



E-ISSN: 2320-7078

P-ISSN: 2349-6800

[www.entomoljournal.com](http://www.entomoljournal.com)

JEZS 2020; 8(5): 2013-2030

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Received: 30-06-2020

Accepted: 09-09-2020

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## Taxonomic notes on Tabanidae from south India with special reference to Western Ghats

**RB Metri, GC Puttalakshamma, KJ David, NL Jaya and H Dhanalakshmi**

**Abstract**

Faunistic studies on Tabanidae along Western Ghats covering Belagavi division, Karnataka, India revealed the presence of 20 species of Tabanidae viz. *Tabanus indianus* Ricardo, *Tabanus biannularis* Philip, *Tabanus diversifrons* Ricardo, *Tabanus sexcinctus* Ricardo, *Tabanus gertrudae* Philip, *Tabanus triceps* Thunberg, *Tabanus dorsilinea* Wiedemann, *Tabanus rubidus* Wiedemann, *Tabanus jucundus* Walker, *Tabanus auristriatus* Ricardo, *Tabanus tenebrosus*, Walker, *Haematopota montana* Ricardo, *Haematopota javana* Wiedemann, *Haematopota longipennis* Stone and Philip, *Haematopota brevis* Ricardo, *Haematopota albimedia* Stone and Philip, *Chrysops dispar* Fabricius, *Chrysops pellucidus* Fabricius, *Atylotus virgo* Wiedemann, *Philoliche taprobanes* Walker. Among the 20 species, seven species are proven vectors for Surra, Anthrax, *Anaplasma marginale*, Buffalo sickness and *Pasteurella multocida* in domestic and wild animals. *Tabanus jucundus* Walker, 1848 was recorded for the first time from Karnataka.

**Keywords:** Tabanidae, vector, Western Ghats, surra, anthrax

**Introduction**

Tabanidae is a brachyceran Diptera of economic importance as many species are vectors of various animal diseases. *Tabanus* Linnaeus, 1758 (horse flies), *Chrysops* Meigen, 1803 (deer flies), *Haematopota* Meigen, 1803 (clegs) and *Philoliche* Wiedemann, 1928 are the few economically important genera in India (Datta, 1985) <sup>[1]</sup>.

Nearly 4,500 species in 144 genera are described worldwide in this family (Baldacchino *et al.*, 2014; Morita *et al.*, 2016) <sup>[2,3]</sup>. 247 species and 1 subspecies belonging to 14 genera in 6 tribes and 3 subfamilies have been recorded from India (Maity *et al.*, 2016) <sup>[4]</sup>. (Kapoor *et al.*, 1990; Veer, 2004; Vasudeva, 2007) <sup>[5, 6, 7]</sup> reported 46 species of tabanids in 5 genera viz., *Tabanus*, *Haematopota*, *Chrysops*, *Atylotus* and *Philoliche* and 3 subfamilies viz., Tabaninae, Chrysopsinae and Pangoniinae from Karnataka. In India, tabanids transmit more than 35 diseases of cattle and humans including surra or trypanosomosis and anthrax (Basu *et al.* 1952) <sup>[8]</sup> which are fatal diseases of livestock. They are responsible for economic loss in the dairy industry as their easy targets are domestic cattle across the rural belts of several states in this country. Tabanid cause annoyance and painful bites. A female usually takes 20 to 200 mg per meal of blood but loss of a blood is greater since the blood oozes out from the punctured wound even after mouthparts are withdrawn and leaves behind wounds in the skin that attracts myiasis producing flies (Veer, 2004) <sup>[6]</sup>, and decreases quality of hides due to biting scars (Egri *et al.*, 2013) <sup>[9]</sup>. One of the reasons for decreased production caused by tabanid flies is host blood loss. The correct identification of horse flies is very important for determining their role in disease transmission and for planning effective vector control and management strategies.

This paper is based on study conducted in Western Ghats of Karnataka and examination of specimens deposited in ICAR-NBAIR, Bangalore. All species collected/examined are redescribed based on female postabdominal structures as it has not been done for most of species from India.

**Materials and Methods**

**Collection:** Female flies were collected by handpicking method while feeding on cattle and buffalo, from two districts of Karnataka (Belagavi and Uttar Kannada Western Ghats region) during March 2019 to February 2020. Nzi trap, Modified Manitoba trap and H- trap were also used to collect the flies.

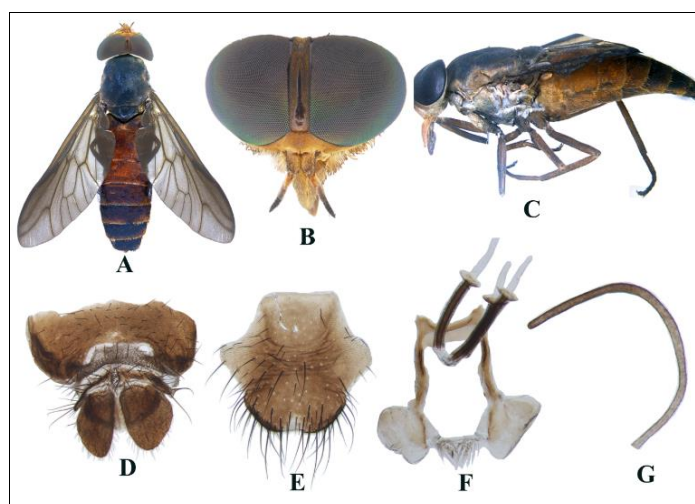
Traps were the most effective method for catching large numbers of tabanids in a short time with minimum effort. During peak season, flies trapped inside the car while moving through forest area and moving on a bicycle by using sweep net during dusk.

**Preservation/Processing:** Collected adults were killed using ethyl acetate, pinned through right side of the thorax/ or pointed on paper points and labelled. For the study of genitalia, abdominal tip of female was removed using a fine pair of forceps, digested in 10% KOH for 10 minutes, dehydrated and examined in cavity blocks with glycerol under the microscope for imaging and description.

**Imaging:** Images of flies and its postabdominal structures were acquired using Leica DFC 425 camera attached to Leica M205A microscope.

### Morphological identification

Morphological identification of adult flies was done by using keys of (Kapoor *et al.*, 1990; Veer, 2004; Burton, 1978; Stone and Philip, 1974; Burger and Chainey, 2000) [5, 6, 10, 11, 12].



**Fig 1:** *Tabanus diversifrons* Ricardo. A–habitus (dorsal view); B–head (frontal view); C–habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### *Tabanus diversifrons* Ricardo, 1911

*Tabanus diversifrons* Ricardo, 1911: 214.

**Material examined:** 10♀♀, INDIA: Karnataka, Kapoli K. C Village, Khanapur, 15° 39' 49.7124"N, 74° 22' 25.0284"E, 651 m, 08.vii.2019, Coll. Raju Metri, Ex. Nzi trap; 4♀♀, INDIA: Karnataka, Ckikhale Village, Khanapur, 15° 40' 12.738"N, 74° 17' 12.6996"E, 651 m, 10.vii.2019, Coll. Raju Metri, Ex. Nzi trap; Modified Manitoba trap. Bullocks (*Bos indicus*); 6♀♀, INDIA: Karnataka, Kankumbi Village, Khanapur, 15° 41' 51.9864"N, 74° 13' 55.38"E, 651 m, 14.vii.2019, Coll. Raju Metri, Ex. Bullocks (*Bos indicus*).

**Diagnosis:** Medium sized (14–15 mm long) orange-black species. Frons length to width ratio, 5.13 (frontal index 4.75; divergence index 0.75), basal callus oval-shaped; dorsal extension black, linear, not touching eyes; tomentum of subcallus and upper gena orange-yellow; facial tomentum and hair including beard white. Palpi yellow with black and orange-yellow pubescence, slightly stouter at base. Antennal scape and pedicel yellowish with black pubescence, flagellum orange, broad, with an obtuse but tall dorsal tooth and short black pubescence, annuli black. Eyes with greenish tint in fresh specimens, black in preserved specimens. Thorax black

### Morphometry

The body size or length measured laterally from frontal callus to the tip of the abdomen.

The frons shape was described by using following formula.

$$\text{Frons shape} = \frac{\text{Width at the vertex}}{\text{Width at the base}} \text{ in mm}$$

It was converging (ratio <1) or diverging (ratio >1) and parallel (ratio =1).

The frontal index was calculated by using following formula. (Veer, 2004) [6]

$$\text{Frontal index} = \frac{\text{Height of frons}}{\text{Width at the base of frons}} \text{ in mm}$$

The length of wing was measured from base of the costa to the tip of wing.

### 3. Results

#### Taxonomic re-description

to dark brown with two faint orange lines; scutellum black with grey tomentum on margin. Wing (12.7–13.3 mm long) hyaline with brown tinge, dark brown on costal border, pterostigma black, basicosta and subcosta setulose, black. Haltere stem brown, knob orange yellow. Coxa black with yellowish-orange long pubescence, femur orange-brown with yellow long pubescence, tibiae brown with yellow and black pubescence, tarsus black with black pubescence. Abdomen reddish-yellow, segment four to last segment black to dark brown, the black pubescence on dorsum not so thick, some grey tomentum on dorsum, segmentations narrowly paler with some yellow hairs.

**Female postabdomen:** tergite IX divided, with few black hairs, almost  $\frac{1}{3}$  width of tergite X; tergite X narrow, divided medially, setose. cerci subtriangular with margins slightly rounded, hypoproct divided, half-moon shape with highly sclerotized margins, reaching half of the cercus length. Hypogynium + hypogynial valve fused, with prominent shoulders, sparse black bristles, nearly as wide as long, basal margin straight and lateral extremities round; posterior margin with a medial indentation. Genital fork with well-developed slender arms, distal expansions and spines, moderately sclerotized; anterior margin moderately excavated with lateral

extremities pointed; spermatheca ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca capsule slender, moderately pigmented, elongate and tubular.

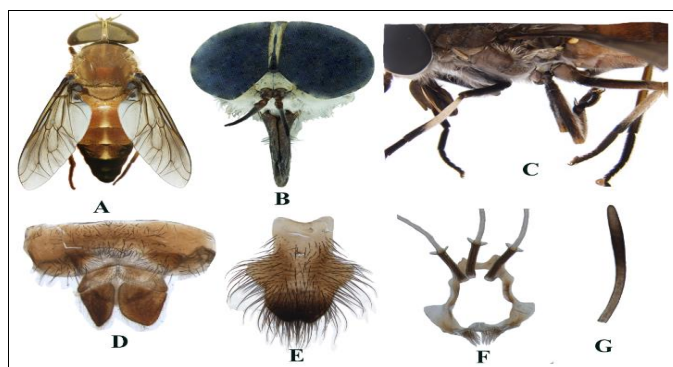
**Host:** Cattle (*Bos indicus*) and Buffalo (*Bubalus bubalis*)

**Known distribution:** Shillong (Assam) Meghalaya, Dehra Dun, Uttaranchal, Darjeeling (West Bengal), Himachal

Pradesh, Annamalai Hills and Karikal (Tamil Nadu).

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** This fly predominantly active during May to September. Preferably feed in the naval region of cattle and buffalo.



**Fig 2:** *Tabanus indianus* Ricardo. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

*Tabanus indianus* Ricardo, 1911.

*Tabanus indianus* Ricardo, 1911:175.

