A SHORT TAXONOMIC ACCOUNT OF DIPTERAN FLIES FROM THE RENUKA WETLAND AND ADJACENT SANCTUARY, HIMACHAL PRADESH, INDIA

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ABSTRACT: The present study is based upon the dipteran collection from the Renuka Wetland and surrounding Sanctuary in the year 2015. Overall 22 species under 21 genera over 10 families have been reported from here including present survey data as well as literature sources. Out of which, 4 species *Ischiodon scutellaris* Fabricius, 1805, *Eristalinus* (*Eristalodes*) *paria* (Bigot, 1880), *Eristalinus* (*Eristalinus*) *quinquestriatus* (Fabricius, 1794), *Eristalis* (*Eoseristalis*) *cerealis* Fabricius, 1805 found to be the new record from this Renuka Wetland & Sanctuary. The conservation of Renuka Lake as Ramsar Site has also attributed to the conservation of fly diversity here.

KEY WORDS: Diptera, taxonomy, new record, Ramsar site, Renuka Lake

Renuka Wetland covers an area of about 30 hectares is located in the Sirmour district of Himachal Pradesh, at longitude and latitude. Due to the biological richness of the Wetland and its fringing areas, it is considered as "Ramsar Site" on 8th November 2011. The in and around an area of this Wetland has been also declared as Wildlife Sanctuary.

The oval shaped Renuka Lake is situated in an elevational range of 620 meters above msl in Himachal Pradesh. The lake follows a riparian course between steep hill slopes on both the sides with thick forest. The lake ecosystem is getting affected by several factors including both man-made as well as natural influences.

Dipteran Diversity has been studied earlier from this region by Parui & Mukherjee (2000), Bhattacharya & Banerjee (2013). The present study includes resurveying of dipteran diversity from this area. The study was conducted in the year 2015 in this conservation area. After affirming this area as a Ramsar Site, it was the first ever consolidated survey of dipteran species from this area. Altogether 22 species under 21 genera over 10 families have been reported from here including present survey data as well as literature sources. Out of which, 4 species namely found to be the new record from this Renuka Wetland & Sanctuary.

MATERIALS AND METHOD

Study area: The current area considered for the study is Renuka Lake and its surrounding area of Wildlife Sanctuary which is located at in the Sirmour district of Himachal Pradesh (Map 1A-1C). This site is located at a longitude of 30°36'N and at a latitude of 77°27'E, and at an average elevation of 583 m.

Collection method: Dipteran flies were collected from the field during day time by using insect sweep nets, and by using malaise trap, pan trap and by light trap

collection during night time etc. The collected samples are narcotized by using ethyl acetate and stored for further study in insect envelopes in the field. The specimens were later carried back to the laboratory, mounted on insect pins and stored in insect cabinets.

Identification method: Identification of the adults followed the keys of Thomson (2013), Vockeroth (1992) and Brunetti (1923) keeping in mind the recent nomenclatural changes (Pape & Thompson, 2016; Pape & Evenhuis, 2010). All the identified specimens were deposited in the designated repository of National Zoological Collection, Diptera section, Zoological Survey of India, Kolkata.

Technical Method: The graphical representations here was made by using Microsoft Excel 2013. The 2D and 3D maps are generated by using ARC-GIS software, version 10.1.

RESULT

The present study includes 22 species under 21 genera over 10 families including present survey data as well as literature sources. Out of which, 4 species namely *Ischiodon scutellaris* Fabricius, 1805, *Eristalinus* (*Eristalodes*) *paria* (Bigot, 1880), *Eristalinus* (*Eristalinus*) *quinquestriatus* (Fabricius, 1794), *Eristalis* (*Eoseristalis*) *cerealis* Fabricius, 1805found to be a new record from this Renuka Wetland & Sanctuary. A detailed systematic account of the new records have been given along with the updated distributional and nomenclature pattern.

