

# First Report of the Bee Fly *Eurycarenum dichopticus* Bezzi (Diptera: Bombyliidae) in North Kordofan State, Sudan

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## Abstract

Sudan's semi-arid land constitutes a diversity of habitats, species, and genetic resources of high ecological and economic value. This diversity is gradually degrading due to climate change and human misuse. Biodiversity monitoring began in Sudan before independence when a considerable number of flora and fauna species were identified. Insects were among the identified fauna where many orders, families, and species were classified especially those of economic, medicinal, and veterinary importance. Bombyliidae or bee flies are considered native to African countries and confined to the semi-arid ecosystem as pollinators of higher plants. The bee fly, *Eurycarenum dichopticus* recorded from these ecosystems, has gained little attention, and meager data on its biology and reproduction have been published. Adults of this insect are nectar feeders, and females also feed on pollen grains while larvae are parasitoids on certain insects. This study was conducted in three Sudanese states that lie within the semi-arid ecosystem; Khartoum, Gezira, and North Kordofan. Field surveys were conducted in these states and insect fauna was obtained and identified. Bee fly specimens were collected from North Kordofan using the butterfly net method. The specimens were then preserved and sent to the Agricultural Research Corporation ARC in (2020) where they were identified as *Eurycarenum dichopticus* Bezzi (Diptera: Bombyliidae) which is the first report in North Kordofan. This identification may contribute to the understanding of its ecological significance and role.

## Keywords

Sudan, Semi-Arid Ecosystem, Diversity, Bee Fly, *Eurycarenum* sp.

## 1. Introduction

Biodiversity refers to the different kinds of living organisms found within a given area. The United Nations Environment Program defines it as the variety and variability of all animals, plants, and micro-organisms and the ecological complexes of which they are a part [1]. Ecologists believe that communities with high species richness tend to be more stable than those with lower species richness. Many factors are thought to be the main causes of biodiversity loss and the extinction of species (plant or animal) worldwide, as well as the reduction or loss of native species in a given habitat. These factors include the alteration of land use, primarily through habitat loss or modification, changes in species diversity and abundance, degradation of soil quality, depletion of water resources, and over-exploitation of endemic species.

Bombyliidae or bee flies are a large family that includes over 5830 species worldwide [2]. Bee flies showed an erratic fossil record, with species collected from different ecosystems. Their ecological distribution is affected by climatic factors especially temperature [3]. As the adults of bee flies are often considered major pollinators of many flowering plants, especially those occurring in more arid regions of the world, their geographical distribution is largely associated with the distribution of these plants [4].

They are named bee flies for their resemblance to bees and their usual visits to flowers. They are cosmopolitan insects contributing to the fly diversity in arid and semiarid ecosystems and are widely distributed in the northern hemisphere; they are found in North America as well as in Europe and Asia. Early studies on the African Bombyliidae indicated significant illustrations of the Bombyliidae origin in this region and clarified their taxonomy had also encouraged some speculations on intercontinental relationships [5].

Morphologically, bee flies resemble honey bees and are thus commonly named after them. Bee flies possess colorful patterns of stripes and spots on the wings and bodies, have hairy surfaces, and produce noisy sounds upon flying activities. As members of Diptera, bee flies have a pair of wings, large compound eyes, three to six-segmented aristate antennae, and long legs. They are prodigious fliers that can hover in midair, move very fast, and maneuver with great skill, changing directions in the blink of an eye. They possess a stiff and long tongue, or proboscis, which they use for probing into flowers to sip their nectar while hovering in front of them. By not landing on the flower they seem to try to avoid the predators that may be hiding in them, such as crab spiders or ambush bugs [6]. Despite barely touching the flowers, some pollen sticks to their furry coat and can easily be transported to other flowers. Thus, bee flies are of economic importance as well as an attractive group of insects for studies on biodiversity and evolution.

**Despite** the ecological role of some Bombyliidae species as pollinators, they remain less abundant in comparison to the known insect pollinators due to their little activity in attending near flowering plants grown on domestic farms [2].

**Bee flies** showed complete metamorphosis with adult feed on plant nectar as

potential pollinators of higher plants. Nevertheless, their larvae are parasitoids or predators in some insect immature stages. They are either small-sized insects of 2 mm in length or large-sized that can reach 40 mm. When at rest, many species hold their wings at a characteristic “swept back” angle. Adult bee flies have large-sized heads and fully developed mouthparts adapted for feeding behavior, where both sexes feed on nectar but females also feed on pollen and many have modified legs for collecting pollen grains. Furthermore, immature stages of most of the bee flies are parasitoids or predators of other insects. Female bee flies may lay their eggs encrusted in sand particles before being deposited into the soil surface [7].

*Eurycarenum* is a genus of bee flies distributed in the Afro-tropical and the Palearctic zones (see [Table 1](#)).