**Material examined:** 10♀♀, INDIA, Karnataka, Maan Village, Khanapur, 15° 40' 57.8784"N, 74° 10' 15.6396"E, 651 m, 20.iv.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*); 10♀♀, INDIA, Karnataka, Kanakumbi Village, Khanapur, 15° 41' 51.9864"N, 74° 13' 55.38"E, 651 m, 22.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 8♀♀, INDIA, Karnataka, Kusumalli Village, Khanapur, 15° 43' 31.692"N, 74° 22' 58.3932"E, 651 m, 02.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*).

**Diagnosis:** Large-sized (20–22 mm long), reddish-brown species. Head wider than thorax, frons length to width ratio 9.15; divergence index 1.75. Forehead covered with yellowish-brown tomentum and with sparsely arranged black hairs. Frontal callus laceolate, not touching the eyes, with elongate linear extension. Face covered with white tomentum, beard white. Palpi elongate, obtuse at apex, stouter at base, yellow with thick black pubescence. Eyes black in preserved specimens, wider than thorax, no ocelli. Antennal scape and pedicel brown with black pubescence, flagellum brown basally, dark apically, tall dorsal tooth with short black pubescence. Thorax covered with grey tomentum and black pubescence. Scutellum black to brown with short black and long white hairs; Wings (17.8–18.5 mm long) faintly tinged, yellow-brown on fore border and along veins, pterostigma yellowish, veins brown, first posterior cell slightly narrowed at opening; basicosta evenly setulose black; Haltere brown

with grey apex. Coxa brown, femur black to dark brown, tibia white with apical one fourth black, all tarsi black. Abdomen reddish-brown with median triangular white-haired patches from tergites II to V.

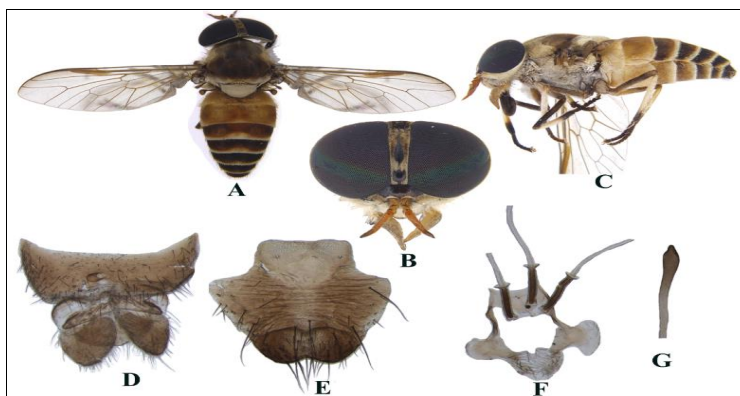
**Female postabdomen:** Tergite IX divided, almost  $\frac{3}{4}$  width of tergite X, triangular; tergite X divided, sparsely pilose, subrectangular, hypoproct rounded, reaching half of the cercus. Hypogynium + hypogynial valve fused, setose, longer than broad with prominent shoulders, posterior margin heavily sclerotised, with a shallow indentation. Genital fork with a median notch in the anterior margin, well-developed slender arms with slight distal expansions and tuft of bristles, caudal end of spermatheca ducts with cup like expansion, Spermatheca tubular, sclerotised, with rounded apex.

**Host:** Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*).

**Known distribution:** Kadra, Coorg (Karnataka); Goa; Pune (Maharashtra); Hempur nr Nainital (Uttaranchal).

**Economic importance/vector status:** mechanical transmission of *Bacillus anthracis* (Rao and Mohiyudeen, 1958)<sup>[13]</sup>

**Remarks:** This is one of the large species prevalent during April to June in the Western Ghats of Karnataka. This species is closely related to *Tabanus tenebrosus*, Walker, 1854, but can be differentiated by the presence of triangular white-haired spots/patches on abdominal tergites II to V.



**Fig 3:** *Tabanus gertrudae* Philip. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Tabanus gertrudae* Philip, 1960**

*Tabanus gertrudae* Philip, 1960:16.

**Material examined:** 7♀, INDIA: Karnataka, Kapoli K. C Village, Khanapur, 15° 39' 49.7124"N, 74° 22' 25.0284"E, 651 m, 28.iv.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*); 4♀, INDIA: Karnataka, Ckikhale Village, Khanapur, 15° 40' 12.738"N, 74° 17' 12.6996"E, 651 m, 24.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*); 12♀, INDIA: Karnataka, Nersa Village, Khanapur, 15° 35' 51.2664"N, 74° 25' 49.7532"E, 651 m, 04.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*).

**Diagnosis:** small sized (7–8 mm long) dark brown species. Frons length to width ratio 6.8, (divergence index, 2). basal callus quadrate, bulged with furrow in the middle, lower margin convex, not touching eyes; median callus black, oblong, black pubescence at vertex. Face covered with grey tomentum and long yellowish-white hairs. Beard yellow; palpi stout ending in an acute point, light grey from outside, densely covered with yellow tomentum and short black pubescence. Antenna yellowish-brown, dark apically, scape and pedicel with black pubescence. Eyes black with green coloured band diagonally across the eye, with faint yellow upper margin in freshly collected flies. No ocelli. Thorax brown with grey tomentum and yellow pubescence, posterior margin white with yellow pubescence at middle and white at lateral margin. pleuron grey with yellow hairs. Scutellum predominantly white with yellow pubescence. Wing (6.5–7.8 mm long) hyaline, basicosta and subcosta setulose black, appendix absent, pterostigma brown. Haltere brown. Coxa and trochanter grey; femora dark brown to black, tibiae creamy white with apical one-fourth black, tarsi black.

Abdomen basal tergites I and II yellowish brown with narrow white-haired pubescence. Tergites III to VI black with narrow, transverse apical white bands; bands on tergites III and IV produced medially.

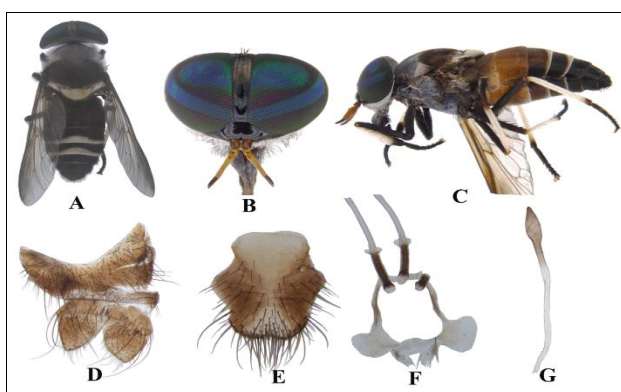
**Female postabdomen:** tergite IX divided with few black hairs, almost  $\frac{3}{4}$  width of tergite X; tergite X divided, but closely united by a membrane; cerci subtriangular with margins rounded; hypoproct rounded with acuminate lower margin, reaching more than half of the cercus length. Hypogynium + hypogynial valve fused, broader than long with prominent shoulders, apex heavily sclerotized with a medial indentation/notch. Genital fork with slender arms, distal expansions and tuft of bristles, moderately sclerotized; anterior margin moderately excavated with lateral extremities pointed; spermatheca ducts long, with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca slender, slightly expanded with an apical teat.

**Host:** Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*).

**Known distribution:** Karnataka, Assam, Megalaya, Tamil Nadu, Dehra Dun and Uttaranchal.

**Economic importance/vectors status:** Not recorded as a vector.

**Remarks:** This fly is active before rainfall during March and April in northern part of Western Ghats of Karnataka. It is closely related to *Tabanus biannularis* Philip, 1960, but can be differentiated by the presence of bands on abdominal tergites III to VI.



**Fig 4:** *Tabanus biannularis* Philip. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Tabanus biannularis* Philip, 1960.**Syn. *Tabanus bicinctus* Ricardo, 1911: 132.

**Material examined:** 25♀♀, INDIA: Karnataka, Kankumbi Village, Khanapur, 15° 41' 51.9864"N, 74° 13' 55.38"E, 651 m, 22.v.2019, Coll. Raju Metri, Ex. *Bos indicus*; 17♀♀, INDIA: Karnataka, Jamboti Village, Khanapur, 15° 40' 59.7036"N, 74° 21' 37.0224"E, 651 m, 26.iv.2019, Coll. Raju Metri, Ex. *Bos indicus*;

**Diagnosis:** Small-sized (9.5–10.5 mm long) black species. Frons length to width ratio, 7.73 (frontal index 6.3; divergence index 1.67). Basal callus glossy black, broad touching the eyes, median callus glossy black, spindle shaped, separate from basal callus, subcallus glossy black. Face covered with pale tomentum and long white hairs, beard white; palpi stout, acute apically, light grey from outside, covered densely with white tomentum and short black pubescence. Antenna with reddish, scape and pedicel with black pubescence. Eyes black with a diagonal fluorescent green band and a fluorescent green patch near vertex. Thorax grey before transverse suture, black post transverse suture, pleuron grey with thick tuft of black hairs at base of wing. Scutellum predominantly white with grey tomentum, dense white pubescence. Wings (8.6–9.4 mm long), haltere brown; basicosta and subcosta setulose black, tinged brown on anterior margin till R<sub>4</sub> vein, pterostigma brown, costal margin yellow and anal margin hyaline. Coxa with long white pubescence, femur black, tibia white, black at apex, tarsus black. Abdomen black with prominent white bands on third and fourth tergite. Second tergite having narrow white pubescence and remaining with dense black pubescence.

Venter of second to fourth abdominal tergites ends with white pubescence.

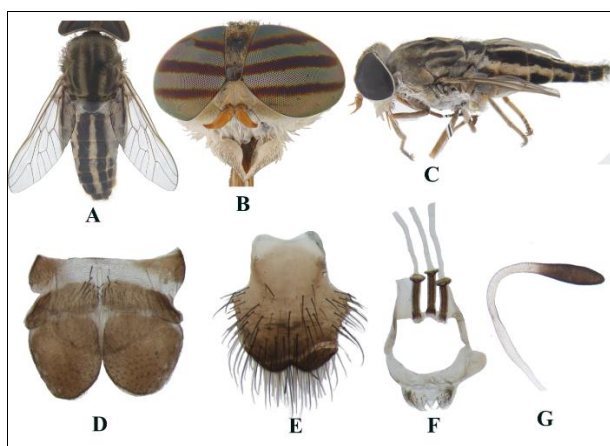
**Female postabdomen:** tergite IX divided almost ½ width of tergite X; tergite X divided, rectangular; cerci with margins rounded and apex slightly acuminate; hypoproct rounded, reaching half of the cercus length. Hypogynium + hypogynial valve fused, quadrate with prominent shoulders, posterior margin with a shallow indentation medially, poorly sclerotized with few long bristles. Genital fork with slender arms, prominent distal expansions and two tufts of strong bristles at apex; anterior margin moderately concave with lateral extremities pointed; spermatheca ducts long, caudal end with cup like expansion. Spermatheca elongate, spindle shaped.

**Host:** Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*).

**Known distribution:** India: North Karnataka, Pollibetta and Sambaji Ghat Coorg, Annamalai Hills (Kerala) Darjeeling (West Bengal), Mohand (Dehra Dun), Uttaranchal.

**Economic importance/vector status:** mechanical transmission of *Bacillus anthracis* (Rao and Mohiyudeen, 1958)<sup>[13]</sup>.

**Remarks:** This fly was active before rainfall during April and May in northern part of Western Ghats of Karnataka. This species is closely related to *Tabanus gertrudae* Philip, 1960, but can be differentiated by the presence of only two bands on abdomen.