List of species

Family Limoniidae
Subfamily limnophilinae
Conosia irrorata (Wiedemann, 1828)

Family Bibionidae
Subfamily Pleciinae
Plecia (*Plecia*) *mallochi* Hardy, 1948

Family Stratiomyidae
Subfamily Stratiomyinae
Oplodontha rubrithorax (Macquart, 1838)
Subfamily Clitellariinae
Adoxomyia heminopla (Wiedemann, 1819)

Family Sciomyzidae
Subfamily Sciomyzinae
Tribe Tetanocerini
Sepedon plumbella Wiedemann, 1830

Family Tabanidae
Subfamily Tabaninae
Tribe Tabanini
Tabanus (*Tabanus*) *striatus* Fabricius, 1787

Family Tephritidae
Subfamily Dacinae
Tribe Dacini
Bactrocera (*Bactrocera*) *dorsalis* (Hendel, 1912)
Subfamily Tephritinae
Tribe Tephritini

Spathulina acroleuca Schiner, 1868
Tribe Tephrellini
Pliomelaena zonogastra Bezzi, 1913
Subtribe Tephrellina
Sphaeniscus quadrincisus Wiedemann, 1824

Family Syrphidae
Subfamily Syrphinae
Tribe Syrphini
Episyrphus (*Episyrphus*) *balteatus* (De Geer, 1776)
Ischiodon scutellaris Fabricius, 1805**
Subfamily Eristalinae
Tribe Eristalini
Eristalinus (*Eristalodes*) *paria* (Bigot, 1880)**
Eristalinus (*Eristalinus*) *quinquestriatus* (Fabricius, 1794)**
Eristalis (*Eoseristalis*) *cerealis* Fabricius, 1805**
Phytomia (*Dolichomerus*) *crassa* (Fabricius, 1787)

Family Muscidae
Subfamily Muscinae
Tribe Muscini
Musca (*Musca*) *domestica* Linnaeus, 1758
Neomyia timorensis Robineau-Desvoidy, 1830
Tribe Stomoxyini
Stomoxys calcitrans (Linnaeus, 1758)
Subfamily Mydaeinae
Gymnodia tonitrui (Wiedemann, 1824)

Family Calliphoridae
Subfamily Chrysominae
Tribe Chrysomini
Chrysomya megacephala (Fabricius, 1794)

Family Sarcophagidae
Subfamily Sarcophaginae
Tribe Sarcophagini
Sarcophaga (*Parasarcophaga*) *albiceps* Meigen, 1826

**New Record of species from the study area.

Diagnosis of the New Records from the Studied Area.

Eristalis (*Eoseristalis*) *cerealis* Fabricius, 1805

1805. *Eoseristalis cerealis* Fabricius, Syst. Antliat. 14: 232.
Type-locality: China.
Material examined: 2♀♀ZSI, Renuka Lake, Sirmour dist., 30°36'34.78"N 77°27'33.84"E, 583 m, 08.iv.2011, coll. J.Sengupta.
Diagnosis: Head: Arista plumose slightly, eyes unicolorous in appearance, ***Thorax:*** Mesonotum with a transverse stripe of grayish pubescence along suture ***Abdomen:*** Abdominal tergite 3 in males with a triangular oblong spot on anterior margin, reaching laterally, in female spots narrower but always on anterior margin. ***Leg:*** shining black with tips of femora narrowly, anterior tarsi to a greater or less extent at base yellow or orange. ***Wing:*** almost clear, a loop of 3rd vein diagonally placed.
Distribution: Himachal Pradesh **(Renuka Lake)**, Assam, Jammu &Kashmir, Meghalaya, Sikkim, Tamil Nadu, West Bengal**.**
Elsewhere: Widespread in Oriental region, Far East.
Ecosystem services rendered: Effective Pollinator.
Remarks: This species is a new record for this Ramsar site.

