

# Taxonomic Study on Some Diptera Insects in Shapotou National Nature Reserve, Zhongwei, Ningxia

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**Abstract:** Nearly 40 years since the establishment of the Ningxia Zhongwei Shapotou National Nature Reserve, great achievements have been made in sand control and sand fixation, improving the diversity of the reserve. In this study, the morphology of Diptera insects collected in the area from 2022 to 2024 was carried out, and the identification was based on the COI gene sequence.

**Keyword:** Taxonomy; Diptera; Ningxia Zhongwei Shapotou National Nature Reserve

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## 1. Introduction

Diptera insects are one of the four groups with the highest diversity of animal species, consisting of the suborder Longhorn and the order Shorthorn, which belong to the complete metamorphosis of insects, with 165,000 species described so far, accounting for 10% of all species on Earth<sup>[1-3]</sup>. Diptera has almost all insect habits, including herbivorous, carnivorous, saprophytic, parasitic, blood-sucking, and so on<sup>[4]</sup>. The habits of Diptera are diverse, which can reflect the diversity of insects in Shapotou Nature Reserve to a certain extent. At present, there is little research on Diptera in protected areas. This paper provides basic data for the conservation, development, and utilization of insect diversity and insect diversity in the reserve.

The reserve is located in the northwest of Shapotou District, Zhongwei City, geographical coordinates: 37°25'0"~37°37'48"N, 104°39'1"~105°9'12"E, with a total area of 27194.27 hm<sup>2</sup>. There are arid sandy lands, wilderness grasslands, and mobile sand dunes in the reserve<sup>[5]</sup>.

## 2. Materials and methods

### 2.1. Research the material

In July 2022, July–August 2023, and July–August 2024, the collection was performed within the Shapotou Nature Reserve.

### 2.2. Morphological identification

Appraisal materials: Insects of Habahu 6<sup>[6]</sup>, Fauna Sinica Insecta Vol. 50 Diptera Syrphidar<sup>[7]</sup>, Fauna Sinica Insect Vol. 8 Diptera: Culicidae 1<sup>[8]</sup>, Flies of China Volume 1<sup>[9]</sup>, Flies of China Volume 2<sup>[10]</sup>, Fauna Sinica Insecta Vol. 49 Diptera Muscidae (1)<sup>[11]</sup>, Atlas of Economic Fruit Flies (Diptera: Tephritidae)<sup>[12]</sup>, Practical fly primary colors illustrated<sup>[13]</sup>, Economic Insect Fauna of China Fasc. 26 Diptera: Tabanidae<sup>[14]</sup>, Economic Insect Fauna of China Fasc. 45 Diptera: Tabanidae (II)<sup>[15]</sup>, Economic Insect Fauna of China Fasc. 37 Diptera: Anthomyiidae<sup>[16]</sup>, Economic Insect Fauna of China Fasc. 37 Diptera: Ceratopogonidae (II)<sup>[17]</sup>.

### 2.3. DNA sequencing

For COI gene sequencing of specimens, MEGA-X was used to run the spliced gene sequence on the NCBI website to run the BLAST program for homology comparison and analysis, and further confirm whether the measured sequence is the COI gene sequence of the sample. After alignment, the genus was determined, and the gene sequence amplified with the same primer was downloaded and applied in GenBank according to the genus name, and the non-conserved region was removed by MEGA-X for alignment. MEGA-X software was used to analyze the base composition, variation sites, and sequence differences between various species, and the NJ neighbor-joining (NJ) phylogenetic tree was constructed.

## 3. Results

An account of Diptera insects in Shapotou National Reserve, Zhongwei, Ningxia is shown as follows.

### Diptera

#### Culicidae

*Aedes (Ochlerotatus) dorsalis* (Meigen, 1830)

The body length is 5.5mm. The top and back of the head are pale yellow; The antennae are pale in color. The thorax is pale yellow, The thorax is almost completely covered in white. The abdomen is covered with light yellow scales. Wing scales are yellowish-brown with black scales.

Distribution: Widely distributed in northern China; Mongolia, Japan, Russia, North America, Central Europe, and North Africa.

*Aedes vexans* (Meigen, 1830)

The male has a body length of 5.4 mm and a wing length of 3.2 mm. The body is brown. The antennae are longer than the beak.

Distribution: Spread all over the world.

*Anopheles (Anopheles) sinensis* (Wiedemann, 1828)

The female wings are 5.1 mm long. The antennae are longer than the antennae, slightly shorter than the beak,

with stubby short hairs. Light-colored marginal hairs at the apical wing.

