

## Original Article

### Incidence of *Culicoides* species in Maiduguri Nigeria

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## Abstract

**Background:** *Culicoides* are Diptera of the Family Ceratopogonidae commonly called biting midges or *no-see-ums* with the capacity as biological vectors of pathogens causing notifiable diseases. **Objectives:** We surveyed to ascertain the presence and species composition of *Culicoides* species from various locations and catch points in Maiduguri, Nigeria. **Methodology:** *Culicoides* insects were trapped from the selected locations and study points using laboratory-designed sticky traps made of wooden cardboard, painted bright yellow, and coated thinly with petroleum jelly (Vaseline®) which serves as an adhesive. **Results:** The incidence of *Culicoides* species between August and November in this study revealed a total catch of 34 using the sticky board trapping with *Culicoides bolitinos* having 32 (94.1%) and *C. engubandei* 2 (5.9%). Distribution of catches based on study location/foci and/or catch points/loci showed the highest incidence on the University of Maiduguri livestock farm with 11 (32.4%) and drinking troughs with 15 (44.1%). In conclusion, this study has revealed a location cum catch point dependent incidence of *Culicoides* in Maiduguri, Nigeria. **Conclusion:** Despite the low incidence of *Culicoides* species, we established their presence across the different study locations. We recommend that further studies be conducted to ascertain the seasonal presence as well as their preferred feeding host in the *study* locations.

**Keywords:** *Culicoides*, Incidence, Maiduguri, Nigeria

## Introduction

The dipterid *Culicoides* commonly known as biting midges, punkies, or *no-see-ums* are haematophagous, having a worldwide distribution, and are vectors of several pathogens of Veterinary and Medical relevance<sup>1</sup> which include more than 50 arboviruses of *Bunyaviridae*, *Reoviridae*, and *Rhabdoviridae* comprising of blue tongue virus (BTV), aka bane virus (AKAV), bovine ephemeral fever virus (BEFV), epizootic haemorrhagic disease virus (EHDV), Schmallenberg virus (SBV), African horse sickness virus (AHSV), Oropuche virus (OROV), equine encephalitis virus (EEV), rift valley fever virus (RVFV)<sup>1,2,3</sup>; protozoans like *Haemoproteus*<sup>4</sup> and *Leucocytozoon*

species,<sup>5</sup> filariid nematodes of *Mansonella*, *Onchocerca*, di-and-*Tetrapetalonema*, and the seasonal recurrent dermatitis of sweet itch or Queensland itch.<sup>3,6,7,8,9,10,11</sup> In Nigeria, epidemiological surveys have confirmed the existence of antibodies to some of the above-listed viral diseases transmitted by *Culicoides* including blue tongue virus,<sup>12</sup> Schmallenberg virus,<sup>13</sup> Nigeria equine encephalitis virus<sup>14</sup> and African horse sickness virus.<sup>15</sup> Furthermore, other protozoan and filarial nematode diseases transmitted by *Culicoides* have been documented highlighting the importance of the vector in transmitting disease-causing agents in Nigeria.<sup>16,17,18</sup> There exist an estimated 1400 species of *Culicoides*

**Cite this article as:** Abdullahi A. Biu, Hyellamada J. Chama, Jummai Musa, ThankGod E. Onyiche; Incidence of *Culicoides* species in Maiduguri Nigeria. Kanem J Med Sci 2024; 18(1): 9-14

worldwide with their distribution closely guided by the presence of suitable breeding habitats, microclimates, and hosts.<sup>3,19</sup> Identification of members of the family Ceratopogonidae is mainly through their 15-segmented antennae and unique wing venation. Their wing pattern is composed of grey and white venation, and each species of the fly has a unique pattern that is useful for identification under a dissecting microscope.<sup>20</sup> However, the absence of wing patterns in about 10% of *Culicoides* species in Africa makes their identification challenging. Consequently, identification is based on dissection and microscopic examination of specimens on glass slides.<sup>21</sup> The blood-feeding behaviour of female biting midges predisposes them as vectors of disease pathogens highlighting their economic importance in disease transmission. Surveys for *Culicoides* species have been undertaken recently in Zaria, Kaduna State,<sup>19</sup> however, in Maiduguri, Borno state, this study appears to be the first. In this study, we aimed to characterize the local fauna of *Culicoides* species collected from livestock farms, horse stables, and abattoir lairage in Maiduguri, Nigeria.

