DIVERSITY OF MUSCIDAE (DIPTERA) IN NEORA VALLEY NATIONAL PARK, WEST BENGAL

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ABSTRACT

Understanding the local biodiversity and associated ecosystem services is important for organisms such as muscids (Diptera: Muscidae). This study aimed at the spatial diversity of muscid flies and their bionomics in the Neora Valley National Park, India. The survey was conducted over an altitude variation of 460–3200 masl having relatively high tree diversity. The study area preserves good ecological balance and provides every habitat that is ideal for the survival of muscid flies. The results revealed 31 species under 13 genera of three subfamilies. The highlight is the new records of two species, Limnophora (Heliographa) ceylanica (Emden, 1965) and Neomyia pacifica (Zimin, 1951) from India.

Key words: Muscidae, Neora Valley National Park, West Bengal, species diversity, bionomics, new record, Limnophora (Heliographa) ceylanica, Neomyia pacifica, altitudinal variation, distribution

The muscid flies belong to the most diverse family Muscidae of Diptera distributed throughout the world. Its members can be found in all terrestrial and aquatic habitats, except for the most arid environments (Skidmore, 1985). These have medical, veterinary and agricultural importance as they are synanthropic indicating the association of a given species with human or human-modified environments (Ishijima, 1967; D’Almeida, 1992). These flies also play a key role in pollination, as in many alpine and arctic areas, these have been identified as the most common flower visitors (Mitra, 2010; Orford et al., 2015; Tiusanen et al., 2016). Muscidae is recognized as important for medico-legal purposes (Grzywacz et al., 2017). A few faunistic surveys had been carried out in India (Joseph and Parui, 1977; Dutta and Chakraborti, 1985; Mitra, 2000; 2003; 2004; 2006a; 2006b; 2010; Nandi and Sinha, 2004; Mitra et al., 2005; 2015; 2016; 2017; Sinha, 2014). More studies with surveys and evaluation of bionomics and lifecycle on muscid flies had been done in West Bengal in comparison to other parts of India- The diversity and bionomics were studied in the Sundarban Biosphere Reserve (Sinha, 2009; 2004). The spatial diversity patterns of Muscidae in the northeast of India, and specifically in the protected forest areas, have not yet been explored. This study is a preliminary one compiling information and listing of the species of Muscidae inhabiting the forest areas of Neora Valley National Park (NVNP), West Bengal, India. In this study, the spatial diversity of muscid flies in NVNP has been explored and bionomics of recorded species are explained.

MATERIALS AND METHODS

The Neora Valley National Park (NVNP) of West Bengal, India is encircled by two states, namely Sikkim and Bihar and two neighboring countries, Nepal and Bhutan. The National Park is situated in the Kalimpong district of West Bengal. It has been nominated as the oldest National Park in India covering an area of over 88 km² (26° 52′ 3″ - 27° 3’N, 88° 45′ - 80° 50’E). The insect diversity of this National Park is exceedingly high and, due to high altitudes in some places, often showing close similarities with Palearctic species. Consecutively, four Biodiversity Assessment Camps were organized by the Department of Forest (North Division), Government of West Bengal, mostly initiated by the Chief Conservator of Forests of North Bengal to explore the rich biodiversity of the NVNP (Fig. 1). Many surveys were made to explore muscid flies in this oldest National Park, for which insect collecting hand net and Malaise trap were used. Specimens collected by hand net were killed with benzene vapour in a killing jar and kept in an envelope for future use. Some specimens were pinned (no. 2) and preserved in insect box. Specimens collected by the Malaise trap were sorted out...
Results and Discussion

A total of 31 species belonging to 13 genera under three subfamilies from the Neora Valley National Park (NVNP) were collected. The details of classification (key to species etc.) according to Emden (1965) and Shinonaga and Singh (1994), their distribution and bionomics are discussed herein.