Eristalinus (*Eristalinus*) *quinquestriatus* (Fabricius, 1794)

1794. *Syrphus quinquestriatus* Fabricius, Ent. syst.4: 289.
= *Syrphus quinquestriatus* Fabricius, 1794
Type-locality: Tamil Nadu: Tharangambadi.
Material examined: 1♀ Renuka Lake, Sirmour dist., 30°36'34.78"N, 77°27'33.84"E, 583 m, 08.iv.2011, coll. J. Sengupta.
Diagnosis: Head: Eyes spotted or irregularly marked, antennae brownish orange with bare arista, smaller vertical triangle; whole frons with dark brown hairs. ***Thorax:*** thorax with yellowish dorsum along with shining black stripes. ***Abdomen:*** comparatively shorter, ovate-conical; the 4th abdominal segment with an inverted open V mark, abdomen covered with yellow pubescence. ***Leg:*** tarsi yellowish white nearly to tip. ***Wing:*** clear with 3rd vein (R_{4+5}) looped downward into 1st posterior cell (R_5).
Distribution: India: Himachal Pradesh (**Renuka lake**), Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Nagaland, Orissa, Uttar Pradesh, Uttarakhand and West Bengal.
Elsewhere: China, Japan and other parts of the oriental region.
Ecosystem services rendered: Effective Pollinator, as well as larvae, are effective biological paste controller.
Remarks: This species is a new record from this Ramsar site, eyes of this species bear characteristic minute black dots on eyes of both sex.

Eristalinus (*Eristalodes*) *paria* (Bigot, 1880)

1880. *Eristalomyia paria* Bigot, Ann. Soc. Ent. Fr. ser. 5 (10): 218.
=*Eristalis arisanus* Matsumura, 1916
=*Eristalis kobusi* Meijere, 1908
=*Eristalomyia zebrina* Bigot, 1880
Type-locality: Sri Lanka.
Material examined: 1♀ Renuka Lake, Sirmour dist., 30°36'34.78"N, 77°27'33.84"E, 583 m, 08.iv.2011, coll. J. Sengupta.
Diagnosis: Head: Eyes with six narrow irregularly outlined but approximately parallel longitudinal dark stripes on each side of the central bump. Antennae dark brown with bare orange arista. ***Thorax:*** Yellowish gray with concolorous pubescence. 4 approximate dull black stripe on dorsum. Scutellum brownish yellow translucent in appearance. ***Abdomen:*** Little shinning black, pubescence of abdomen ground colored, the tip of abdomen more or less blackish. ***Leg:*** Blackish brown with anterior femora, rather narrowly orange at tips, pubescence of legs mainly yellowish grey. ***Wing:*** Clear with a minute dark brown spot at the tip of the auxiliary vein.
Distribution: India: Himachal Pradesh (**Renuka lake**).
Elsewhere: Sri Lanka, Taiwan, Java, Moluccas.
Ecosystem services rendered: Render effective pollination services.
Remarks: This species is a new record from this Ramsar site, eyes of this species bear characteristic stripes in both sex.

Ischiodon scutellaris (Fabricius, 1805)

1805. *Scaeva scutellaris* Fabricius, Syst. Antliat.: 252.
=*Epistrophe magnicornis* Shiraki, 1963
=*Epistrophe platychiroides* Frey, 1946
=*Ischiodon boninensis* Matsumura, 1919
=*Ischiodon penicillatus* Hardy, 1952
=*Ischiodon trochanterica* Sack, 1913
=*Melithreptus novaeguineae* Kertesz, 1899
=*Melithreptus ogasawarensis* Matsumura, 1916
=*Sphaerophoria annulipes* Macquart, 1855
=*Sphaerophoria macquarti* Goot, 1964
=*Syrphus coromandelensis* Macquart, 1842
=*Syrphus erythropygus* Bigot, 1884
=*Syrphus nodalis* Thomson, 1869
=*Syrphus ruficauda* Bigot, 1884
=*Syrphus splendens* Doleschall, 1856