### Materials and Method

#### Description of Maiduguri, the Study Area

Maiduguri, the capital and largest city of Borno State in north-eastern Nigeria lies within the coordinates of Latitude 11°46'18"N to 11°53'21"N and Longitude 13°03'23"E to 13°14'19"E with a total area of 208Km<sup>2</sup> at an elevation of 1050 feet.<sup>22</sup> The climate according to the Köppen-Geiger classification system is a hot semi-arid type (BSh) with a hot-dry season between March and May (temperature range: 79°F – 103°F), the wet season between July and September (temperature range: 73°F-92°F) and cold dry Harmattan season from December to February with an average low temperature of 59°F. (Department of Geography, University of Maiduguri, Nigeria, November 2022).

#### Sample Collection Sites

During August and November 2016, an incidence study of *Culicoides* species was conducted using catches obtained from 5 locations within Maiduguri viz:

- (i) University of Maiduguri Livestock Farm
- (ii) College of Agriculture Livestock Farm
- (iii) Kasuwan Shanu Livestock Market
- (iv) Kasuwan Shanu Abattoir Lairage
- (v) Unguwan Doki Horse Stables

Using 6 catch points viz:

- (a) Drinking troughs
- (b) Leaking water pipes
- (c) Decomposing grass heaps
- (d) Plant shades
- (e) Animal shades
- (f) Gutters

#### Trapping

Laboratory-designed sticky traps made of wooden cardboard painted bright yellow (reported as highly attractive to many insects including *Culicoides* species,<sup>23</sup> and coated thinly with petroleum jelly (Vaseline®) which serves as an adhesive were used. Trapping was conducted from dusk (18.00) to dawn (06:00) as *Culicoides* are crepuscular in the habit of suspending the cardboards on any nearby tree or convenient objects at about 1.5 – 2m above the ground and midges landing on them were unable to extricate themselves. In the laboratory, the Vaseline® was dissolved in xylene and trapped insects preserved in 80% ethyl alcohol before species identification.

#### Morphological Identification

In the Parasitology Laboratory, Department of Veterinary Parasitology and Entomology, University of Maiduguri, *Culicoides* species were sorted from other insects based on their wing pigmentations under a binocular stereoscopic microscope and prepared as permanent slide mounts on Canada balsam and examined under x100 magnification of the Olympus microscope for morphological identification to species level using their characteristic wing maculations and distribution of macrotrichia, shape and size of the antennae and palpal segments in comparison to referenced taxonomic keys.<sup>6,24</sup>

#### Results

This study identified *Culicoides bolitinos* and *Culicoides engubandei* based on the reference keys by Coetzer and Tustin.<sup>6</sup> with incidence rates represented as pie chart percentiles. The highest incidence of 94.1% with 32 catches was for *Culicoides bolitinos* while *Culicoides engubandei* had 5.9% with 2 catches (Figure 1). The distribution of catches was evenly spread amongst all the locations sampled in this study but on comparison was highest on small and large ruminant locations with 28 (82.4%) compared with the 6 (17.6%) on horse stables (Figure 3). Incidence based on catch points was highest for drinking troughs 15 (44.1%) than leaking pipes 9 (26.5%), animal dung 4 (11.8%), gutters 3 (8.8%), plant shades 2 (5.9%) and decomposing grass heaps 1 (2.9%) (Figure 3)

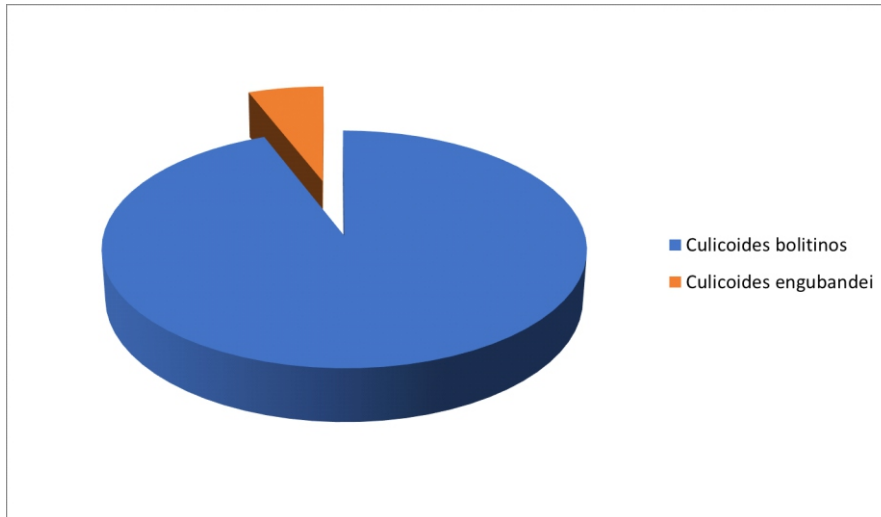


Figure 1: Pie chart showing the species diversity of *Culicoides* in Maiduguri, Borno State