**Fig 5:** *Tabanus dorsilinea* Wiedemann. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Tabanus dorsilinea* Wiedemann, 1824***Tabanus dorsilinea* Wiedemann, 1824:22.

**Material examined:** 13♀♀, INDIA, Karnataka, Modga Village, Hukkeri, 16° 3' 22.4784"N, 74° 24' 36.144"E, 650 m, 11.ix.2019, Coll. Raju Metri, Ex. Buffalo (*Bubalus bubalis*).

**Diagnosis:** small size (9–10 mm long), black species. Frons length to width ratio 5.23, (divergence index 2), frons yellowish brown with rectangular basal callus touching eyes, separate from median callus (irregular shaped), subcallus white pruinose; face covered with grey tomentum and white pubescence, beard white; palpi grey, with sparsely arranged white and black hairs. Eye black in preserved specimens, banded in fresh specimens with three reddish bands, ocelli

lacking. Antenna with scape, pedicel yellow with black pilosity, basal plate broad, yellowish with a raised dorsal projection, style with 4 segments much smaller than basal plate. Thorax grey with three longitudinal, black stripes, medial one extending till the tip of scutellum. Wing (8.7–9.4 mm long) hyaline, stigma and veins yellow; haltere stem creamy yellow to yellowish brown, knob whitish yellow. Legs uniformly reddish yellow, only tarsi a little darker; femora with grey tomentum and white pubescence. Abdomen narrow, black with three white stripes across tergites I to VI.

**Female postabdomen:** tergite IX divided, roughly triangular with acuminate medial edge and rounded lateral margins, few black hairs, almost ½ width of tergite X; tergite X divided into two, subrectangular; cerci with short bristles, margins

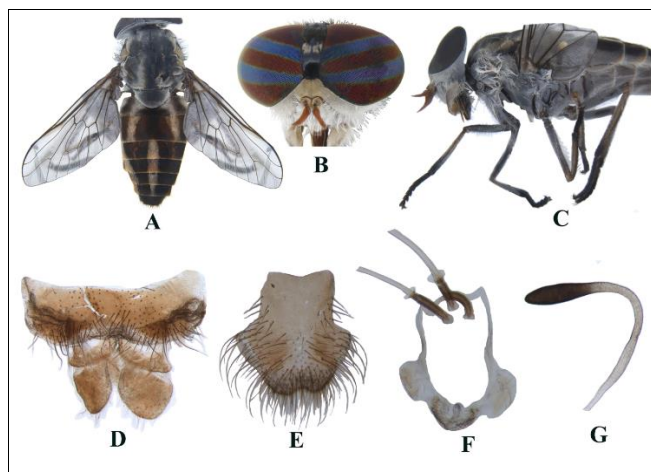
round; hypoproct roughly oval, reaching half of the cercus length. Hypogynium + hypogynial valve fused, anterior margin concave with lateral extremities rounded, longer than wide, posterior margin with a shallow depression, highly sclerotized with long bristles. Genital fork poorly sclerotized with slender arms, slight distal expansions and two tufts of bristles at apex; anterior margin straight with lateral extremities acuminate; spermathecal ducts long, stem with cup like expansions, spermatheca elongate with apex clavate, pigmented.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** wide spread and common species in the southern and western parts of India.

**Economic importance/vector status:** mechanical transmission of surra disease in domestic animals (Singh, 1926; Burton 1978) <sup>[14, 10]</sup>.

**Remarks:** This fly active during August to February, preferably feeds at naval region of Cattle and Buffalo. This species is closely related to *Tabanus triceps* Thunberg, 1827, but can be differentiated by the small size and all three stripes reaching from tergite I to VI.



**Fig 6:** *Tabanus jucundus* Walker. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### *Tabanus jucundus* Walker, 1848

*Tabanus jucundus* Walker, 1848:187.

**Material examined:** 3 ♀♀, INDIA, Karnataka, Modga Village, Hukkeri, 16° 3' 22.4784"N, 74° 24' 36.144"E, 650 m, 11.ix.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*).

**Diagnosis:** Small sized (9–10 mm long), dark brown species. Frons length to width ratio, 5.3, slightly divergent above (divergence index 1.67), basal callus brownish-black, rectangular, filling approximately the lower 2/5 of frons; subcallus with very pale yellowish tomentum; face with white tomentum, ventral aspect fairly greyish and white hairs including beard. Palpus creamy white with sparse black hairs. Eyes black in preserved specimens, in fresh specimens, red with two, fluorescent blue, diagonal bands, ocelli absent. Antennal scape white-haired, with black hairs on and near dorsal apex; flagellum orange, the apical annulus darkened at the tip, dorsal tooth of plate obtuse to rounded. Thorax with grey black with two incomplete white stripes, scutellum black with grey margins. Wing (8.4–9.6 mm long) hyaline with yellow pterostigma, veins dark and basicosta evenly setulose. Haltere stem pale yellow, knob yellowish white. Coxa, trochanter, femur, grey with white hairs; fore tibia brownish yellow with pale hairs all tarsi black. Abdomen striped, black, with three creamy white stripes, median stripe starts at the base of the tergite III and ends at tergite VI; sublateral white stripes on tergites I & II, lateral white stripes extend from tergites I–VI.

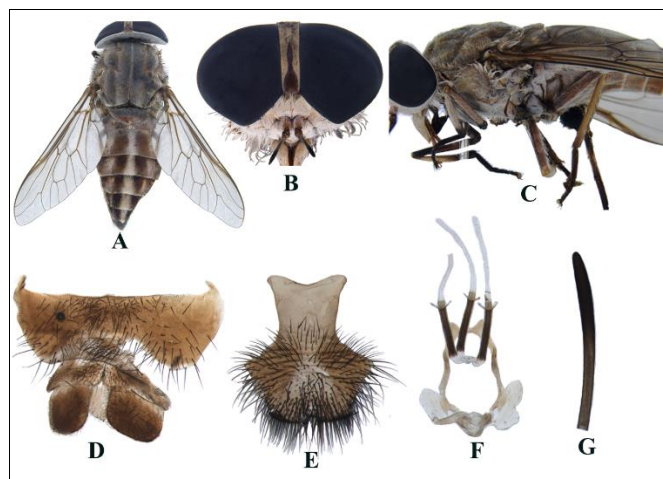
**Female postabdomen:** tergite IX divided, with long black bristles, almost ¾ width of tergite X, subtriangular with margins slightly rounded; tergite X divided into two; cerci with sparse light black hairs, margins rounded; hypoproct rounded, almost on the half of cercus. Hypogynium + hypogynial valve fused, base moderately sclerotized, concave with lateral extremities rounded, length to width almost same. Genital fork poorly sclerotized with slender arms, slight distal expansions and two tufts of bristles at apex; anterior margin convex with lateral extremities round; spermathecal ducts long, stem with cup like sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca black, clavate.

**Host:** Cattle and Buffalo.

**Known distribution:** India: Uttaranchal, Maharashtra.

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** This species is recorded for the first time from Karnataka, prevalent in August to October and January, February months. Preferably feeds on naval region of cattle and buffalo. This species is closely related to *Tabanus dorsilinea* Wiedemann, 1824, but can be differentiated by the size and white median stripe begins at the base of the tergite III and ends at tergite VI; sublateral white stripes occur only on tergite I and II.



**Fig 7:** *Tabanus rubidus* Wiedemann. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### ***Tabanus rubidus* Wiedemann, 1821**

*Tabanus rubidus* Wiedemann, 1821:69-70

**Material examined:** 2♀♀, INDIA, Karnataka, Malagi Village, Mundagod, 14° 45' 26.5716"N, 74° 1' 3.7812"E, 634 m, 23.vi.2019, Coll. Raju Metri, Ex. Bullock (*Bos indicus*).

**Diagnosis:** Medium sized (16–17 mm long), brownish species. Frons length to width ratio, 4.9, (divergence index 1.4) tomentum yellowish, yellowish-brown when viewed from below; frontal callus reddish brown, acuminate, truncated below, dorsal extension spindle shaped. Subcallus and upper cheek corners white; face and beard white with white hairs. Basal segment of palpus creamy-white with a few black hairs, apical segment white-haired with scattered black hairs. Eyes black, wider than thorax, no ocelli. Antennal scape reddish with white and black-hairs; pedicel not broad, dorsal tooth acute; flagellum entirely black but with orange basal segment. Thorax with dorsum brownish-grey, black and orange-haired centrally; poorly defined areas of paler tomentum create a striped appearance; pleuron grey with long white hairs. Scutellum bicolorous, with the base dark and the apex orange-brown. Wing (12.5–13.6 mm long) basicosta evenly setulose, hyaline, veins brown; haltere stem yellow, knob yellowish white. Coxa grey with white hairs; fore femur, inner face orange-brown, outer face whitish to grey with white hairs; middle and hind femora orange-brown with white hairs; fore tibia white, dark at apex, middle and hind tibiae pale with pale hairs on inner face and black hairs on outer face; all tarsi black. Abdomen brown to black with three white stripes, median stripe on tergites one to six, which appear as a series of connected narrow triangles, lateral stripe on tergites two to five, venter dull orange.

**Female postabdomen:** tergite IX divided, almost  $\frac{3}{4}$  width of tergite X, subtriangular with lateral margin concave,

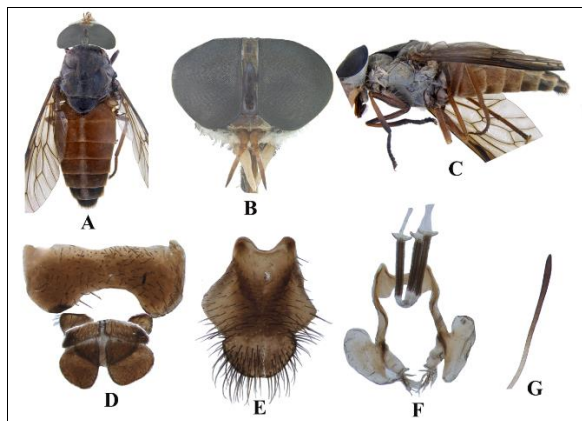
acuminate medially; Tergite X divided into two pieces closely united by a membrane, short bristles, lateral and lower margins concave, upper margin straight; cerci square with margins rounded, sparse light black hairs. Hypoproct rounded, more than half length of cercus. Hypogynium + hypogynial valve fused, vase shaped, prominent shoulders, longer than wide, concave basally with lateral extremities rounded, black bristles, apex with notch and tuft of long black bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin concave with lateral extremities round; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca slender, highly pigmented with rounded apex.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** wide spread and common species in the Indian sub-region.

**Economic importance/vector status:** mechanical transmission of *Trypanosoma evansi* (Basu *et al.*, 1952)<sup>[8]</sup>; *Trypanosoma theileri* (Kraneveld, 1931)<sup>[15]</sup>; *Bacillus anthracis* (Nieschulz, 1929a)<sup>[16]</sup>; *Clostridium chauvoei* (Nieschulz and Huber, 1928)<sup>[17]</sup> and *Pasteurella multocida* (Nieschulz and Kraneveld, 1929b)<sup>[18]</sup> in domestic animals.

**Remarks:** This fly is predominantly found in the months of May to July and November to February. Preferably feed on fetlock region of cattle and Buffalo. It is closely related to *Tabanus triceps* Thunberg, 1827, but can be differentiated by presence of median stripe of pale tomentum on tergite I to VI, which appear as a series of connected narrow triangles on abdomen.



