch, domestic and wild cattle patch etc. by following the method of Datta et al. (1997) later modified by Veer (2002) and placed in killing jar containing cotton soaked with ether as narcotizing agent. Flies were pinned using insect pin and kept in the collection box and preserved following method of Datta et al. (1997) for further identification. All specimens were labelled with the location of the sampling along with date and time of collection.

(iii) Identification of the specimen

Identification of the adults followed the keys of Thomas (2011) and Stone and Philip (1974) and description by the Ricardo (1911 a,b) and Stone (1975), the State Fauna Series of Zoological Survey of India (1997), Thomson (2013) keeping in mind the recent nomenclatural changes in the Pape & Evenhuis (2013) and Pape & Thompson (2016). Classification scheme of Burger & Thompson (1981) was followed for the current study on tabanids. Morphology and terminology part was adapted from McAlpine et al. (1989). All the tabanid specimens were identified using binocular microscope Leica EZ4 HD. All the identified specimens were deposited to the designated repository of National Zoological Collection, Diptera section, Zoological Survey of India, Kolkata. Photographs were captured in Leica Sterio microscope M205A.

RESULTS

Systematic account with key is given wherever deemed necessary along with first reference, current reference, type locality, material examined, diagnosis and distribution are given for each tabanid species.

List of Taxa (new records of tabanid species are indicated with asterix)

Subfamily Tabaninae
Tribe Tabanini
Genus *Atylotus* Osten Sacken, 1876
Atylotus virgo (Wiedemann, 1824)
Genus *Tabanus* Linnaeus, 1758
Tabanus dorsiger Wiedemann, 1821*
Tabanus (Tabanus) rubidus Wiedemann, 1821
Tabanus (Tabanus) striatus Fabricius, 1787
Tabanus (Tabanus) tenens Walker, 1850

Tribe Haematopotini
Genus *Haematopota* Meigen, 1803
Haematopota javana Wiedemann, 1821
Haematopota marginata Ricardo, 1911
Genus *Hippocentrodes* Philip, 1961
Hippocentrodes desmotes Philip, 1961

Key to the subfamily, tribe, genus and species of tabanid flies of the study area

Systematic account
Family Tabanidae
Subfamily Tabaninae

Key to the tribes of sub family Tabaninae

1. 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

1. Antennal style with 4 annulations, frons with prominent callus.....*Tabanus* Linnaeus
-. Frons with reduced or spotted calli.....*Atylotus* Osten-Sacken

Key to the species of Genus *Tabanus* Linnaeus

1. Frontal callus with spindle shaped linear extension.....2
-. Frontal callus with linear extension not spindle shaped.....3
2. Abdomen with median stripe continuous up to 6th segment, except on 2nd tergite absent, lateral stripes up to 4th segment, costal cell clear.....*T. striatus*
-. Abdomen with median stripe light and complete, present on 2nd tergite, lateral stripes much straight, costal cell tinge yellowish.....*T. tenens*
-. Abdomen with median stripe complete, broad on 2nd tergite, lateral stripes in form of irregular spots appearing as steps.....*T. dorsiger*
3. Abdomen and thorax lilac or blackish brown, femora reddish brown to blackish.....
.....*T. rubidus*

Tribe: Haematopotini

Key to the genera

1. Eyes bare. Wings with infuscations and spots.....2
-. Wings with double apical band.....3
2. Wings with pale spots, wavy lines or punctulate; mid and hind tibiae usually with two pale rings.....*Haematopota* Meigen
-. Wings infuscated with 6 or more pale transverse bands, no rosettes.....*Hippocentrodes* Philip
3. Wings dark brown with fairly distinct rosettes. 3rd rosette very irregular, anal cell has curved white streak.....*H. javana*
-. Wings brown, numerous light markings, three rosettes distinct, small transverse bars on posterior border zigzag, anal cell has no such streak.....*H. marginata*

Diagnostic accounts of eight species of family Tabanidae

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 *Atylotus* Osten-Sacken, 1876

1876. *Atylotus* Osten-Sacken, Mem. Boston Soc. Nat. Hist., 2: 425-426.

Type species: *Tabanus bicolour* Wiedemann, 1821.

Diagnosis: Usually small sized fly, frons with spotted calli or without calli. Colour of eyes in living specimen green or yellow. Basal plate of flagellum broad and obtuse dorsal angle. Basicosta pale to brown setulose.