Distribution: China (except Qinghai and Xinjiang); Japan Korean Peninsula, India, and Southeast Asia.

### **Chironomidae**

*Polypedilum nubifer* (Skuse, 1889)

Body length 5.0 mm. The body is black, and the thorax has a gray-pink quilt. The wings are transparent and have weak wing spots. There are no bristles on the outer side of the protrusion of the appendage.

Distribution: Spread all over the world.

*Chironomus oryzae* (Matsumura, 1931)

The male is about 3 mm. The body is yellow. The top of the head and face are yellow, and the back of the head is gray. The ends of the leg and tibia are black. The wings are white and transparent. The female is 2.5 mm long.

Distribution: Ningxia, Heilongjiang, Hunan, Gansu; Japan, and South Korea.

*Chironomus sinicus* (Kiknidze & Wang, 2005)

The male has a body length of 8.2–9.2 mm and a wing length of 4.2–4.5 mm. The body is light brown. The mid-wing transverse veins are black-brown, sometimes inconspicuous.

Distribution: Ningxia, Beijing, Tianjin, and Hebei.

*Chironomus dorsalis* (Meigen, 1818)

The male mosquito has a body length of 6.1 mm and a wing length of 3.2 mm. The body is yellowish-green. The wings are transparent and have no spots. The head has a pronounced frontal tumor. The tip of the anus is elongated and the tip is slightly rounded.

Distribution: Ningxia, Beijing, Inner Mongolia, Liaoning, Hebei, Shanghai; and the Palaearctic region.

*Prosilocerus akamusi* (Tokunaga, 1938)

The male has a body length of 8.9 mm and a wing length of 5.8 mm. Body dark brown Hue. Black-brown at mid-transverse veins of forewings. The feet are black, and the legs and tibiae are reddish-brown. The tip of the anus is short and protruding, pointing posteriorly and superiorly.

Distribution: Beijing, Inner Mongolia, Liaoning, Tianjin, Hebei, Jiangsu, Shanghai, Hubei, Yunnan; Japan, and Korean Peninsula.

### **Tipulidae**

*Nephrotoma lundbecki lundbecki* (Nielsen, 1907)

Body length 11.0–14.5 mm. The head is yellow, and the upper margin of the beak, nasal process, and antennae are black. The abdomen is yellow.

Distribution: Ningxia, Inner Mongolia; Mongolia, Russia, Canada, USA, Greenland, Finland, Norway, and Sweden.

### **Stratiomyidae**

*Odontomyia angulata* (Panzer, 1798)

Body length 8.0–12.0 mm. Head: males with brown eyes and yellow antennae; The female has larger eyes and a yellow head.

Distribution: Ningxia, Beijing, Shanxi, Xinjiang; and the Palearctic region.

### **Tabanidae**

*Chrysops mlkosiewiczzi* (Bigot, 1880)

Body length 9.0–11.0 mm. The frontal blades are moderate, the margins are black, and the rest are yellowish-brown. The abdomen is pale yellow.

Distribution: Ningxia, Spread all over the world; Iran, Russia, and Central Asia.

*Atylotus bivittateinus* (Takahasi, 1962)

The female is 12.3–17.0 mm long. Earthy yellow. Compound eyes yellow-green, with pupils; antennae orange-yellow, with 2 dark spots below the middle of the forehead and a heart-shaped above. The male is 11–13 mm long.

Distribution: Beijing, Shaanxi, Inner Mongolia, Heilongjiang, Jilin, Liaoning, Hebei, Shanxi, Henan, Shandong, Jiangsu, Zhejiang, Fujian, Guizhou; Japan, and Russia.

*Atylotus horvathi* (Szilady, 1926)

Body length 12–15 mm. The forefoot segments are greyish-brown with yellow at the ends, the middle hindfoot segments are often grayish-brown only at the base, and the tibial ends and tarsal joints of the forefoot are black.

Distribution: Beijing, Shaanxi, Heilongjiang, Jilin, Liaoning, Hebei, Henan, Shandong, Jiangsu, Zhejiang, Anhui, Hubei, Guizhou; Japan, the Korean Peninsula, and Russia.

### **Asilidae**

*Cophinopoda chinensis* (Fabricius, 1794)

Body length 20.0–28.0 mm. Black head and chest; The chest is covered in gray powder. The abdomen is reddish brown. Feet black. Prey small insects.

Distribution: China Guangfu, North Korea, Japan, India, Nepal, Sri Lanka, and Indonesia.

### **Syphidae**

*Episyrphus balteatus* (De Geer, 1776)

Body length 7.0–11.0 mm. Male: compound eyes naked; The top of the head is black; The face is yellow. The thorax is black. The abdomen is yellow. The feet are brownish-yellow. The wings are hyaline.