Key to subfamilies

1.  M1+2 vein sharply bends anteriorly ............................................2
   M1+2 vein gradually bends anteriorly and bow shaped ...........................................Morellia


Key to species

1.  Metallic blue or purple in colour; no distinct median vittae...........................................Neomyia

2.  Suprasquamal ridge entirely bare...........................................2
   Suprasquamal ridge hairy...........................................3

3.  Metallic coloration; with distinct stripes on the thorax...........................................3
   No metallic coloration; with distinct stripes on the thorax...........................................2

i.  Subgenus Byomyia Robineau-Desvoidy


1.  Musca (Byomya) conducens Walker

   1864. Musca praecox Walker, l.c., VII, 236. Type: Ceram. B.M.

   Material examined: India, 2♂ NVNP, Ashalay, 04.III.2018; 3♂, 2♀, Choudaferi, 07.X.2019; 5♂, 8♀, Mouchaki, 07.III. 2018.
Bionomics: This fly is basically found on dung of different phytophagus animal and haematophagus in nature. This fly is biologically associated with *Stephanofilaria assamensis* (Greenberg, 1971; Shinonaga and Kano, 1971). In NVNP, this fly was captured from sores and wound of cows.

Distribution: India [West Bengal (NVNP), Andaman Island, Andhra Pradesh, Arunachal Pradesh, Assam, Madhya Pradesh, Orissa, Punjab, Uttar Pradesh]. This species is distributed through whole Ethiopian and Oriental region to Burma, China, Java, Malay, New Guinea, Philippines, Sri Lanka, Sumatra, and Thailand.

2. **Musca (Byomyia) tempestiva** Fallen


Material examined: 2♂, Gogune, NVNP, 3.XI.2018. 3♀ Botay Kharga, 4.XI.2018

Bionomics: Haematophagous in nature. Found on cattle (Cow, horses). Found on batches. In NVNP, this fly was collected from cattle.

Distribution: India [Kashmir, West Bengal (NVNP), Arabia, Central Asia, Egypt, Europe, Iraq, Persia].

ii. **Subgenus Eumusca Townsend**


3. **Musca (Eumusca) hervei** Villeneuve


Bionomics: This fly basically found on cattle, cow, horses. Generally, this fly laid eggs in patches on fresh cow-dung. This is haematophagous species. Also feeds on tears and wounds of cattle. It was reported as vector of *Thalazia sp.* (Shinonaga and Kano, 1971). In NVNP, many of this species were collected from forest village, precisely from the cattle.

Distribution: India [West Bengal (NVNP), Assam, Himachal Pradesh, Punjab, Sikkim, Shimla, Uttar Pradesh], Burma, China.

iii. **Subgenus Viviparomusca Townsend**


4. **Musca (Viviparomusca) bezzii** Patton and Cragg

1913. *Musca bezzii* Patton and Cragg., Indian Journal of Medical Research, I, 19, PI. IV;


Bionomics: Larviparous in nature. Single larva deposited at a time in cow dung. Found near human habitation. Purely haematophagous in nature. Vector of Thelaziasis. In NVNP, this flies were collected from bushes, cow dung and sores of cow.

Distribution: India [West Bengal (NVNP), Assam, Kashmir, Missouri, Nainital, Punjab, Sikkim, Uttar Pradesh], Burma, China, Japan, Korea, Malaya.

B. **Neomyia Walker**


**Key to species**

1. DC 2+4/ 5. Para frontals black, bare on upper two thirds, which are slightly shining and purplish in colour..........................Neomyia fletcheri

Presutural Dorso-central bristle absent or very fine

.............................................................2

2. DC 0+1. Sternopleural bristle 1. ........................................

.........................................................Neomyia chalybea faceta

DC 0-1+1-2. Sternopleural bristle 1+2........................

.........................................................Neomyia pacifica
5. *Neomyia chalybea faceta* Enderlein  


Bionomics: Found on cow dung, cattle manure, human stool. Sometimes they visit flowers though. In NVNP, these flies were collected from cattle manure and bushes near cattle.

Distribution: India [Assam, Punjab, Sikkim, Shimla, Uttar Pradesh, West Bengal (NVNP)], Burma, China, Java, Nepal, Pakistan, Sri Lanka, Sumatra.

6. *Neomyia fletcheri* Emden  


Bionomics: Found on cow dung, cattle manure, human stool. In NVNP, collected from bushes, flowers, and cattle manure.

Distribution: India [Assam, West Bengal (NVNP, Darjeeling, Siliguri)], Burma, Sri Lanka.

7. *Neomyia pecifica* Zimin (Fig. 2)  


Bionomics: Found on cow dung, horse dung, flowers, bushes. Eggs are deposited on horse or cow dung. In NVNP, this fly was collected from flowers and bushes. It looks like *Neomyia fletcheri* in appearance, but genitalia study reveals the real species, and its first report from India (Fig. 2).

Distribution: New record from India (West Bengal: NVNP), China, Japan, Korea.