**Table 1.** Classification of the genus *Eurycarenum* [8].

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Diptera
Family	Bombyliidae
Genus	Eurycarenum

Adults of this genus are nectar feeders and larvae are parasitoids. These larvae are used in biological control trials against some insect pests including locusts.

## 2. Life Stages

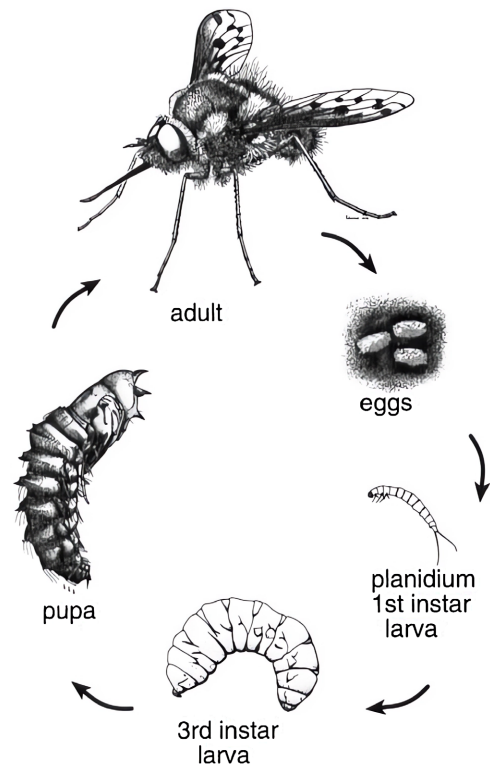
Bee flies develop in a complete metamorphosis and have four stages in their life cycle: egg, larva, pupa, and adult. This cycle starts when adult females lay eggs in or near burrows of host insects such as beetles, wasps, and bees. A few days later, eggs hatch into larvae, feed on the host insect and later pupate, exit the host’s nest, and become mature winged adults ([Figure 1](#)).

## 3. Adult

The adult stage usually, mimics bees of the superfamily Apoidea in body shape; its body is compressed and covered with thick hairy cuticles. The size ranges from (1.0 mm to 2.5 cm), and has different colors such as brown, blackish-grey, white or yellow. In other species patches of flattened hairs occur that can serve as sense organs to produce visual signals that trigger reproduction or perhaps imitate reflecting surface particles on bare soils with high content of materials like quartz, mica or pyrite.

**The legs** are long and thin and the front legs are sometimes smaller and slenderer than the middle and rear legs. Typically, they are provided with bristles at the apex of the tibiae, without empodia and, sometimes, also without pulvilli.

**The wings** are transparent, often hyaline or evenly colored, or with bands. The



**Figure 1.** Diagrammatic representation of bee fly life cycle [7].

basal flap or alula are well developed and in the rest position, the wings are kept open and horizontal in a V-shaped position revealing the sides of the abdomen.

**The abdomen** is generally short and wide, subglobose-shaped, cylindrical, or conical, composed of six to eight apparent segments or urites. The remaining abdominal segments comprise external genitalia. In females, the abdomen terminates with spiny processes, which are used in oviposition.

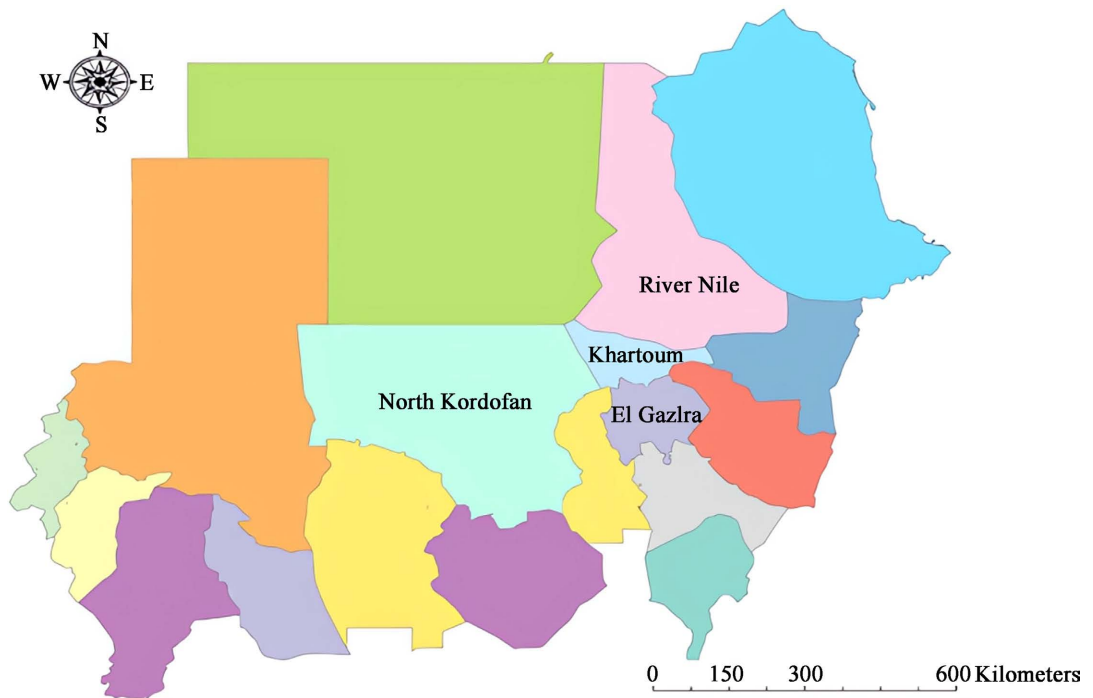
**Larvae** are grouped into two types; the first type has an elongated and cylindrical body shape and has a different tracheal system, provided with a pair of abdominal spiracles and, possibly, a thoracic pair. Those of the second type are stubby and eucephalic and have one pair of spiracles positioned in the abdomen. Most bee fly larvae are ectoparasitoids, that attach themselves to hosts, usually insect larvae, in concealed places such as burrows or nests. Their hosts are solitary bees and wasps, grasshopper egg pods and beetle larvae. These larvae are distributed in open dry sandy habitats that support the greatest diversity of preferred hosts [9].