Type-locality: Tranquebar, India.
Material examined: 10 ♀♀ Renuka Lake, Sirmour dist., 30°36'34.78"N, 77°27'33.84"E, 583 m, 08.iv.2011, coll. J. Sengupta.
Diagnosis: Head: Third antennal segment twice as long as broad, sub-acute apically; sterno pleuron at its upper margin with distinct yellow spot; ***Thorax:*** Dorsum shinning aeneous black in colour, pleurae also of same colour, scutelllum yellowish with the centre of it more or less brownish, pubescence of both thorax and scutellum greyish or pale yellow. ***Abdomen:*** moderately shinning black, the 2nd segment with a large sulphar yellow spot on each side while broad continuous yellow bands on each of the 3rd and 4th segment. 5th segment mainly orange in colour. ***Legs:*** moderately yellow in colour with a broad sub apical black ring on the hind femora. ***Wing:*** with vein R_{4+5} ending well before wing apex; lower lobe of squama with only microscopic pile; hind trochanter in the male with spine-like process ventrally.
***Distribution*:** Himachal Pradesh (**Renuka lake**), Andhra Pradesh, Assam, Chandigarh, Delhi, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand and West Bengal.
Elsewhere: Java, Philippines, Taiwan and other parts of the S.E. Asia; Australia, Hawaii, Japan, and Micronesia.
Ecosystem services rendered: Act as effective Pollinator.
Remarks: This species is a new record for this Ramsar site.

DISCUSSION

From diversity point of view, the importance of this conservation area is immense. As it is not only a Ramsar Site but the surrounding area is also considered as Wildlife Sanctuary. The high level of taxonomic diversity from this area may be attributed to the less human interference and anthropogenic disturbances. Brachyceran Diptera (96.42%) has been reported in a quite high percentile than Nematoceran Diptera (3.57%) (Fig. 2A). The diversity of dipteran families is quite high with the family Syrphidae representing the highest diversity (66.26%) while family Sciomyzidae representing the lowest percentile of species. (1.19%) (Fig. 2B). Among the 21 genera, genera *Eristalinus* found to be most abundant (22.6%) while the genera *Sepedon* the least (1.1%) (Fig. 2C). Among the 22 species, *E. balteatu*s has shown the maximum diversity (22.7%) while the species *S. plumbella* the least (1.1%) (Fig. 2D). 4 species are new record from this conservation area of which *Ischiodon scutellaris* (Fabricius, 1805) found to be most prevalent while *Eristalinus quinquestriatus* (Fabricius, 1794) found to be rare. Among these 22 species, those with saprophagy and coprophagy feeding mode (21%) has shown much more abundance than those exhibiting hematophagy feeding mode (5.5%) (Fig. 2E). More over the pollinator flies are found in a higher percentile (34.61%) than vector and predator flies here (6.85%) (Fig. 2F).This higher abundance may attribute to the fact of less anthropogenic disturbances in this conservation area. The differential pattern observed among dipteran families gives some indication of the range of their possible responses to habitat types. Future studies should focus on whether there are seasonal shifts in the distribution and abundance of individual species across this Ramsar Site.