8. *Morellia nigrisquama* Malloch  


Bionomics: Laid eggs on dung of herbivorous animal. Basically found on cattle, near cattle manure, animal dung. In NVNP, this fly was collected from bushes, dead leaf and cattle manure.

Distribution: India [West Bengal (NVNP), Assam, Uttarakhand], Burma, Malaya, Sumatra.

9. *Morellia pectinipes* Emden  

Material examined: 1♂, Dolay, 8.III.2018. 1♂ Ashalay, 6.III.2018.

Bionomics: Found on cow dung, cattle, cattle manure. In NVNP, collected from bushes and dead leaves.

Distribution: India [West Bengal (NVNP), Bihar, Uttar Pradesh, Uttarakhand], Sri Lanka.
D. **Rypellia Malloch**


**Key to species**

1. Eyes covered with long dense hair. Prst dorsocentral bristle 3.........................*Rypellia malaise*  
Eyes with microscopic hairs. Prst dorsocentral bristle 2............................*Rypellia flavipes*  

10. **Rypellia flavipes Malloch**


Bionomics: Unknown in India. In NVNP, flies were collected from dead leaves, bushes.

Distribution: India [West Bengal (NVNP), Assam], Burma, Indonesia, Nepal, Sumatra.

11. **Rypellia malaise Emden**


Bionomics: Unknown. In NVNP, flies were collected from bushes.

Distribution: India [West Bengal (NVNP), Assam], Burma, Nepal.

II. **Stomoxyninae**  

E. **Stomoxys Geoffroy**


**Key to species**

1. Eyes separated in male by a quarter head-width or somewhat more of head-width (Dichoptic) .........  

2. Hind tibia with one weak pd bristle on distal2/3. Yellow bodied small fly...........................Atherigonini  

3. Hind tibia with strong pd setae between the middle of the leg and d pre apical..................Phaonini  

12. **Stomoxys calcitrans Linnaeus**


Bionomics: This fly is a haematophagus in nature. Found on cow, cattle shed. Laid eggs on the dung of a harbivorus animal. Very distinct and found in batches near cattle shed. In NVNP, these flies were collected from sores and wounds of cow.

Distribution: India [West Bengal (NVNP), Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Kerala, Orissa, Sikkim, Tamil Nadu and Uttar Pradesh].

13. **Stomoxys dubitalis Malloch**

1932. *Stomoxys dubitalis* Malloch, Annals Magazine of Natural History (10), IX, 426


Material examined: 2♀, 1♂ Ambiok Basti, 15.III.2020.

Bionomics: Flies of this species are haematophagus in nature. These flies are basically found on cattle. In NVNP, collected from cattle shed.

Distribution: India [Madras, Orissa, Uttar Pradesh, West Bengal (NVNP)], Burma, China, Malay, Philippine.

III. **Phaoniinae**  

**Key to tribes**

1. Metathorasic spiracle with some black setulose hairs. (Inserted along lower margin) in addition to the feather like operculum..................Dichaetomyiini  

Metathorasic spiracle without black setulose hairs  

2. Hind tibia with one weak pd bristle on distal2/3. Yellow bodied small fly...........................Atherigonini

Hind tibia with one strong pd bristle...............3

3. Hind tibia with strong pd setae between the middle of the leg and d pre apical..................Phaonini
Hind tibia without strong pd setae between the middle of the leg and d pre apical.........4

4. Well-developed Ad preapical. Femur with pre apical .................................................................Mydaeini

Without an Ad preapical. Mid femur without preapical............................................Limnophorini

Atherigonini

F. Atherigona Rondani
1865. Atherigona Rondani, Dipterologiae Italicae prodromus, 1:97.

14. Atherigona orientalis Schiner

Material examined: 3♂ Ashalay, 6.III.2018.

Bionomies: These flies are generally found on crops (Sorghum, wheat). Larva causes a huge loss in crop production causing dead heart. In NVNP, these flies were collected from bushes.

Distribution: India [West Bengal (NVNP), Arunachal Pradesh, Andhra Pradesh, Bihar, Chhattisgarh, Kerala, Madhya Pradesh, Maharashtra, Nicobar Island, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh], widely distributed in oriental region.