**Fig 8:** *Tabanus auristriatus* Ricardo. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### *Tabanus auristriatus* Ricardo, 1911

*Tabanus auristriatus* Ricardo, 1911:161

**Material examined:** 2♀♀, INDIA, Karnataka, Kankumbi Village, Khanapur, 15° 41' 51.9864"N, 74° 13' 55.38"E, 651 m, 22.v.2019, Coll. Raju Metri, Ex. Bullock (*Bos indicus*).

**Diagnosis:** Medium sized (15.5–16.5 mm long) chestnut brown species. Frons length to width ratio 4.99. Frons narrow, parallel sided, frontal callus reddish-brown, long, narrow, not reaching the eyes, prolonged as a thick line just beyond the middle of forehead (frontal index 4.6; divergence index 1). Face covered with pale grey white tomentum on lower part; subcallus and forehead covered with yellowish brown tomentum, pubescence on face scanty, black, beard sparse, white. Palpi long, narrow, yellowish white with white pubescence. Eyes black in preserved specimens, bigger than thorax, no ocelli. Antenna long, slender, scape and pedicel pale orange with black and white hairs, flagellum orange yellow, black at apex, with a small tooth. Scutum and scutellum covered with very short yellow and black pubescence, sides with yellowish white and black hairs. Wing (13.8–14.4 mm long) tinged brown on fore margin, paler on the posterior margin, stigma dark brown, veins brown, basicosta setulose. Haltere brown with grey at apex. Coxa grey with long grey pubescence, femur orange brown with white hairs lateral and black hairs medial side; tibia brownish yellow with yellow hairs and black at with black hairs; tarsus black with black hairs; middle and hind legs orange yellow with white hairs but tarsus with black hairs. Abdomen chestnut brown anterior, darker at apex, with black and golden yellow pubescence, the median stripe is indistinct, chiefly marked by the golden yellow hairs which also border the segmentations; Venter brown with white-haired segmentations.

**Female postabdomen:** tergite IX divided with few black hairs, almost  $\frac{3}{4}$  width of tergite X; Tergite X divided into two pieces with few long hairs and narrow internal lateral margins, creating a membranous space between the contact area of the internal lateral margins and tergite IX, rounded on lateral margins with few long hairs; cerci subtriangular with margins slightly rounded. Hypoproct rounded, almost on the half of cercus. Hypogynium + hypogynial valve fused, prominent shoulders, length and width almost equal. Indentation basally with lateral extremities rounded, black bristles, apex semi-circular with tuft of long black bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin concave with lateral extremities acuminate; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca capsule slender, heavily pigmented, apex rounded.

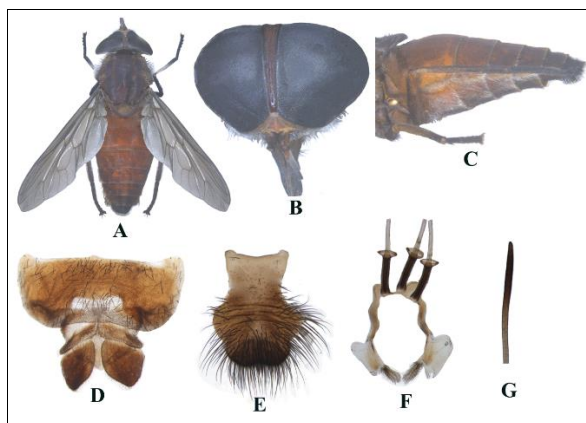
**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** Oriental region (India: Northern Karnataka, Kerala, Tamil Nadu, Uttarakhand; Myanmar)

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** This species is active during rainy season in north Karnataka, prefers to feed on udder and teat region of cattle and Buffalo. It is closely related to *Tabanus triceps* Thunberg, 1827 but can be differentiated by single indistinct median stripe from tergite I to VI.





**Fig 9:** *Tabanus tenebrosus* Walker A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### *Tabanus tenebrosus* Walker, 1854

*Tabanus tenebrosus* Walker, 1854:242

**Material examined:** 2♀, INDIA, Karnataka, Ckikale Village, Khanapur, 15° 40' 12.738"N, 74° 17' 12.6996"E, 651 m, 24.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*).

**Diagnosis:** Large sized (20–21mm long) dull reddish brown species. Frons length to width ratio 9.24 (divergence index 1.75) velvety brown, wider towards vertex. Frontal callus reddish and elongate oval shaped with fine threadlike linear extension, not reaching eyes; subcallus, cheeks and face velvety brown. Face and subcallus covered with yellowish brown tomentum, the former with pretty long blackish brownish hairs in the middle and on the cheeks, beard blackish brown. Eyes black in preserved specimen; ocelli absent. Antenna reddish yellow, scape and pedicel with black pubescence, flagellum black at apex. Palpi appear black with black pubescence. Thorax reddish-black shoulders reddish, sides with black hairs. Scutellum reddish brown, covered with grey tomentum. Wing (17.5–18.6 mm long) basicosta setulose, anterior (up to R<sub>4</sub> vein) dark brown and posterior hyaline, no appendix. Haltere brown with grey apex. Coxa black with white pubescence; femur black with white and black pubescence; fore tibiae whitish at basal two third and black at apex, middle and hind tibiae dull reddish, pubescence entirely black; tarsus black. Abdomen reddish-brown with black pubescence and black at apices, lateral borders with greyish brown pubescence.

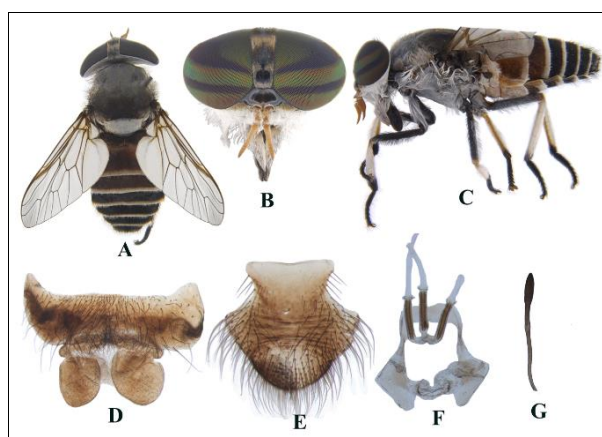
**Female postabdomen:** tergites IX and X, cerci and hypoproct: tergite IX divided (not fused), with few black hairs, almost ½ width of tergite X; tergite X divided rounded on lateral margins with short bristles; cerci subtriangular with margins slightly rounded. Hypoproct with apex slight acuminate, reaching half of the cercus length. Hypogynium + hypogynial valve fused, vase shaped, prominent shoulders, longer than wide, concave basally with lateral extremities rounded, black bristles, apex heavily sclerotized with indentation and tuft of long black bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin concave with lateral extremities rounded; spermatheca ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca capsule slender, heavily pigmented, apex rounded.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** India: Northern Karnataka.

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** It is active during late summer in north Karnataka. It prefers to feed on udder and teat region of cattle and Buffalo. It is closely related to *Tabanus indianus* Ricardo, 1911 but can be differentiated by absence of triangular white-haired spots from tergite II to V.



**Fig 10:** *Tabanus sexcinctus* Ricardo. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Tabanus sexcinctus* Ricardo, 1911***Tabanus sexcinctus* Ricardo, 1911:133

**Materials examined:** 12♀♀, INDIA: Karnataka, Shippur Village, Hukkeri, 16° 20' 47.0904"N, 74° 23' 6.5616"E, 650 m, 11.x.2019, Coll. Raju Metri, Ex. Buffalo (*Bubalus bubalis*)

**Diagnosis:** Medium sized (11–13 mm long) black species. Frons length to width ratio is 4.9, slightly divergent above (divergence index 1). Basal callus black square, overall to rounded above and uneven below, median callus irregular and variable, smaller than basal callus, \subcallus bare and shining, brownish black, orange brown at midline. Upper cheek corner with brown tomentum and some brown hairs, remainder of face with greyish white to white tomentum and white hairs including beard. Basal segment of palpus pale grey with white hairs; apical segment pale grey becoming creamy yellow at tip, with white hairs basally and mixed white and black hairs beyond the tip. Antennal scape with black hairs above and white hairs below, pedicel similar to scape; flagellum orange, with a low, obtuse dorsal tooth; apex darkened. Eyes in fresh specimen with two dark blue bands on green field, no ocelli. Scutum grey with white hairs in anterior half, black posterior half; scutellum with whitish grey tomentum and mixed black and white hairs. Wing (13.7–14.4 mm long) hyaline pterostigma yellow, venation yellowish; no appendix; haltere stem brownish yellow; Coxa pale grey with white hairs; femur black except for yellow apex, with white hairs except some black hairs on fore femur; tibiae white with apex black tarsi black. Abdomen predominantly black with white transverse bands on tergites II -VI.

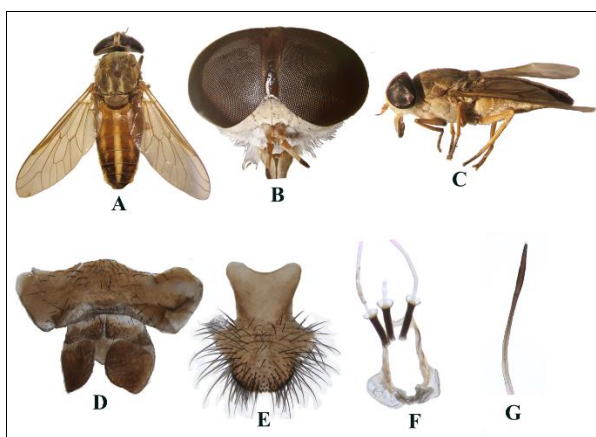
**Female postabdomen:** tergite IX divided with narrow space between internal lateral margin, short black bristles, almost  $\frac{3}{4}$  width of tergite X; tergite X divided into two, rounded lateral margins with short bristles; cerci sub circular with short bristles. Hypoproct rounded, reaching half of the cercus length. Hypogynium + hypogynial valve fused, vase shape, prominent shoulders, length to width almost same, basal margin straight, lateral extremities rounded, apex round with tuft of long black bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin straight with lateral extremities rounded; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermathecal capsule ellipsoid with rounded apex and highly pigmented.

**Host:** Cattle (*Bos indicus*), Buffalo (*Bubalus bubalis*).

**Known distribution:** India:Karnataka, Assam and Uttaranchal. Myanmar, China and Thailand.

**Economic importance/vectors status:** Not recorded as a vector.

**Remarks:** It is active during October and November, northern part of Western Ghats of Karnataka. Preferred feeding site was base of the tail. This species is closely related to *Tabanus gertrudae* Philip, 1960, but can be differentiated by the presence of white transverse bands on abdominal tergite II to VI and larger size.



**Fig 11:** *Tabanus triceps* Thunberg. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Tabanus triceps* Thunberg, 1827***Tabanus triceps* Thunberg, 1827:59

**Material examined:** 3♀♀, INDIA, Karnataka, Chikhale Village, Khanapur, 15° 40' 12.738"N, 74° 17' 12.6996"E, 651 m, 24.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 2♀♀, INDIA, Karnataka, Sonda village, Sirsi, 14° 44' 6.09"N, 74° 28' 57.2376"E, 576 m, 21.v.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*).