Atylotus virgo (Wiedemann, 1824)

1824. *Tabanus virgo* Wiedemann, Analecta. Entomol., p. 22.

1973. *Atylotus virgo* Philip, Entomol. Scand. Suppl., 4: 57.

Type locality: "Indies orientalis"

Material examined: 1♀, collected from cow, 23°13′56.5″ N, 87°04′43.7″ E, 125 m, Bandarhati, Bankura, 23.ix.2013, Coll. A. Naskar.

Diagnosis: Antennae bright rufous, palpi yellow, beard white, forehead yellowish grey with no callus. Thorax with faint white stripes and narrow median line. Abdomen greyish with light yellow haired segmentations, 2 white haired roundish spots on each segment. Wings hyaline with ochre yellowish veins. Legs ochre yellow with chamois-leather coloured femora.

Distribution: India (West Bengal: Bankura, Puruliya, S 24 Paraganas; Andaman Island, Himachal Pradesh, Madhya Pradesh, Punjab, Uttarakhand).

Elsewhere: Sri Lanka, Pakistan.

Remarks: Burger (1981) put forwarded the conflict regarding placement of this species under genus *Atylotus* as it differs in many features from it. It can transmit Surra disease pathogens.

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.

Tabanus dorsiger Wiedemann, 1821

1821. *Tabanus dorsiger*. Wiedemann, Diptera Exotica, Kiliae, pp. 43-50, 101.
Type locality: Indian subcontinent.

Material examined: 2♀♀, collected from cow, 23°13′56.5″ N, 87°04′43.7″ E, 125 m, Bandarhati, Bankura, 27.ix.2013, Coll. S. Hazra.

Diagnosis: Adult fly is usually larger (14–16 mm in length) than the other two trivittate flies, *T. striatus* and *T. tenens*. 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. 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. Fore femur and fore tibia are uniformly orange to orangy brown in colour but are darkened apically. Thoracic stripes are distinct. The male has a yellow tinted costal cell on the wing.

Distribution: India (West Bengal: Bankura, East Midnapre, Hooghly, S 24 Paragana; 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.

Tabanus rubidus Wiedemann, 1821

1821. *Tabanus rubidus* Wiedemann, Dipt. Exot., 1: 69.
Type locality: Bengalia.

Material examined: 1♀, collected from cow, 23°47′10.8″ N, 87°49′04.4″ E, 35.6 m, East Kadhpur, Birbhum, 20.iv.2014, Coll. A. Maity.

Diagnosis: Face covered with grey tomentum and white hairs. Palpi stout and large, light yellow with black pubescence. Frontal callus oblong with short linear extension. Abdomen lilac to reddish brown in colour. Thorax dark reddish with grey tomentum and indistinct stripes. Median abdominal stripes not continuous rather composed of greyish white tomentose triangular spots and lateral stripes are also composed of greyish white irregular tomentose spots, appears as step like. Sides of abdomen serrated. Femora dark, fore tibiae light yellowish but dark at apices. Wings hyaline, in middle slight yellowish.

Distribution: India (West Bengal: Birbhum, Hooghly, Maldah; Arunachal Pradesh, Meghalaya, Orissa, Sikkim).

Elsewhere: Pakistan, Philippines, China, Indonesia.

Remarks: This species is very common across different study area of West Bengal. This species shows wide distribution pattern across different districts of the state.

Tabanus striatus Fabricius, 1787

1787. *Tabanus striatus*. Fabricius, Mantissa insect. 2: 356.
Type locality: China.

Material examined: 7♀♀, collected from cow, 23°13′56.5″ N, 87°04′43.7″ E, 125 m, Bandarhati, Bankura, 27.ix.2013, Coll. R.S. Mridha; 1♀, collected from cow, 6♀♀, collected from buffalo, 23°16′48.0″ N, 87°18′00.0″ E, 45 m, Panchal, Bankura, 29.ix.2013, Coll. R.S. Mridha; 2♀♀, collected from cow, 22°58′18.9″ N, 86°51′16.0″ E, 147.4 m, Khatra, Bankura, 29.ix.2013, Coll. S.K. Sinha; 10♀♀, collected from

cow, 23°41′31.4″ N, 87°40′18.3″ E, 15 m, Boner pukur danga, Birbhum, 27.vii.2014, Coll. A. Maity; 7♀♀, collected from buffalo, 23°41′12.4″ N, 87°39′40.3″ E, 50.5 m, Ballavpur, Birbhum, 26.vii.2014, Coll. A. Maity; 1♀, collected from cow, 23°40′49.2″ N, 87°40′31.6″ E, 66 m, Pearson palli, Birbhum, 20.iv.2014, Coll. A. Maity; 1♀, collected from cow, 23°47′10.8″ N, 87°49′04.4″ E, 35.6 m, East Kadhpur, Birbhum, 20.iv.2014, Coll. A. Maity.