Dichaetomyiini

G. Dichaetomyia Mallock
1921. Dichaetomyia Mallock, Annals Magazine of Natural History. (9)7: 163

1927. Lophomala Enderlein., Konowia, VI, 54.
Genotype: Mydaea flavipalpis Stein.

1952. Hennig, Beiträge zur Entomologie, II, 82.
Genotype: Dichaetomyia polita Mall., 1921

Key to species
1. Scutellum setulose at lower edge.........................2
   Scutellum bare at the lower edge. Longest hair of arista is not or slightly longer than the width of the 3rd antennal segment. .................................Dichaetomyia indica Walker

2. Arista long-plumose, longest rays almost half as long as width of the third antennal segment ......... Dichaetomyia bibax.
   Arista long-plumose, longest rays fully twice as long as width of third antennal segment ........ Dichaetomyia nubiana.

15. Dichaetomyia indica Walker
1856. Anthomyia indica Walker Diptera Saunders, 325♀. Type: E. Indies. B.M.


Material examined: 1♂,1♀, Joributi, 8.III.2018.

Bionomics: In NVNP, these flies were collected from bushes, stones and from the mountain path.

Distribution: India [West Bengal (NVNP), Assam], Sumatra, Java, North Burma.

16. Dichaetomyia nubiana Bigot


Material examined: 1♀,2♂ Alubari, 3X.2018.

Bionomics: In NVNP, the flies were collected from bushes, stone and along mountain path.

Distribution: India [West Bengal (NVNP), Bombay, Uttar Pradesh, Vizag], Burma, Java, Nepal, Sri Lanka, Sumatra, Entire Ethiopian Region.

17. Dichaetomyia bibax Wiedemann
1830. Anthomyia bibax Wiedemann, Aussereuropäische Zweiflügelige Insekten, II, 431

1915. Mydaea laevisvintris Stein, Supplementa entomologica, IV, 16; 1915.

1927. Lophomala laevisvintria (Stein), End., Konowia, VI, 55.

1928. Dichaetomyia laevisvintris(Stein), Mallock, Entomologische Mitteilungen, XVII, 319.


Material examined: 2♂,3♀, Tham Kharga, 15.III.2020.

Bionomics: Found on bushes, plant leaves, dead leaves. In NVNP, the flies were collected from bushes along mountain path.
Distribution: India [West Bengal (NVNP), Assam, Shimla], China, Japan, Java, Malaya, North Burma, Sumatra, Taiwan.

**Limnophorini**

**H. Limnophora Robineau-Desvoidy**


**Genotype, L. palustris R-D.**

**Subgenus Limnophora**

**Key to species**

1. Arista plumose, slightly wider, including plumosity than the 3rd antennal segment. Rays evenly decrease in length from 2nd to 5th onwards. The longest rays about three fifth as long as the width of third antennal segment....................*Limnophora latiseta*

Arista is very short-haired, including hair about one quarter the width of the 3rd antennal segment. The longest hairs are about as long as the basal diameter....................*Limnophora brunnescens*

18. *Limnophora latiseta* Emden


Material examined: 2♂, 1♀ Alubari, 6.X.2018, 1♂ Choudapheri, 7.X.2018.

Bionomics: Unknown.

Distribution: India [West Bengal (NVNP), Assam, Manipur, Mysore], Burma.

19. *Limnophora brunnescens* Emden


Material examined: 2♂, 1♀ Alubari, 6.X.2018, 1♂ Choudapheri, 7.X.2018.

Bionomics: Unknown.

Distribution: India [West Bengal (NVNP), Assam, Silong], Burma.

**Subgenus Heliographa Malloch**

**Key to species**

1. 1+1 stpl. Underside scutellum bare....................

...............*Limnophora (Heliographa) ceylanica*

1+2 stpl. Underside scutellum with some black documented hairs on lateral part....................

...............*Limnophora (Heliographa) tonsa*

20. *Limnophora (Heliographa) tonsa* Stein

1851. *Hydrotaea javana* Macquart., Dipt. exot., suppl. 4, 262

1909. *Limnophoratonsa* Stein, Tijdschrift voor Entomologie, LII, 244, 245.

1921. *Heliographatonsa* (Stein), Malloch, Annals Magazine of Natural History (9), VII, 169.


Material examined: 3♂, 2♀, Botey Kharga. 20.X.2018.

Bionomics: Unknown. In NVNP, these species were collected from stream side soil and stones.

Distribution: India [Northern part of West Bengal, Darjeeling], Buru, Formosa, Java, Malaya, Siam, Sumatra.