**Diagnosis:** Medium sized (14–15 mm long) reddish-brown species. Frons length to width 4.3 (divergence index 1.25), covered with yellowish grey tomentum and short white pubescence. Frontal callus shining, reddish-brown, oblong, not touching eyes. Face grey haired, white pubescent, beard

white, palpi light yellow, white tomentum with some curved black hairs. Eyes bare, black in preserved specimens; Ocelli absent. Antennal scape orange yellow with yellowish white hairs; pedicel orange yellow with sparsely black and yellowish white hairs; flagellum orange yellow with grey tomentum and tip of annuli black. Scutum reddish brown with three indistinct 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 margin. Wing (11.3–12.5 mm long) basicosta evenly setulose, hyaline, pterostigma brownish, veins reddish. Haltere brownish with white knob. Coxa yellowish brown with long white hairs; fore femora rusty reddish, with black hairs on upper sides. Middle and posterior pair yellowish brown with grey tomentum, pubescent

predominantly white. Tibia yellowish brown with grey tomentum, tarsi reddish brown with black pubescence. Abdomen long and slender, ranging from reddish brown to blackish brown, the median stripe continuous, reaching the sixth segment, composed of oblong grey tomentum spots slightly narrower at their apices on the second and third segment, the side stripes usually prolonged very distinctly to the fourth segment, appearing on the fifth as an indistinct spot, the sides of abdomen white with white hairs, the pubescence on dorsum black, white on the stripes. Venter reddish yellow or darker covered with grey tomentum.

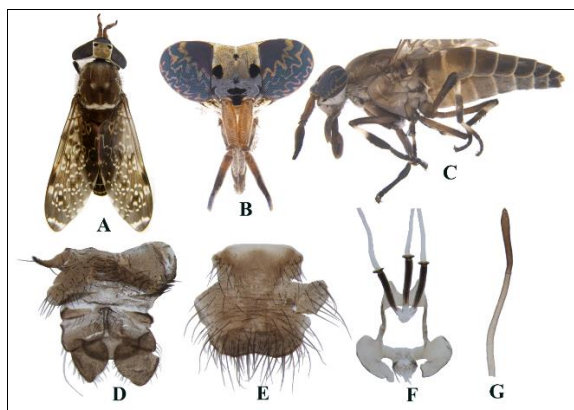
**Female postabdomen:** tergites IX and X, cerci and hypoproct: tergite IX divided with few black hairs, almost  $\frac{3}{4}$  width of tergite X, subtriangular with margins slightly rounded, upper margin straight, lateral margin rounded, acuminate medially; Tergite X divided into two pieces closely united by a membrane, roughly trapezoid shape with rounded edges, short bristles; cerci sub circular with short bristles. Hypoproct rounded, reaching half of the cercus length. Hypogynium + hypogynial valve fused, vase shape, prominent shoulders, longer than wide, concave basally with lateral extremities rounded, black bristles, apex moderately sclerotized with long black bristles. Genital fork with slender arms, slight distal expansions and two tufts bristles at apex; anterior margin concave with lateral extremities rounded; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca slender, heavily pigmented with slightly acuminate apex.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Distribution:** India: common and widespread throughout the country.

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** Medium size species prevalent during May to July in the Western Ghats of Karnataka. This species is closely related to *Tabanus dorsilinea* Wiedemann, 1824, but can be differentiated by the large size and side stripes reaching from tergite I to V.



**Fig 12:** *Haematopota montana* Ricardo. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

*Haematopota montana* Ricardo, 1917

*Haematopota montana* Ricardo, 1917:225

**Material examined:** 36♀♀, INDIA, Karnataka, Maan, Khanapur, 15° 40' 57.8784"N, 74° 10' 15.6396"E, 651 m, 20.vi.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*) and Buffalo (*Bubalus bubalis*); 15♀♀, INDIA, Karnataka, Ckikale village, Khanapur, 15° 40' 12.738"N, 74° 17' 12.6996"E, 651m, 24.v.2019, Coll. Raju Metri, Ex. Bullock (*Bos indicus*).

**Diagnosis:** Small sized (7.5–8.5 mm long) greyish brown species. Frons greyish brown with width at vertex about 0.78 of height, slightly widened below, frontal index, 1.1; (divergence index 0.9) midfrontal spot small; paired spots large, circular touching eyes, separated from callus; callus brown, about three times as wide as high, touching eyes broadly, upper margin with small median projection, lower margin weakly curved; subcallar area with large black interantennal spot; face and parafacials greyish yellow, upper face often with pair of dark spots, upper parafacial irregularly mottled with dark brown; beard white. Eye bare, bigger than thorax, three green zig-zag bands, no ocelli. Antennal scape shiny dark reddish, pedicel with small dorsal projection; flagellum reddish brown, blackened distally, long and slender, first flagellomere slightly shorter than scape, tapering only slightly distally. Palpus dark reddish grey with black hair. Scutum brown with distinct pair of triangular spots behind transverse suture and with strong prescutellar grey band that includes prescutellar sclerite; scutellum dark; pleuron grey. Wing (7.3–8.7 mm long) brown with pale spots in usual pattern; subapical band complete, slightly broad and nearly straight; all posterior cells with strong pale triangles. Haltere with brown knob. Fore coxa grey, darkened near apex; femur dark brown; fore tibia about two-fifths white; midtibia with two pale bands; hind tibia with basal white band and indistinct pale subapical spot; basitarsi of midleg and hind leg white on basal half. Dorsum of abdomen dark brown with pale incisures, narrow mid dorsal stripe, and pale sublateral spots on posterior terga; venter dark with rather broad grey incisures.

**Female postabdomen:** tergite IX divided with few black hairs, almost  $\frac{3}{4}$  width of tergite X, rounded margins, medially acuminate; tergite X divided into two pieces closely united by a membrane, roughly trapezoid shape with rounded edges, short bristles; cerci subcircular, acuminate apex with short bristles. Hypoproct ellipsoid, reaching half of the cercus length. Hypogynium + hypogynial valve fused, prominent shoulders, length to width almost same, basal margin straight, lateral extremities rounded, apex heavily sclerotized with indentation and long bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin deeply concave with lateral extremities rounded; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermathecal capsule ellipsoid, highly pigmented with acuminate apex.

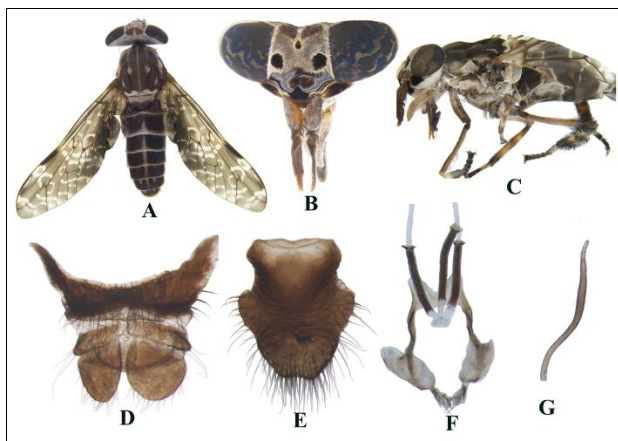
**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** India: Bababuddin Hills, Coorg (Karnataka); Anaimalai Hills; Nilgiri Hills (Tamil Nadu)

Shillong (Meghalaya); Mapum (Manipur).

**Economic importance/vector status:** mechanical transmission of *Bacillus anthracis* (Rao and Mohiyudeen, 1958)<sup>[13]</sup>.

**Remarks:** this species active during May to July in Western Ghats region. It is closely related to *Haematopota brevis* Ricardo, 1906, but can be differentiated by subapical band complete, slightly broad and nearly straight; all posterior cells with strong pale triangles.



**Fig 13:** *Haematopota javana* Wiedemann. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

*Haematopota javana* Wiedemann, 1821

*Haematopota javana* Wiedemann, 1821:100

**Material examined:** 8♀♀, INDIA, Karnataka, Modga village, Hukkeri, 16° 3' 22.4784"N, 74° 24' 36.144"E, 650 m, 11.ix.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 2♀♀, INDIA, Karnataka, Bhairapur village, Hukkeri, 16° 18' 30.1788"N, 74° 22' 13.9728"E, 650m, 12.ix.2019, Coll. Raju Metri, Ex. Buffalo (*Bubalus bubalis*).

**Diagnosis:** Small sized (9.5–10.5 mm long) greyish brown species. Frons reddish grey, width at vertex about 0.85 of height, (divergence index 0.85) distinctly widened below; midfrontal spot reddish brown; paired spots medium sized to rather large, reddish brown to black, separated from eyes and callus; callus glossy, orange brown, touching eyes, both upper and lower margins sinuous; upper face and upper parafacials black, forming three separated spots; rest of lower head nearly white with long white hair. Eye bare, broader than thorax, with green zig-zag bands, no ocelli. Antenna orange brown; scape and pedicel with black hairs; scape slightly enlarged distally; pedicel short with distinct dorsal projection; flagellum compressed laterally. Palpus yellow with pale hairs. Scutum brown with yellowish-grey markings as follows: slender median stripe; triangular submedian spot behind transverse suture, often with slender anterior stripe to it; slender, short, sublateral stripe posteriorly; broad lateral stripe from humerus to above wing base; two broad prescutellar patches, pleuron yellowish gray, scutellum with basal half white. Wing (8.6–9.5 mm long) brown with pale markings mostly in curved streaks rather than small spots; subapical band slender, sinuous, usually with second, often less distinct

band beyond it; posterior cells except cell 4 with large marginal triangles; costal cell brown with pale spot at apex. Haltere with brown knob. Coxae grey, fore coxa darkened on distal half; femora yellowish brown, apex of hind femur darkened; fore tibia slightly swollen, brown, basal two-fifths pale; midtibia with two broad pale bands; hind tibia distinctly enlarged with two rather distinct pale bands; midbasitarsus and hind basitarsus pale; hind femur with unusually long hairs near apex, distal ones black, more basal ones white; hind tibial fringe strong. Abdomen brown with pale incisures, grey laterally on terga II-IV, slender middorsal stripe on tergite II-V, expanding posteriorly on II. Venter yellowish grey with broad central brown stripe on posterior tergite.

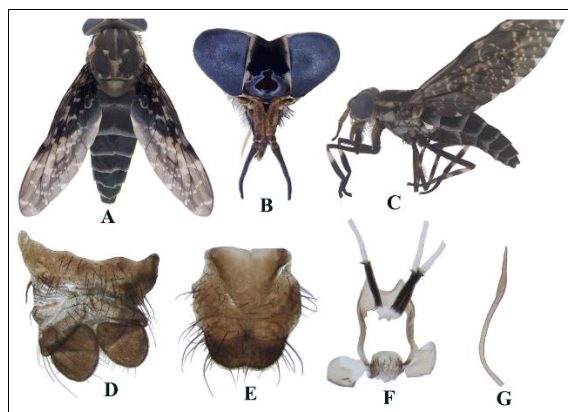
**Female postabdomen:** tergite IX divided with few black hairs, almost  $\frac{3}{4}$  width of tergite X, rounded margins, medially acuminate; Tergite X divided into two pieces closely united by a membrane, sub rectangular shape with rounded edges, short bristles; cerci sub circular with short bristles. Hypoproct ellipsoid, reaching half of the cercus length. Hypogynium + hypogynial valve fused, vase shape, heavily sclerotized, prominent shoulders, longer than wide, basal margin concave, lateral extremities rounded, indentation at apex with long bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin deeply concave with lateral extremities rounded; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermathecal capsule slender, moderately pigmented, tapering towards apex.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Distribution:** widespread and common species in India.