Distribution: widely distributed in China; Russia, Mongolia, Japan, Afghanistan, North Africa, Australia, Oriental Zone, and Europe.

*Eristalis cerealis* (Fabricius, 1805)

Body length 11.0–13.0 mm. Males: head black; compound eyes densely covered with brown hairs; The antennae have pinnate hairs at the base. Most of the foot is black.



Distribution: widely distributed in China; Russia, the Republic of Korea, Japan, and the oriental Zone.

*Eristalis campestris* (Meigen, 1822)

The body length is 14–15.5mm. The compound eyes are covered with brown hairs. The top of the head is black. Antennae black. The scutarea are yellow. The foot is mainly black. There is 1 brown spot in the middle of the wings, and the ends of the wing nevus are brownish-black.

Distribution: Ningxia, Shanxi, Shaanxi, Gansu, and Qinghai.

*Eupeodes corollae* (Fabricius, 1794)

The body length is 7.0–10.0 mm. Female: black on the top of the head, covered with black hair; the face is yellow, the thorax is black; the dorsal plate of the mesothoracic plate is patina green; the lateral margin is dark yellow; and the abdomen is black. In males, the middle of the 3rd and 4th segments of the dorsal plate of the abdomen are often connected.

Distribution: Widely distributed in China: Russia, Mongolia, Japan, Asia, Europe, and North Africa.

### **Trypetidae**

*Tephritis sinensis* (Hendel, 1927)

The female wing is 4.5 mm long. Half of the base of the wing is nearly transparent, and the terminal half is black-striped. The ovipositor tubes are short, yellowish-brown, and black-brown at the ends.

Distribution: Ningxia, Hebei, Shanxi, Henan, Jiangsu, Guangxi, Sichuan; Japan, and Korean Peninsula.

*Trupanea amoena* (Frauenfeld, 1856)

The body length is 3.2–4.0 mm. The body is light yellowish-brown, and the compound eyes have an iridescent sheen. The outer margin of the forewings has black stellate markings, its costal margin has 2 hyaline spots. Females have distinct and long ovipositors.

Distribution: Ningxia, Beijing, Gansu, Xinjiang, Inner Mongolia, Hebei, Jiangsu, Taiwan region, Sichuan, Yunnan; Asia, Europe, Africa, and Australia.

### **Chloropidae**

*Meromyza nigriventris* (Macquart, 1835)

The female has a body length of 3.9 mm and a wing length of 2.9 mm. The body is pale yellowish-green. The head is black-brown only in the single-eye area. The dorsal abdomen has three rows of black longitudinal stripes, the two sides are shorter, and the middle one is almost continuing.

Distribution: Ningxia, Beijing, Gansu; Gubei District, Palearctic realm, and Neartic realm.

### **Uliidiidae**

*Melieria omissa* (Meigen 1826)

The body length is 7.0 mm, and the wing length is 6.0 mm. The head is pale yellow. The wings are transparent with punctate dark spots.

Distribution: Ningxia, Beijing, Xinjiang, Inner Mongolia, Tibet; Japan, Korean Peninsula, Mongolia, Israel, and Europe.

## **Conopidae**

*Myopa buccata* (Linnaeus, 1758)

Body length 5.0–11.0 mm. The top of the head is yellow; The lower margin of the cheeks has long cilia pale yellow; the beak is longer than the head, black-brown, reddish-brown at the end. The antennae are reddish-brown. Smoke-coloured wings with transparent windows. The abdomen is reddish-brown.

Distribution: Ningxia, Zhejiang, Shandong, Sichuan, Russia, Europe, and the Palearctic realm.

## **Muscidae**

*Fannia canicularis* (Linnaeus, 1761)

The male is 5.0 mm long. Compound eyes naked; antennae black, antennae with short vellus hairs; The lower jaw is black and rod-shaped. The thorax is covered with a gray-pink coat. The feet are black and the knees are slightly brownish.

Distribution: Spread all over the world.

*Muscina stabulans* (Fallén, 1817)

The body length is 6.5–8.9 mm, and the wing length is 5.3–7.5 mm. In males, the two compound eyes are slightly separated, and the forehead is about twice the width of the antennae. The antennae are black. The tips of the scutarea are reddish-yellow. The leg segments are black.

Distribution: Spread all over the world

*Musca domestica* (Linnaeus, 1758)

Body length 6–8 mm. The body is gray-black. The compound eyes are reddish-brown and glabrous, similar to the width of the compound eyes.

Distribution: Spread all over the world.