21. *Limnophora (Heliographa) ceylanica* Emden


Bionomics: Found exclusively on stream side soil, stone, moshes. In NVNP, it was seen on stone covered with moshes, beside a stream. They are very slow mover. Seen in batches.

Distribution: First time report from India [West Bengal (NVNP)], Sri Lanka.

I. *Graphomyia* Robineau-Desvoidy


22. *Graphomyia maculata* Scopoli


Bionomics: In NVNP, the species was found on stones near stream water. A single fly was collected from the stone surface. Very slow mover.


23. *Graphomyia stipata rufitibia* Stein

1918. *Graphomyia rufitibia* Stein, Annales Hiistorico-Naturales Musei Nationalis Hungarici. XVI, 147;

1926. *Graphomyia vittata* Stein of Malloch (nec Stein), Treubia, VIII, 340;


Bionomics: Unknown.

Distribution: India [West Bengal (NVNP), Maharashtra], Burma, China, Colombia, Java, Mexico, Sumatra.

Tribe Mydaeini

J. *Helina* Robineau-Desvoidy

Key to species
1. Post DC 3. Hind tibia black in colour..................<i>Helina appendiculata</i>
   Post DC 4. Hind tibia orange in colour..................<i>Helina iwasai</i>

24. *Helina appendiculata* Stein


1918. *Mydaea duplex* (Stein), Stein, Annales Hiistorico-Naturales Musei Nationalis Hungarici. XVI, 180


Bionomics: In NVNP, the species was collected from bushes, and stones along the mountain path.


K. *Myospila* Rondani

1856. *Myospila* Rondani, Dipterologiae Italicae prodromus, 1:91

Key to species
1. A pair of faint shifting elongate fuscous black paramedian spots on the 2<sup>nd</sup> and 3<sup>rd</sup> abdominal segment.........................<i>Myospila tenax</i>

A pair of small brown spot near hind margin of the 2<sup>nd</sup> and 3<sup>rd</sup> abdominal segment......................................................<i>Myospila bina</i>

25. *Helina iwasai* Shinonaga


Bionomics: In NVNP, the species was collected from bushes, and stones along the mountain path.


26. *Myospila bina* Wiedemann


1909. *Mydaea ungulata* Stein, Tijdschrift voor Entomologie LII, 233

1921. *Xenosia ungulata* (Stein), Malloch, Annals Magazine of Natural History (9) VII, 422;


Bionomics: Unknown. Collected along the mountain path.

Distribution: India [West Bengal (NVNP), Bihar, Sikkim, Shimla], Burma, China, Java, Malaya, Philippine, Sri Lanka, Sumatra.

27. *Myospila tenax* Stein


1965. *Xenosina tenax* (Stein.) Emeden, Fauna India, Muscidae, 7(1):442
Bionomics: Unknown. Collected from bushes along mountain path.
Distribution: India [Assam, West Bengal (NVNP)], Burma, China.

Tribe Phaoniini

L. Phaonia Robineau-Desvoidy

28. Phaonia kambaitiana


Material examined: Bionomics: Unknown. The species was seen on bushes along jungle path.
Distribution: India [West Bengal (NVNP), Dehradun, Himachal Pradesh, Sikkim], Burma, Nepal.

30. Brontaea distincta Stein


Bionomics: Unknown.
Distribution: India [West Bengal (NVNP), Assam, Bihar, Punjab], Burma, Ceylon, China, Nepal.

31. Brontaea lasiopa Emeden


Bionomics: Unknown. The species was seen on bushes, soil and stones along the mountain path.
Distribution: India [West Bengal (NVNP), Shimla], Burma, Nepal.

Habitat figures of some species are given in Figs. 3-15. The diversified environment of the forests of NVNP in association with altitudinal variation harbors lots of flies of family Muscidae. The present work has reported 31 species of Muscidae belonging to 13 genera of three subfamilies. There may be a significant contribution to the muscid fly family diversity in this national park in which most parts were untouched till the survey (Fig. 3). It was found that muscid flies play a significant role in pollination in this National Park in scarcity or complete absence of honey bees (a scientific observation has been communicated to a journal for publication). From the diversity of muscid flies, it can easily be concluded that the National Park preserves good ecological balance and provides every habitat that is ideal for the survival of insect species. The new records of two species viz., Limnophora (Heliothrica) ceylanica (Emden, 1965) and Neomyia pecifica (Zimin, 1951) from India is a significant outcome of this study.
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