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** This species commonly active during September and October in Western Ghats of Karnataka. It feeds on neck region of cattle and buffalo. It is closely resembling *Haematopota longipennis* Stone and Philip, 1974, but can be differentiated by compressed flagellum, reddish midfrontal and paired spots and apical band of wing.



**Fig 14:** *Haematopota Longipennis* Stone and Philip. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Haematopota Longipennis* Stone and Philip, 1974***Haematopota Longipennis* Stone and Philip, 1974: 135

**Material examined:** 6♀♀, INDIA, Karnataka, Kanasur village, Siddapura, 14° 31' 6.9276"N, 77° 50' 0.8916"E, 576 m, 24.vi.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 5♀♀, INDIA, Karnataka, Antravalli village, Kumata, 14° 28' 27.1488"N, 74° 27' 53.5608"E, 20 m, 22.vi.2019, Coll. Raju Metri, Ex. Cow (*Bos indicus*).

**Diagnosis:** Small sized (9.4–10.3 mm long) brownish species. Frons width at vertex about 0.68 of height and widened below, frontal index, 1.2; (divergence index 0.8) frons with large dark-brown obscuring midfrontal and paired spots; broadly touching callus, narrowly separated from eyes by pale yellowish-brown area. callus shiny, protuberant, smooth, yellowish brown, broadly touching eyes, convex above, nearly straight below; subcallus area with shiny triangle, concolorous with callus; face and clypeus greyish, mottled with brownish above; beard pale brownish. Eyes bare, bigger than thorax and black in preserved specimens; no ocelli. Antenna long and slender, yellowish brown; scape cylindrical, with black hair; pedicel short and stout with distinct dorsal projection; flagellum very slender. Palpus yellowish brown. Scutum dark brown with yellowish-grey markings, very slender median stripe that widens before scutellum and ends in broad spot on scutellum not reaching hind margin; pair of slender submedian stripes, broad anteriorly but rapidly tapering and evanescent posteriorly, not reaching pair of postsutural spots; humerus and broad lateral stripe to above wing base; pair of crescentic transverse spots anterior to scutellum; pleuron grey with distinct darker central spot. Wing (8.4–9.7 mm long) brown with moderately coarse pale spots in usual pattern; subapical band a straight oblique stripe from anterior margin and large posterior marginal spot near center of cell R<sub>4</sub>; posterior cells 1, 3, and 5 usually with large marginal spots, cell 2 with very small one; distinct darker spot at furcation. Haltere creamy white. Fore coxa pale basally, darker apically; fore and hind femora dark, midfemur slightly paler; fore tibia white on basal third; midtibia and hind tibia each with two pale bands. Abdomen dark brown with grey incisures.

**Female postabdomen:** tergite IX divided with few black hairs, almost ¾ width of tergite X; tergite X rectangular shape with rounded edges, long bristles, divided into two pieces with internal lateral margins widened, creating a membranous space between the contact area of the internal lateral margins and tergite IX; cerci circular with short bristles; Hypoproct ellipsoid, reaching half of the cercus length. Hypogynium + hypogynial valve fused, as wide as long, basal margin straight, lateral extremities rounded, apex heavily sclerotized with indentation and long bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin deeply concave with lateral extremities acuminate; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermathecal capsule slender, moderately pigmented, tapering towards apex.

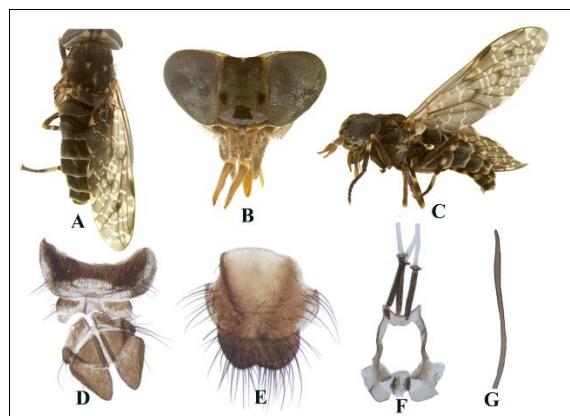
**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** India: Coorg (Karnataka); Nilgiri Hills

(Tamil Nadu) and Malabar (Kerala).

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** large species active during June and July in Western Ghats of Karnataka. Preferably feed on the neck and dewlap region of cattle and buffalo. It is closely related to *Haematopota javana* Wiedemann, 1821, but it can be differentiated by frons with large dark-brown patch surrounding and obscuring midfrontal and paired spots, subapical band of wing.



**Fig 15:** *Haematopota brevis* Ricardo. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

***Haematopota brevis* Ricardo, 1906***Haematopota brevis* Ricardo, 1906:122

**Material examined:** 3♀♀, INDIA, Karnataka, Adakalli, Siddapura, 14° 31' 2.4888"N, 74° 48' 37.7892"E, 576 m, 24.vi.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 5♀♀, INDIA, Karnataka, Indoor village, Mundagoda, 15° 1' 37.1568"N, 75° 1' 8.5548"E, 634m, 23.vi.2019, Coll. Raju Metri, Ex. Bullock (*Bos indicus*) and Buffalo (*Bubalus bubalis*).

**Diagnosis:** Small sized (8.5–9.5 mm long) black species. Frons greyish brown, width at vertex about 1.38 of height (divergence index .088) scarcely visible midfrontal spot rather distinctly swollen; paired spots roughly triangular, not reaching eyes, ventral angle not reaching callus; callus smooth, shiny, protuberant, yellowish brown, distinctly separated from eyes, upper margin convex, lower margin weakly concave; subcallar area yellowish brown, median cleft usually narrowly darkened above; face and parafacials gray, slightly yellowish above. Eye bare, broader than thorax and black in preserved specimens, no ocelli. Antenna yellowish brown; scape short, expanded distally, slightly grayish pollinose with short black hair above; pedicel with short dorsal projection; first flagellomere broad basally, tapered to style, slightly longer than scape; Palpus yellowish brown with dark hairs, stout basally, tapering towards apex. Scutum brown with three yellowish brown stripes anterior to transverse suture, middle one very slender, pair of strong triangular spots behind transverse suture, rather broad median stripe on posterior half tapering to slender line both anteriorly and posteriorly, pair of curved spots on posterior margin;

scutellum pale on posterior margin and slender median stripe; pleuron greyish brown with rather shiny dark-brown area on lower anepisternum. Wing (6.5–7.6 mm long) dark brown with heavy pattern of concentric white rings and yellowish marks; subapical band double; posterior cells with strong marginal triangles. Haltere brown and tip of knob pale. Legs dark brown; fore coxa pale basally; fore tibia with narrow subbasal band; midtibia and hindtibia each with two pale bands; midtarsus and hind tarsus pale basally. Abdomen brown with incisures on the dorsal side; venter brownish with pale incisures.

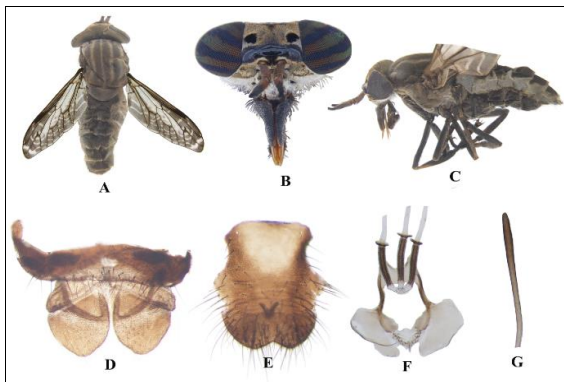
**Female postabdomen:** tergite IX divided with few black hairs, almost ½ width of tergite X; Tergite X rectangular shape with rounded edges, long bristles, divided into two pieces with internal lateral margins widened, creating a membranous space between the contact area of the internal lateral margins and tergite IX; cerci triangular, highly sclerotized; hypoproct divided, half-moon shape, highly sclerotized margins, reaching half of the cercus length. Hypogynium + hypogynial valve fused with prominent shoulders, length to width almost same, basal margin convex, lateral extremities rounded, apex heavily sclerotized with notch and long bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin concave with lateral extremities acuminate; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca capsule slender, heavily pigmented, tapering towards apex.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** India: Karnataka, Tamil Nadu and Punjab.

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** It is common species found in Western Ghats of Karnataka. It prefers to feed on neck region of cattle and buffalo. It is closely resembling *Haematopota montana* Ricardo, 1917, but can be differentiated by double subapical band; two pale bands on mid and hindtibia and smooth, shiny, protuberant and yellowish brown callus.



**Fig 16:** *Haematopota albimedia* Stone and Philip. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

*Haematopota albimedia* Stone and Philip, 1974

*Haematopota albimedia* Stone and Philip, 1974: 39

**Material examined:** 2♀♀, INDIA, Karnataka, Shippur village, Hukkeri, 16° 20' 47.0904"N, 74° 23' 6.5616"E, 650 m, 12.ix.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*).

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

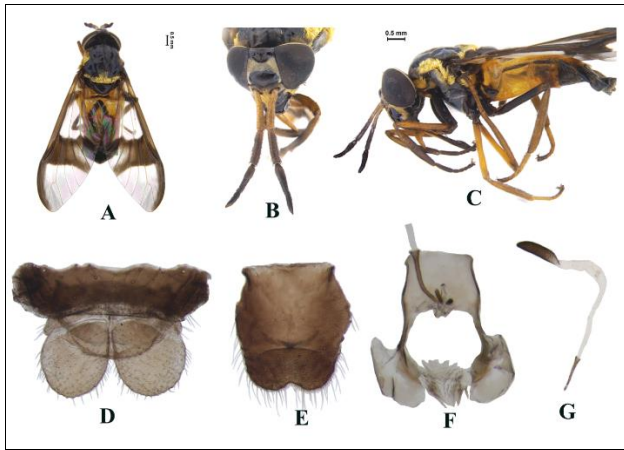
**Diagnosis:** Small sized (8.5–9.5 mm long) greyish brown species. Frons grey, broader than long, width at vertex greater than height (frontal index 0.89; divergence index 0.89), nearly parallel-sided; no midfrontal pollinose spot, paired spots, subcircular, not touching eyes, well separated from callus; callus dark brown, broadly touching eyes, upper margin weakly trilobed; lower margin concave centrally, subcallar area with distinct interantennal dark spot; face and parafacials grey; narrow broken brownish band across the middle of parafacial and top of face; parafacials above the band light brown with dark stippling. Eyes bare, green straight bands on blue back ground, no ocelli. Antenna reddish-brown, scape cylindrical; pedicel short and stout; flagellum slightly darkened except at base; palpus dark brown with dark hairs. Scutum dark brown with five grey stripes, median one very slender; scutellum dark brown. Wing (7.5–8.6 mm long) grey a broad hyaline band medially covering cells br, bm, d, and r<sub>5</sub>; subapical band complete, posteriorly joined to continuous row of pale spots along wing margin and also joined to one of the submarginal row of oblique spots. Haltere with dark knob. Legs almost dark brown, base of fore tibia with yellowish-brown band, midtibia and hind tibia also slightly paler but without distinct bands. Abdomen dark brown, dorsum with broad lateral grey stripe and faint indications of small sublateral grey spots.