Diagnosis: Face grey haired, white pubescent, beard white, palpi light yellow, white tomentose with some curved black hairs. Antennae reddish yellow with dark apex, forehead about 6 times as long as it is wide with yellowish grey tomentum and short white pubescence. Frontal callus shining reddish brown, oblong, not reaching eyes anteriorly, posteriorly receding and continued in fine line, then become broadened. A proboscis on back part of head short & wide, thorax reddish brown with 4 distinct greyish white tomentose stripes with white pubescence. Sides of thorax black haired, venter grey with white pubescence. Scutellum same colour as thorax with white hairs on posterior border. Legs reddish yellow, fore femora rusty reddish, with black hairs on upper sides. Middle and posterior pair blackish with grey tomentum, pubescent predominantly white. Tibiae with dorsal black hairs, tarsi reddish brown with black pubescence, coxae white pubescent. Wings hyaline, stigma yellowish, veins reddish. Abdomen long and slender, varying from reddish brown to blackish brown, median stripe continuous up to 6th segment, composed of grey tomentose spots, side stripes up to 4th segment. Venter sides with long white hairs, reddish yellow and covered with grey tomentum. Halteres yellowish brown with lighter knob.

Distribution: India (West Bengal: Alipurduar, Bankura, Birbhum, Bardhaman, Darjeeling, East Midnapore, Hooghly, Howrah, Jalpaiguri, Kolkata, Maldah, Murshidabad, N 24 Paragana, Nadiya, Puruliya, S 24 Paragana, S Dinazpur, West Midnapore; Arunachal Pradesh, Assam, Bihar, Delhi, Gujrat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharastra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh).

Elsewhere: Bangladesh, Bhutan, Combodia, China, Laos, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand and Vietnam.

Remarks: There was taxonomic misinterpretation through ages and hence the distributional records associated with the species were in a mess everywhere before Burton (1978) who took pains to sort out the perplexed identity of the species from its allies. Later, Burger and Thompson (1981) aptly illustrated, keyed and discussed these species with a view to making away with the recurrent confusion. This is a very common and widespread species in India, and is often found to enter the house, being attracted by light in hot summer night.

Tabanus tenens Walker, 1850

1850. *Tabanus tenens* Walker, Insecta Saunders., Dipt., 1: 49.

Type locality: East India.

Material examined: 1♀, collected from cow, 22°58′18.9″ N, 86°51′16.0″ E, 147.4 m, Khatra, Bankura, 29.ix.2013, Coll. S.K. Sinha; 1♀, collected from cow, 23°47′10.8″ N, 87°49′04.4″ E, 35.6 m, East Kadhpur, Birbhum, 20.iv.2014, Coll. A. Maity.

Diagnosis: Medium size fly (10–13 mm in length). Antennae rusty yellow. Scape and pedicel light yellowish, flagellum reddish, darker at apical annuli. Palpi orangish with long white hairs and few black hairs, ending at acute point. Face grey haired. Beared whitish. Frontal callus broad oblong with broad spindle shaped extension. Thorax with four distinct stripes composed white tomentum

and a narrow brown line on the middle, ashy grey hairs at sides and posterior margin. Scutellum white pubescent and posterior margin with long whitish grey hairs. Brown to grey in colour with trivittate abdomen. The adult fly has a complete pale median abdominal stripe. Wings clear, veins brown, pterostigma light brownish. Fore tibia is bicoloured with blackish apical one-third and paler basal two-thirds.
Distribution: India (West Bengal: E Midnapore, Bankura, Maldah, Birbhum, Hooghly, S 24 Paragana; Assam, Orissa, Sikkim); SE Asia.
Remarks: The adult fly is an important mechanical vector of Surra disease and is also implicated in the transmission of anthrax.

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 Kude, 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.