Conclusively it can be said that the conservation effort in this degrading habitat of Ramsar Site has been found to be very advantageous. Which is specified by flourishing pollinators in this region after declaring it as a Ramsar Site? More over if we take such conservation efforts in our degrading natural habitats it will not only ensure the survival of pollinators but also the future food security of our country will also be protected.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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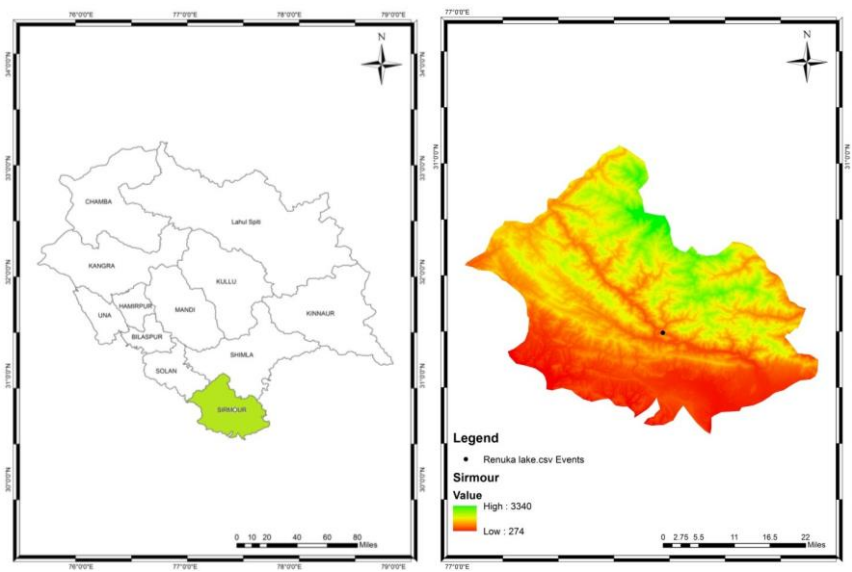

Figure 1A-B. GIS MAP showing State of Himachal Pradesh and GPS location of surveyed area i.e.: Renuka Lake and surrounding Wildlife Sanctuary.

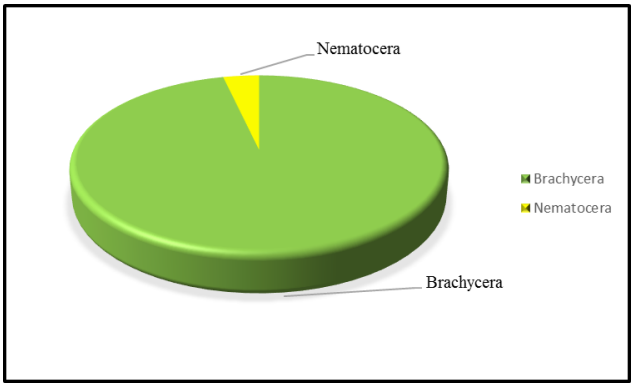

Figure 2A. Pie diagramme representing higher and lower group of dipteran abundance from Renuka Wetland and surrounding Wildlife Sanctuary.

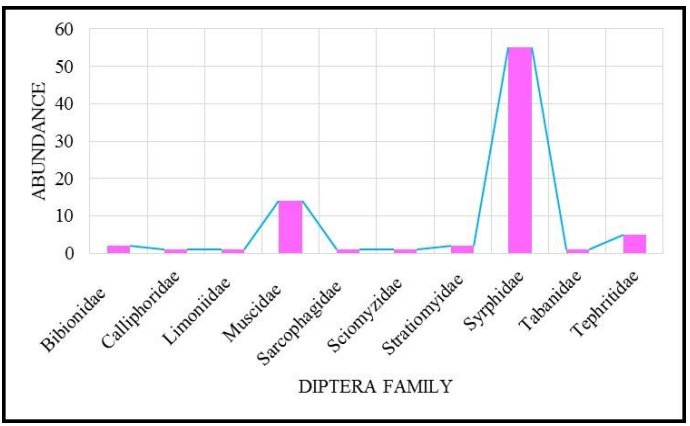

Figure 2B. Graph representing dipteran family abundance from Renuka Wetland and surrounding Wildlife Sanctuary.