**Female postabdomen:** tergite IX divided, heavily sclerotized, almost ½ width of tergite X; tergite X divided into two pieces closely united by a membrane sub rectangular shape with rounded edges, few short bristles; cerci roughly circular, moderately sclerotized with few short bristles; Hypoproct divided, half-moon shape, highly sclerotized margins, reaching less than half of the cercus length. Hypogynium + hypogynial valve fused, prominent shoulders, longer than wide, basal margin straight, lateral extremities rounded, notch at apex, heavily sclerotized with long bristles. Genital fork with slender arms, well developed distal expansions and two tufts bristles at apex; anterior margin deeply concave with lateral extremities acuminate; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermathecal capsule slender, heavily pigmented, apex rounded.

**Known distribution:** India: Shimoga, Bhagavati (Karnataka)

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** It is active during September and October in Western Ghats of Karnataka, preferably feeding on neck and dewlap region of cattle and buffalo. It is closely related to *Haematopota montana* Ricardo, 1917, but can be readily distinguished by its dark colour, broad frons, and very distinctive central hyaline patch on the wing.



**Fig 17:** *Chrysops dispar* Fabricius. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### *Chrysops dispar* Fabricius, 1798

*Chrysops dispar* Fabricius, 1798: 567 ♀♂

**Material examined:** 10 ♀♀, INDIA, Karnataka, Kanasur village, Siddapura, 14° 31' 6.9276"N, 74° 50' 0.8916"E, 576m, 24.vi.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 6 ♀, INDIA, Karnataka, Kapoli K.C village, Khanapur, 15° 39' 49.7124"N, 74° 22' 25.0284"E, 651m, 30.vi. 2019, Coll. Raju Metri, Cattle (*Bos indicus*).

**Diagnosis:** Small sized (5.8–6.3 mm long) slender, yellow and black species. Frons yellow, as broad as long (frontal index, 1.3; divergence index 0.71), callus broad, shiny black. vertex and area surrounding ocelli shining black, frontoclypeus shining yellow-brown, with darker tones laterally, bearing mid-facial yellow tomentose stripe, maxillary palpi pale reddish brown. Eye bare, black in preserved specimens. Ocelli well developed. Antenna long and slender, scape yellow-brown, pedicel light brown, flagellum dark brown to black, all antennal segments approximately of equal length. Thorax predominantly black with golden yellow hairs at the base of transverse suture and apex of scutum, scutellum dark brown to black. Legs pale yellow-brown to brown, coxae and hind femur darker brown to black, hind tibia moderately swollen. Wing (6.4–7.2 mm long) hyaline with broad costal band from cell c to apex of wing (cell  $r_4$ ) and a broad transverse band from the costal margin to anal margin leaving a hyaline patch posteriorly. Abdomen yellow, tergite I with narrow black band on posterior margin, tergite II with broad black median inverted v-shaped marking that extends posteriorly onto tergite third and often tergite fourth, width of black pattern variable, tergites second to sixth with brown to black lateral margins. Sternites I–V yellow, sternite VI, VII brown to black.

**Female postabdomen:** tergite IX fused, trapezoid shape, highly sclerotized; tergite X divided into two pieces closely united by a membrane sub rectangular shape with rounded edges, few short bristles; cerci circular with short bristles; Hypoproct round, highly sclerotized margins, reaching half of the cercus length. Hypogynium + hypogynial valve fused, less developed shoulders, longer than wide, basal margin straight, lateral extremities rounded, notch at apex, heavily sclerotized with long bristles. Genital fork with slender arms, well

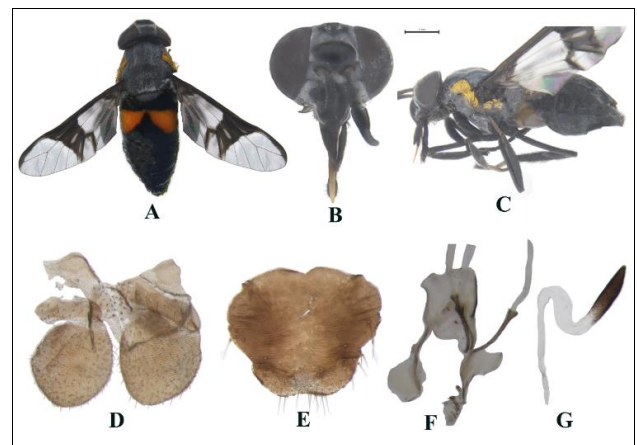
developed distal expansions and two tufts bristles at apex; anterior margin straight with lateral extremities rounded; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca ellipsoid, heavily pigmented, apex rounded.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Distribution:** Widespread and common in the country including Andaman Island.

**Economic importance/vector status:** Mechanical Vector for transmission of Surra (*Trypanosoma evansi*) in cattle and buffalo (Krinsky, 1976)<sup>[19]</sup>.

**Remarks:** It is usually easily recognized by the characteristic inverted V-shaped dark marking on the abdomen that extends to tergite III. This species occurs during May and June in Western Ghats of Karnataka, preferably feeds on fore leg and neck region of cattle and buffalo.



**Fig 18:** *Chrysops pellucidus* Fabricius. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

### *Chrysops pellucidus* Fabricius, 1805

*Chrysops pellucidus* Fabricius, 1805: 113

**Material examined:** 3 ♀♀, INDIA, Karnataka, Shippur village, Hukkeri, 16° 20' 47.0904"N, 74° 23' 6.5616"E, 650 m, 12.ix.2019, Coll. Raju Metri, Ex. Buffalo (*Bubalus bubalis*).

**Diagnosis:** Small (7.5–8.7 mm long), slender, black and yellow species. Frons slightly longer than broad (frontal index, 1.25; divergence index 0.88), grey tomentose, frontal callus ovoid-transverse, well separated from eye margins, vertex and area surrounding ocelli shining black. Eyes bare, black in preserved specimens. Ocelli present. Antenna long and slender, scape, pedicel and flagellum black-brown. Frontoclypeus bulged, shining dark brown to black, maxillary palpi dark brown. Scutum black with densely covered with flattened golden on notopleural lobes, pleuron concolorous with mesoscutum except posterodorsal margin of mesanepisternum and laterotergite densely covered with flattened golden hairs. Coxae, femora and tibiae dark brown

to black brown, tibiae moderately incrassate, basal three tarsomeres of mid- and hind tarsi pale brown, remainder of tarsi dark brown to black-brown. Wing (8.6–9.4 mm long) with cells basal radial and basal medial infuscated at extreme base and apex, cross band relatively narrow, strongly divided posteriorly by hyaline area in cell  $cu_1$ , outer margin concave, apicocostal infuscation distinct, just filling width of cell  $r_1$  and extending to upper apical margin of cell  $r_4$ . Abdominal tergites dark brown to black, except second tergite which is pale yellow with large median posterior black triangle whose apex extends three fourth distance to anterior margin at midline and narrowly extended laterally along posterior margin of tergite to lateral margin. Sternites first and second yellow, second with small dark spot posteriorly, sternites three to seven black.

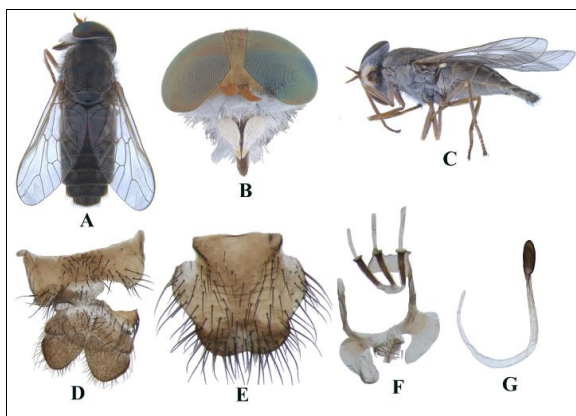
**Female postabdomen:** tergite X divided into two pieces closely united by a membrane subrectangular shape with rounded edges, few short bristles; cerci circular with short bristles; Hypoproct round, highly sclerotized margins, reaching half of the cercus length. Hypogynium + hypogynial valve fused, bulged at middle, longer than wide, basal margin with notch, lateral margins round, notch at apex, moderately sclerotized with short bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin straight with lateral extremities rounded; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermathecal capsule ellipsoid, highly pigmented, apex acuminate.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** India: Karnataka, Tamil Nadu, Orissa, Tranquebar (Kerala), Pondicherry.

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** This species is active during August and September in Western Ghats. They prefer to feed on udder region of cattle and buffalo. It is usually easily recognized by the characteristic abdomen tergite two pale yellow with large median posterior black triangle.



**Fig 19:** *Atylotus virgo* Wiedemann. A–habitus (dorsal view); B–head (frontal view); C– habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

*Atylotus virgo* Wiedemann, 1824

*Atylotus virgo* Wiedemann, 1824:22

**Material examined:** 2♀♀, INDIA, Karnataka, Bhagavati, Haliyal, 15° 9' 2.322"N, 74° 45' 33.1992"E, 567 m, 07.vii.2019, Coll. Raju Metri, Ex. Cattle (*Bos indicus*); 1♀, INDIA, Karnataka, Bhairapur Village, Hukkeri, 16° 18' 30.1788"N, 74° 22' 13.9728"E, 650m, 12.ix.2019, Coll. Raju Metri, Ex. Buffalo (*Bubalus bubalis*).

**Diagnosis:** Small sized (9.5–10.5 mm long) grey species. Frons longer than broad, narrow basally and widening towards vertex, (frontal index, 5; divergence index 2) frons golden yellow with no callus, vertex with a black spot; subcallus with golden yellow tomentum. Face grey, beard white, palpi creamy white with long white and short black pubescence, eye golden yellow with green bands in fresh specimens; bare; ocelli absent. Antennal segments orange yellow with sparse white/black hairs Scutum blackish brown with grey tomentum, black and golden yellow pubescence, stripes scarcely visible, pleuron black with grey tomentum and long white pubescence. Scutellum blackish brown with grey tomentum, black and golden yellow pubescence. Wing (6.5–7.5 mm long) hyaline without any appendix, basicosta setulose, black, veins yellowish brown; Haltere yellowish white with creamy white knob. coxa brown with grey tomentum and white pubescence. Femur orange yellow with white pubescence, tibia orange yellow with white and black pubescence, tarsus orange yellow with white and black pubescence. Abdomen dark grey with grey pubescence and light grey spots on each side of midline from two to fifth segment. Venter brownish yellow with grey tomentum and yellow pubescence.

**Female postabdomen:** tergite IX divided with few black hairs, almost ½ width of tergite X; tergite X rectangular shape with rounded edges, black bristles, divided into two pieces with internal lateral margins widened, creating a membranous space between the contact area of the internal lateral margins and tergite IX; cerci triangular with rounded margins, short bristles; Hypoproct ellipsoid, reaching less than half of the cercus length. Hypogynium + hypogynial valve fused, vase shape, prominent shoulders, slightly wider than long, basal margin straight, lateral extremities rounded, apex heavily sclerotized with indentation and long bristles. Genital fork with slender arms, distal expansions and two tufts bristles at apex; anterior margin concave with lateral extremities acuminate; spermathecal ducts long, stem with cup like expansion, heavily sclerotized before cup like expansion, translucent and tubular after cup like expansion. Spermatheca ellipsoid, highly pigmented, apex round.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

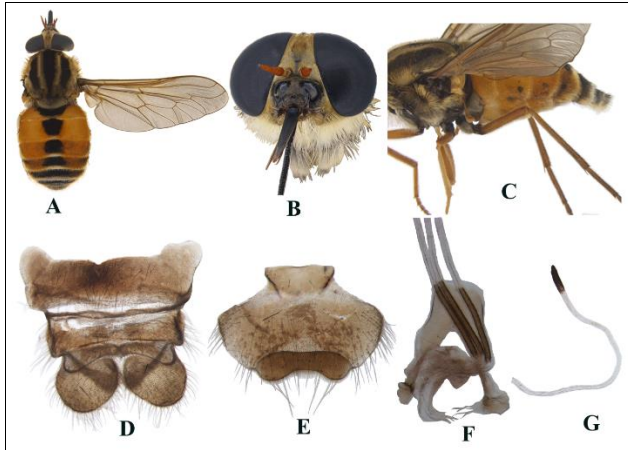
**Distribution:** India: common and widespread throughout the country.