Haematopota javana Wiedemann, 1821

1821. *Haematopota javana* Wiedemann, Dipt. Exot., 1: 100.
Type locality: Java.
Material examined: 1♀, collected from cow, 23°47′10.8″ N, 87°49′04.4″ E, 35.6 m, East Kadhpur, Birbhum, 20.ii.2014, Coll. A. Maity.
Diagnosis: Frontal callus ochre brown, face grey with a black spot on each side. Antennae reddish yellow, scape little incrassate, scape and pedicel with black pubescence. Thorax greyish brown with 3 lineal white stripes. Scutellum grey tomentose with ferruginous pubescence. Triangular grey haired median spot on each segment and grey lateral spots up to 3rd segments. Venter grey haired with broad blackish median stripe. Femora pale reddish, white haired, hind tibiae with 3 brownish bands, fore tibiae white at base. Wings dark brown with fairly distinct rosettes and apical band double. Stigma is large white mark consisting of round white ring with dark centre. 3rd rosette very irregular, anal cell has curved white streak.
Distribution: India (West Bengal: Birbhum, Nadia; Bihar, Himachal Pradesh, Kerala, Meghalaya, Mizoram, Tamil Nadu).
Elsewhere: Andalas, Bangladesh, China, Java, Laos, Malaya, Myanmar, Thailand and Vietnam.
Remarks: This is a common and widespread species, and hence it shows certain amount of variable characters (vide Stone & Philip, 1974).

Haematopota marginata Ricardo, 1911

1911. *Haematopota marginata* Ricardo, Rec. Indian Mus., 4:347.
Type locality: Pusa, Bihar.

Material examined: 1♀, collected from cow, 23°40′49.2″ N, 87°40′31.6″ E, 66 m, Pearson palli, Birbhum, 20.ii.2014, Coll. A. Maity.
Diagnosis: Face grey with white pubescence. Palpi reddish with grey tomentum and black pubescence. Antennae reddish yellow, scape not as long as first joint of flagellum. Fore head dark brown with light circles round the spot and few grey tomentum. Frontal callus narrow, glossy, dark brown, with upper border curved and inner border concave. Small inter antennal black spot present, oval large paired spots not quite reaching eyes or callus. Thorax dark brown with three narrow grey stripes. Abdomen dark brown with inconspicuous faint grey tomentose median stripe and grey tomentose lateral spots. Legs reddish brown, light yellowish rings on tibiae, fore tibiae yellowish at base. Wings brown, numerous light markings, three rosettes distinct, small transverse bars on posterior border zigzag, pterostigma distinct, brown. Lower branch of apical band narrow and not always continued to end of upper broad part of band.
Distribution: India (West Bengal: Birbhum; Assam, Bihar, Meghalaya).
Elsewhere: Bangladesh.
Remarks: This species is commonly found in hilly region of North Bengal.

Hippocentrodes desmotes Philip, 1961

1961. *Hippocentrodes desmotes* Philip, Indian J. Entomol., 21(2): 83.
Type locality: Kanchrapara, West Bengal.
Material examined: 1♀, collected from cow, 23°13′56.5″ N, 87°04′43.7″ E, 125 m, Bandarhati, Bankura, 27.ix.2013, Coll. R.S. Mridha.
Diagnosis: Fore head glossy with grey pollinose area near eyes above dark reddish brown callus, slightly protuberant, shallowly concave below, touching eyes, pair of shiny triangles below. No inter antennal dark spots. Face and parafacials dark greyish brown. Scape yellow, slender, pedicel without dorsal projection, flagellum darkened at apical annuli. Palpi stout, dark brown with dark hair. Thorax dark brown, pair of light triangles behind transverse suture and pair of grey stripes on posterior part. Wings brown with six nearly complete rather broad light bands and partial band across end of first two posterior cells. Coxae and femora brown, fore tibia yellowish on basal half. Abdomen dark reddish brown.
Distribution: India (West Bengal: Bankura, N 24 Paragana; Rajasthan).
Elsewhere: Nepal.
Remarks: This species is rare in occurrence across study area of West Bengal.