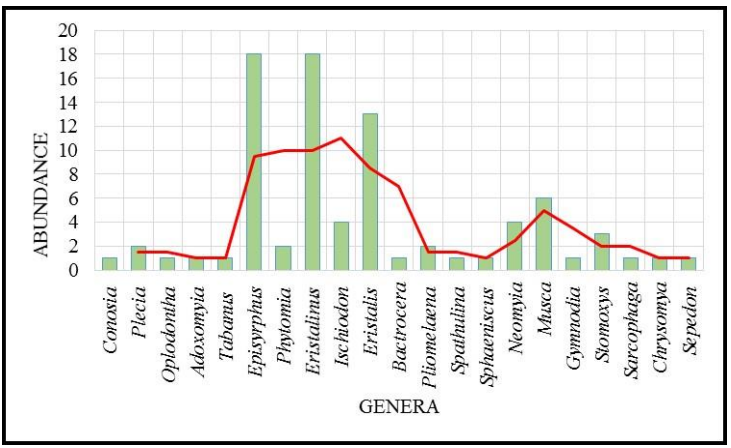

Figure 2C. Graph representing generic abundance of dipteran species from Renuka Wetland and surrounding Wildlife Sanctuary.

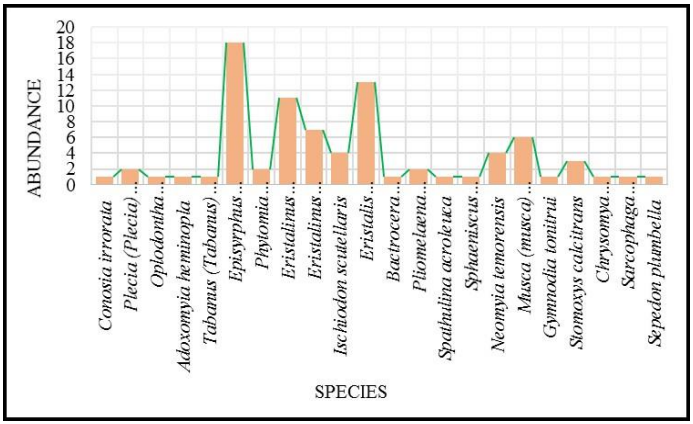

Figure 2D. Graph representing species diversity of different dipteran families from Renuka Wetland and surrounding Wildlife Sanctuary.

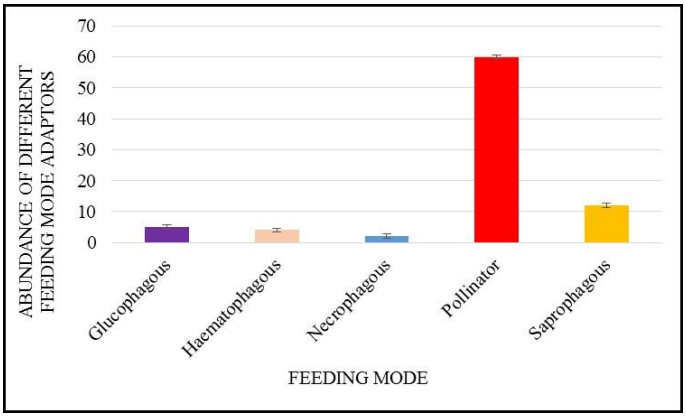

Figure 2E. Graph representing abundance of different dipteran feeding mode adaptors from Renuka Wetland and surrounding Wildlife Sanctuary.

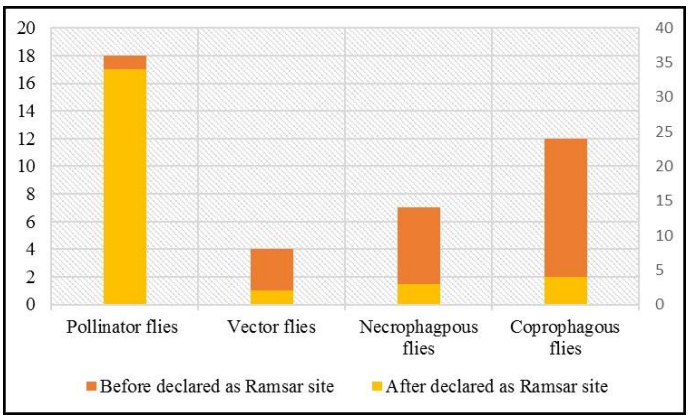

Figure 2F. Graph representing dipteran diversity status from the study area before and after declaration of it's as a Ramsar Site.