#### **4. Collection of *Eurycarenum dichopticus***

A research project was designed to monitor insect diversity in Sudan's semi-arid land aimed at clarifying its diversity and ecological role by providing a database on insects' functional groups needed to manipulate strategic planning in biological control efforts. During the study course of this research project, bee fly specimens were obtained within the insect collection using butterfly netting method

from North Kordofan State and the specimens were then preserved for further identification [10].

North Kordofan State (15.1706°N, 29.4179°E (Figure 2), is a part of Sudan's semi-arid ecosystem; its prevailing climatic conditions show a short duration of annual rainfalls extending during the summer season with average evaporation potential of 1800 mm and air temperature reaches over 40°C. The soil texture is sandy clay loam texture and poor organic nitrogen and carbon contents, where the natural vegetation is composed mainly of *Acacia* spp. and other trees of economic importance [11] (Figure 3).



**Figure 2.** Location map of the study sites (Source Abdelatif and Elias, 2018).



**Figure 3.** Natural vegetation in north Kordofan state (Photographed by the author Maha, 2022).

## 5. Identification of *Eurycareus dichopticus*

Bee fly specimens were identified by the Agricultural Research Corporation, (ARC), the National Insect Collection, Insect Taxonomy Unit, as three different species of Bombyliidae: Diptera; *Exhyalanthrax* sp., *Exoprosopa* sp. and *Eurycareus dichopticus* (Table 2). The latter is reported for the first time in North Kordofan State (Figure 4).

**Table 2.** Taxonomic list of bee fly specimens collected from North Kordofan state during the study period (2019 - 2021) [12].

Scientific Name	Genus	Family	Order	Common Name
<i>Exhyalanthrax</i> sp.	<i>Exhyalanthrax</i> Becker, 1916	Bombyliidae	Diptera	Bee fly
<i>Eurycareus dichopticus</i> Bezzi, 1920	<i>Eurycareus</i> Loew, 1860	Bombyliidae	Diptera	Bee fly
<i>Exoprosopa</i> sp.	<i>Exoprosopa</i> Macquart, 1840	Bombyliidae	Diptera	Bee fly



**Figure 4.** Bee fly, *Eurycareus dichopticus* (Photographed by the author Essra, 2020).

## 6. Discussion

Efforts to document the biological diversity in Sudan began before the country's independence. These efforts resulted in the identification of 3132 flowering plant species, 106 species of the Nile fish, 265 species of mammals, 938 species of birds and two species of amphibians and many insects and other arthropods [13]. However, there are several combined factors that led to a loss of many of these species, including dominant harsh conditions, frequent cycles of drought, desertification, flooding, fire, habitat destruction, and climatic fluctuations [14]-[16]. The absence of information on approximately 114 animal species, and 127 species have been reported as threatened [17], with many species having gone extinct since 1980s or having been extirpated from their natural habitats in the Blue Nile, South Darfur,

and Nuba Mountains regions.

Recently, many biodiversity projects have been implemented to investigate the state of insect diversity in various areas of Sudan. These projects led to the identification of numerous functional groups of different insects.

*Eurycarenus* specimens obtained from North Kordofan state were preliminarily identified into three species but one of these three was fully ascribed as *Eurycarenus dichopticus* which is the first record in this region in Sudan where the first record of this species in the Sudan was in 1966 during field surveys conducted in central and north Sudan [17]. This record may add to the understanding of its zoological distribution and abundance in relation to temporal climatic variability. It is obvious that the geographical distribution of species in Sudan is confined to semi-arid ecosystems, and these areas are often susceptible to droughts and human practices, which threaten the diversity of the species, necessitating the conservation of biodiversity.

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### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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