DISCUSSION

A total of eight tabanid species namely *Atylotus virgo* (Wiedemann, 1824); *Tabanus dorsiger* Wiedemann, 1821; *Tabanus (Tabanus) rubidus* Wiedemann, 1821; *Tabanus (Tabanus) striatus* Fabricius, 1787; *Tabanus (Tabanus) tenens* Walker, 1850; *Haematopota javana* Wiedemann, 1821; *Haematopota marginata* Ricardo, 1911; *Hippocentrodes desmotes* Philip, 1961 under four genera viz. *Atylotus* Osten Sacken, 1876; *Tabanus* Linnaeus, 1758; *Haematopota* Meigen, 1803; *Hippocentrodes* Philip, 1961 and single subfamily i.e. Tabaninae are recorded during study period from March, 2013 to March, 2015 in study sites across arid zone of West Bengal. Among these eight tabanid species, one species namely *Tabanus dorsiger* Wiedemann, 1821 are recorded for the first time from this zone of the state. Notably the species *Hippocentrodes desmotes* Philip, 1961 of genus *Hippocentrodes* Philip, 1961 are recorded for the second time from the state.

Among all these tabanid fauna recorded from arid zone of the state, only one

species i.e. *Haematopota marginata* Ricardo, 1911 exhibit endemism to this zone within the state. Other 7 tabanids are more or less distributed widely with one species namely *Tabanus (Tabanus) striatus* Fabricius, 1787 is most widespread and almost found to be cosmopolitan in distribution. Distribution map of Tabanidae in arid region of West Bengal (Map 1) exhibited their collection sites along with species richness of the family on the basis of number of species collected from study sites. It revealed that Bandarhati study site in Chotanagpur dry deciduous eco region and East Kadhpur in lower gangetic plains moist deciduous eco region are most species rich as far as tabanid fauna are concerned. It can be said that Certain tabanid species occurring in eco-region of Chotanagpur dry deciduous forest and associated arid region of West Bengal may immigrate at least to the neighbouring states i.e. Bihar, Jharkhand, Chattisgarh and countries, such as Bangladesh, Myanmar, Thailand, etc. or emigrate from those states and countries. Though family Tabanidae are presumed to exhibit discontinuous distribution in arid region of the state 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 large part of Jungle mahal but in far future the distribution is expected to be continuous due to influence of similar topographic conditions prevailing in surrounding states encompassing same eco-region of Chotanagpur dry deciduous forest of arid zone.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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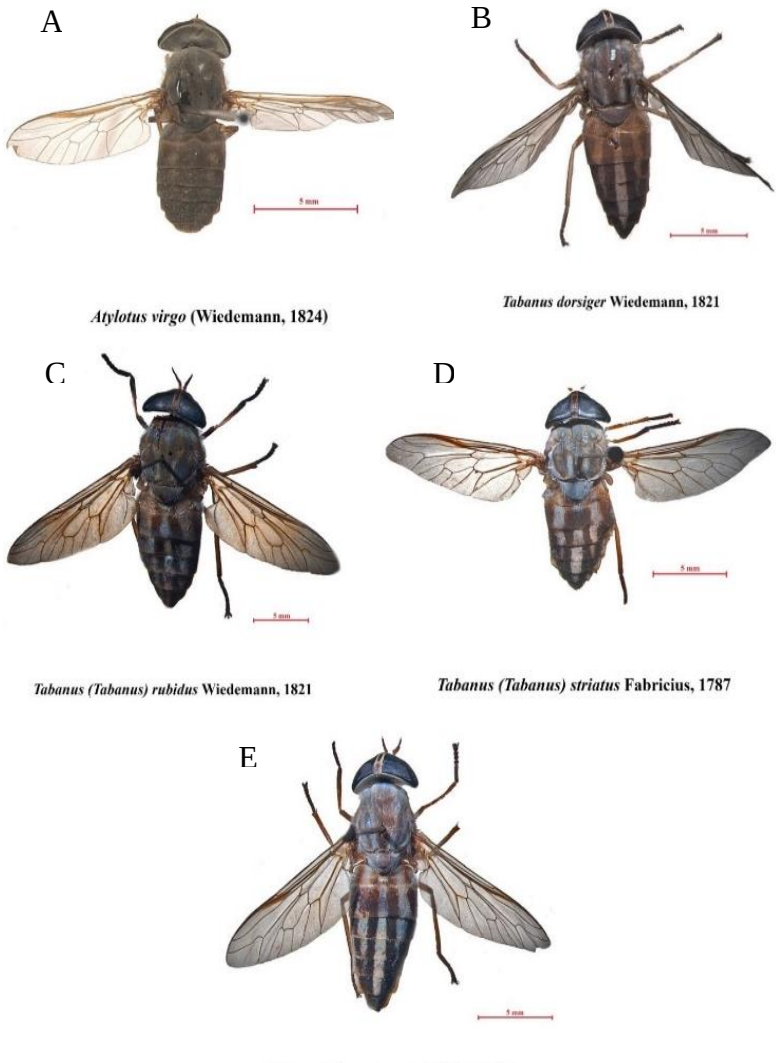