**Economic importance/vector status:** transmit *Trypanosoma evansi* (surra) in camels in India (Singh, 1926)<sup>[14]</sup>.

**Remarks:** It is a trivoltine species preferably feeds on dorsal region of buffalo. It resembles *Tabanus dorsilinea* Wiedemann, 1824, by the striped abdomen and size but can



differentiated by the absence of frontal callus and light grey spots on each side of midline from II to V tergite.



**Fig 20:** *Philoliche taprobanes* Walker. A–habitus (dorsal view); B–head (frontal view); C–habitus (lateral view); D–tergite IX, X, cerci and hypoproct (dorsal view); E– Hypogynium + hypogynial valve (dorsal view); F– genital fork, (dorsal view); G– spermatheca capsule.

*Philoliche taprobanes* Walker, 1854

*Philoliche taprobanes* Walker, 1854: 324

**Material examined:** 2♀, INDIA, Karnataka, Modga village, Hukkeri, 16° 3' 22.4784"N, 74° 24' 36.144"E, 650 m, 12.x.2019, Coll. Raju Metri, Ex. Buffalo (*Bubalus bubalis*).

**Diagnosis:** Medium size (14.7–15.5 mm long) golden yellowish species. Forehead covered with yellowish grey tomentum and with pale pubescence, frontal index is 1.36 and divergence index 0.43. Face black, protuberant, covered with greyish tomentum, cheeks black but densely covered with greyish yellow tomentum and with yellow hairs. Palpi blackish brown, the second joint nearly as long as the first joint, slightly pointed, with short black hairs, first joint with some longer yellow hairs at its base. Beard pale yellowish-white. Antenna bright reddish yellow, the scape and pedicel dull yellowish grey with some long yellow hairs, the flagellum bare with 8 distinct flagellomeres. Eyes bare, not quite adjacent, black in preserved specimen; no ocelli. Scutum blackish brown with yellowish sides and two yellowish grey tomentose narrow stripes, these and the whole dorsum with fairly thick yellow pubescence, sides and breast with yellowish pubescence. Scutellum blackish brown with a yellowish grey tomentose outer border and with yellow pubescence. Wings (13.6–14.6 mm long) hyaline, vein Subcosta bare above and below, fore border pale yellowish, veins brown, first posterior cell open, second submarginal cell appendiculate. Halteres yellowish brown with grey apex. Legs light reddish yellow, coxae black, posterior tibiae and all tarsi at apex brownish, pubescence on femora yellowish. Abdomen pale reddish yellow, the first segment with a median black spot which extends anteriorly to the sides, the second and third with broad transverse black marks, the fourth with a narrower one, the last two almost wholly black, with whitish grey segmentations, on the second and third these are slightly indicated on the center, all segmentations with yellow hairs, which are white on the last three, some scanty black pubescence appears even on the yellow parts and also on the black parts; venter paler, only blackish at extreme apex,

segmentations with white hairs.

**Female postabdomen:** tergite IX fused, rectangular shape with weakly concave on upper and lower margins, wider than tergite X; tergite X divided into two pieces closely united by a membrane, rounded lateral margins with short bristles; cerci sub circular with short bristles; Hypoproct divided, hook shape at apex, highly sclerotized margins, reaching more than half of the cercus length. Hypogynium + hypogynial valve fused, vase shape, prominent shoulders, almost twofold wider than long, basal margin straight, lateral extremities rounded, long bristles. hypogynial valve dumbbell shape, highly sclerotized with abundant short and few long bristles. Genital fork with thick arms, little distal expansions and two tufts bristles at apex; anterior margin straight with lateral extremities round; spermathecal ducts long, stem without cup like expansion, heavily sclerotized basally, translucent and tubular towards apex. Spermatheca slender, highly pigmented, apex acuminate.

**Host:** Cattle, Buffalo, Horse, wild herbivorous and carnivorous animals.

**Known distribution:** India: Hassan (Karnataka); Anamalai Hills (Tamil Nadu); Malabar (Kerala).

**Economic importance/vector status:** Not recorded as a vector.

**Remarks:** large species active during September and October in Western Ghats of Karnataka. Preferably feeds on lower part of body in cattle and buffalo. It is usually easily recognized by the characteristic long and slender proboscis; antennal flagellum with 8 distinct flagellomeres; hind tibiae always with apical spurs; wing with appendix.

## Discussion

In the present study the tabanid flies were abundant throughout the study area and were collected during March to December with a decline at higher elevations during winter season. This trend is in accordance with (Maity *et al.*, 2016) [4]. Among the 20 species, 7 species were proven vectors for Surra, Anthrax, Buffalo sickness and *Pasteurella multocida* in domestic and wild animals.

(Priya *et al.*, 2009; Suchitra *et al.*, 2010) [20, 21] and Economic times news update (28 January 2013) [22] reported deaths of domestic and wild animals due to anthrax in Karnataka and Kerala. There is a high probability that tabanids might have played a key role in the transmission of the disease apart from its other modes of transmission. Four species collected during the study *viz.* *Tabanus indianus* Ricardo, 1911, *Tabanus biannularis* Philip, 1960, *Haematopota montana* Ricardo, 1917 (Rao and Mohiyudeen, 1958) [13] and *Tabanus rubidus* Wiedemann, 1821 (Nieschulz, 1929a) [16] have been associated with mechanical transmission of anthrax. Three of the tabanid species collected during our study *viz.* *Tabanus dorsilinea* Wiedemann, 1824, *Atylotus virgo* Wiedemann, 1824 (Singh, 1926; Burton 1978) [14, 10], *Tabanus rubidus* Wiedemann, 1821 (Basu *et al.*, 1952) [8] were the proven vectors of surra disease in wild and domestic animals. *Tabanus rubidus* Wiedemann, 1821 also responsible for successful mechanical transmission of *Trypanosoma theileri* (Kraneveld, 1931) [15]; *Clostridium chauvoei* (Nieschulz and Huber, 1928) [17] and *Pasteurella multocida* (Nieschulz and Kraneveld, 1929b) [18] in domestic animals.

## Conclusion

Knowledge of the species composition of vector species of Tabanidae will help in formulating better management strategies for the control and spread of diseases like Surra, Anthrax, Blackleg and Haemorrhagic septicaemia. Data generated with regard to species composition of vectors in Belagavi division can pave way for the prevention and spread of epidemics like Surra and Anthrax. Such studies should be undertaken for Karnataka as a whole and also adjoining states in south India as it well helps us to appreciate the prevalence of various diseases in cattle transmitted by Tabanidae and also to prevent the uncontrolled spread by opting timely management methods.

## 5. References

- Datta M. A synopsis of the Indian Tabanidae (Diptera). Bulletin of the Zoological Survey of India.1985; 7(1):127-138.
- Baldacchino F, Desquesnes M, Mihok S, Foil LD, Duvallet G, Jittapalapong S. Tabanids: Neglected subjects of research, but important vectors of disease agents! Infection, Genetics and Evolution. 2014; 28:596-615.
- Morita SI, Bayless KM, Yeates DK, Wiegmann BM. Molecular phylogeny of the horse flies: a framework for renewing tabanid taxonomy. Systematic Entomology. 2016; 41:56-72.
- Maity A, Naskar A, Sengupta J, Hazra S, Parui P, Homechaudhuri S *et al.* An annotated checklist of Horseflies (Diptera: Tabanidae) from India with remarks on Surra disease vectors. The Journal of Zoology Studies. 2016; 3(4):53-84.
- Kapoor VC, Grewal JS, Sharma SK, Gupta SK. Taxonomic studies of Indian tabanids (Diptera: Tabanidae): final report of the work done in the PL-480 Research. Project no. FG-IN-684 (IN-AES-328). Ludhiana, India: Dept. of Zoology, Punjab Agricultural University. leaves of plates, 1990, 232(23).
- Veer V. Tabanidae flies (Diptera) from the Indian sub-region. Annals of Forestry. 2004; 12(2):301-447.
- Vasudeva SP. Studies on the ecology and population dynamics of a few species of tabanidae. M.Sc. Thesis, submitted to University of Mysore Manasagangotri, Mysore, 2007, xi+179.
- Basu BC, Menon PB, Sengupta CM. Regional distribution of *Tabanus* flies in India and its relationship to the incidence of Surra. Indian Journal of Veterinary Science and Animal Husbandry.1952; 22:273-292.
- Egri A, Blaho M, Szaz D, Kriska G, Majer J, Herczeg T *et al.* Horvath G. A horizontally polarizing liquid trap enhances the tabanid-capturing efficiency of the classic canopy trap. Bulletin of Entomological Research. 2013; 103:665-674.
- Burton JJS. Tabanini of Thailand Above the Isthmus of Kra (Diptera: Tabanidae). Entomological Reprint Specialists, Los Angeles, 1978, 165.
- Stone A, Philip CB. The Oriental species of the tribe Haematopotini (Diptera, Tabanidae). USDA Technical Bulletin.1974; 1489:1-240.
- Burger JF, Chainey JE. Revision of the Oriental and Australasian species of *Chrysops* (Diptera:Tabanidae). Invertebrate Taxonomy. 2000; 14:607-654.
- Rao NSK, Mohiyudeen S. Tabanus flies as transmitters of anthrax- A field experience. Indian Veterinary Journal. 1958; 35:348-353.
- Singh K. Surra transmission experiments. Department of Agriculture Punjab Veterinary Bulletin. 1926; 16:20.
- Kraneveld FC. Enkele Overbringingsproeven van *Trypanosoma theileri* Laveran 1902 met Tabaniden. Nedland. Blad. Diergeneesk. 1931; 43:132-192.
- Nieschulz O. Uber die mechanische Ubertragung von einigen Bakterienkrankheitench Blutsaugende Insekten. The Royal Society of Tropical Medicine and Hygiene. 1929a; 33:282-287.
- Nieschulz O, Huber FL. Over enkele boutvuuren parabout-vuuroverbrenningsproeven met Tabaniden.Veeartsenijk meded. 1928; 67:24-27.
- Nieschulz O, Kraneveld FC. Experimentelle Untersuchungen uber die Ubertragung der Buffelseuche drunch Insekten. Zentralbl. Bakteriol. 1929b; 133:403-417.
- Krinsky WL. Animal disease agents transmitted by horse flies and deer flies (Diptera: Tabanidae). Journal of Medical Entomology. 1976; 13(3):225-275.
- Priya PM, Mini M, Rameshkumar P, Jayesh V. A case of anthrax in wild elephant from the Western Ghats region of Kerala, India. Journal of Threatened Taxa. 2009; 1(3):192-193.
- Suchitra BR, Anil Kumar MC, Kalmath GP, Prakash L. Outbreak of Anthrax and its management in Bangalore rural district. Veterinary World. 2010; 3(3):135-136.
- <https://economictimes.indiatimes.com>, 2013.