*Lispe loewi* (Ringdahl, 1922)

Gena without a seta. Notum with at least two pairs of dorsoventral setae; fore femur usually with pv row. Hind first tarsomeres without such finger-like protuberance. Hind first tarsomere is normal. Mid tibia with 1–2 strong ad. Hind tibia without av; basi phallus of male with thorns, branches of distiphallus distinctly present. Mid-forth tarsomere without an apical spine. Mid first tarsomere with 1 solely long hair-like seta (rarely with two long setae) on basal, mid tibia with long ventral hairs on distal half, in which with 2 short spines; vibrissae absent or very weak.

Distribution: China, Scandinavia, Northern Africa, Great Britain, and Afrotropics.

## **Sarcophagidae**

*Kozlovea cetu* Chao & Chang, 1978

The male is 11.2 mm long. The body is black, with a white or off-white pink coat. The forehead is 0.57 times the width of the compound eye, there is no outer parietal mane. antennae black, antennae long pinnae;

Distribution: Ningxia, Beijing, Tibet.

## **Calliphoridae**

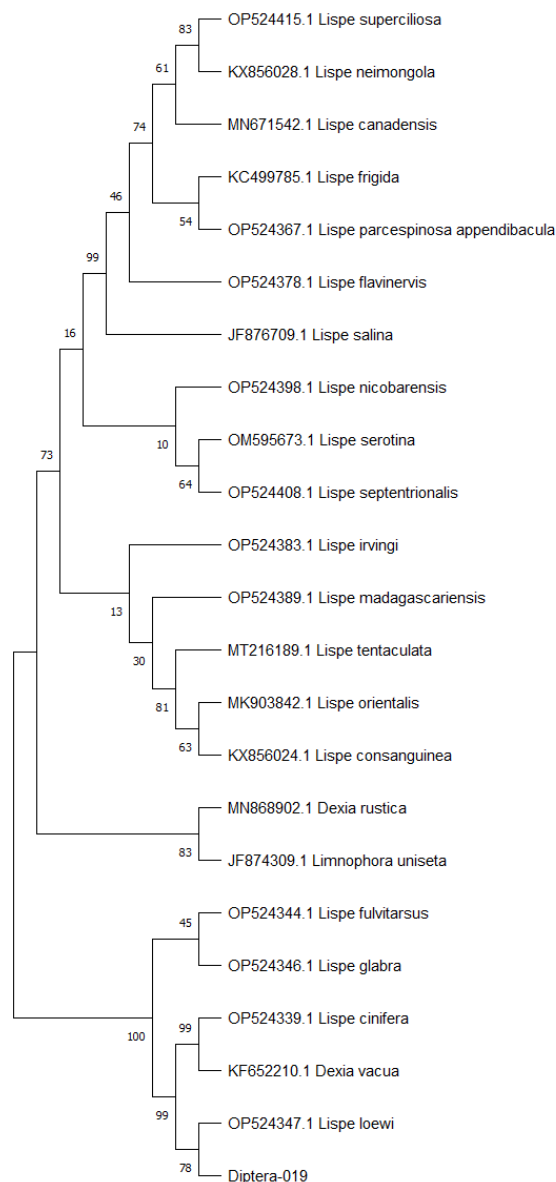
*Lucilia cuprina* (Wiedemann, 1830)

The body length is 5.0–8.0 mm. The forehead is at the narrowest point: The male forehead is about the same width as the middle front; The abdomen of the lateral male is arched in the posterior and upper part.

Distribution: Ningxia; Spread all over the world.

#### 4. Phylogenetic tree analysis

Due to the large number of species in the Diptera order, this study calculated using the intra- and inter-species genetic distances for the overall identification. For some species, the study used the construction of a NJ phylogenetic tree. **Figure 1** shows the phylogenetic tree (NJ tree) of specimen number Diptera-019 based on COI genes and using the MEGA-X software component for *Lispe Loewi*.



**Figure 1.** Adjacent NJ phylogenetic tree constructed by Diptera based on COI

From the above results, it can be concluded that DNA barcodes combined with morphological features can be used to detect 29 species of insects belonging to 25 genera and 14 families in the Shapotou National Nature Reserve in Zhongwei, Ningxia.

## 5. Discussion

The diverse habits of Diptera insects reflect the diversity of insects in Shapotou Nature Reserve to a certain extent. This study carried out a detailed taxonomic performance of Diptera insects in Shapotou National Nature Reserve in Zhongwei, Ningxia, updated the existing species list of Shapotou Nature Reserve, and enriched the biodiversity data of Diptera in the reserve.

## Disclosure statement

The author declares no conflict of interest.

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