Plate 1. Habitus of 5 tabanid species namely A: *Atylotus virgo* (Wiedemann, 1824); B: *Tabanus dorsiger* Wiedemann, 1821; C: *Tabanus* (*Tabanus*) *rubidus* Wiedemann, 1821; D: *Tabanus* (*Tabanus*) *striatus* Fabricius, 1787; E: *Tabanus* (*Tabanus*) *tenens* Walker, 1850; recorded from arid zone of West Bengal.

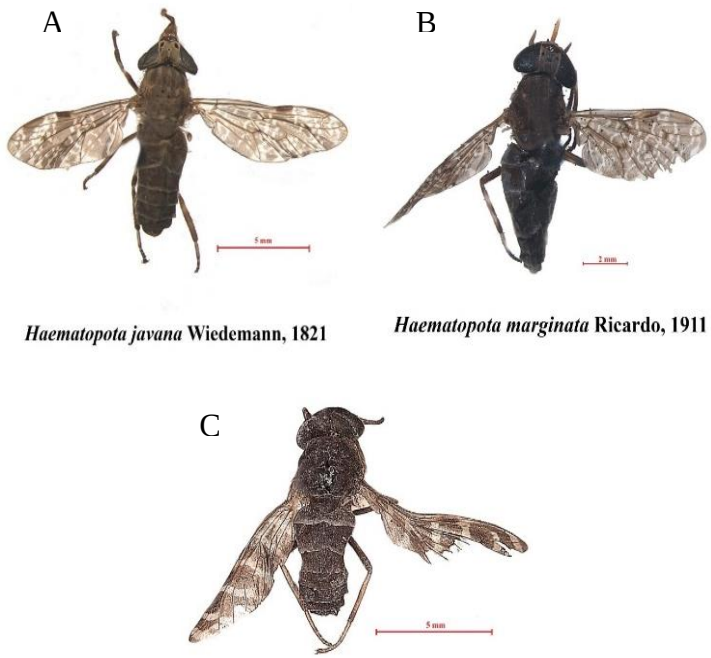
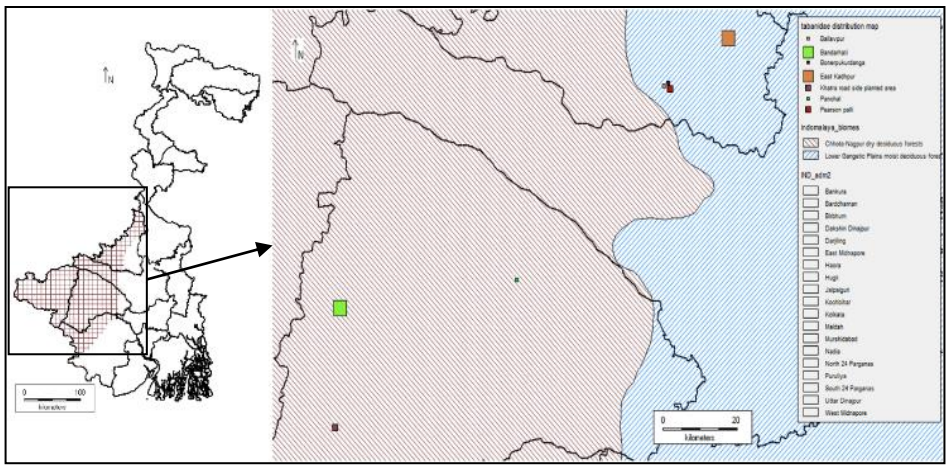


Plate 2. Habitus of 3 tabanid species namely A: *Haematopota javana* Wiedemann, 1821; B: *Haematopota marginata* Ricardo, 1911; C: *Hippocentrodes desmotes* Philip, 1961; recorded from arid zone of West Bengal.



Map 1. GIS map showing distribution and richness of family Tabanidae on the basis of eco-regions in Indo-malayan biome of arid region of west Bengal.