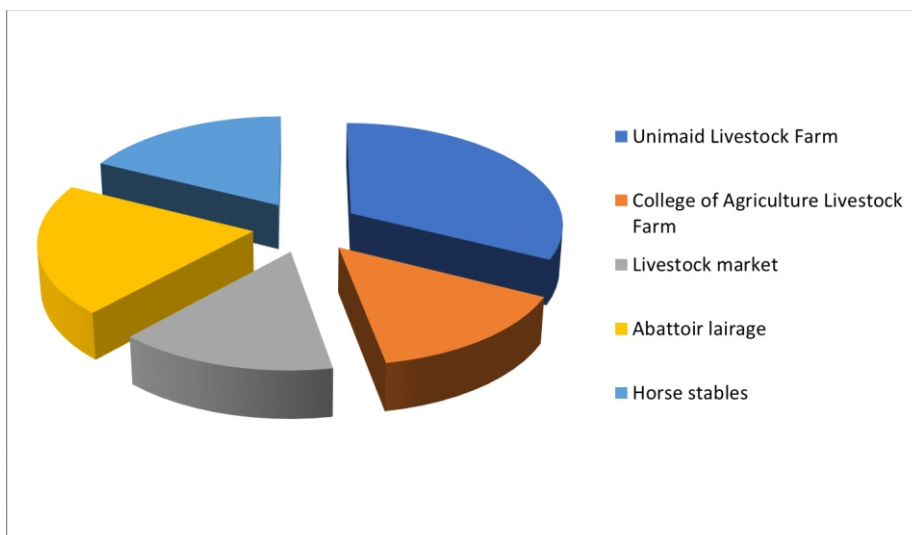


Figure 2: Showing the distribution of catches based on Livestock location

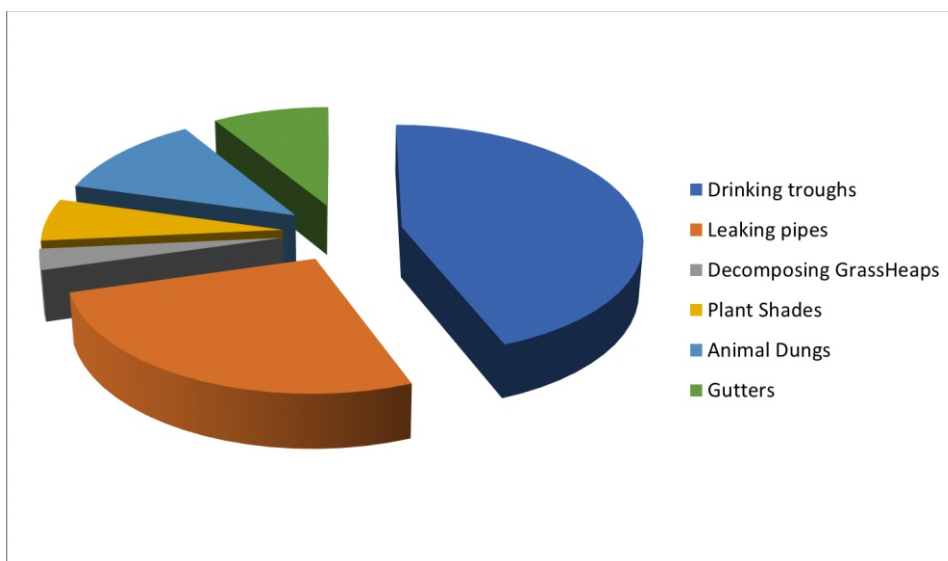


Figure 3: Showing the distribution of catches based on catch points

## Discussion

This study on the incidence of *Culicoides* species using sticky trap catches has identified *Culicoides bolitinos* and *Culicoides engubandei* with 94.1% and 5.9% respectively. These two species have been identified as catches in Botswana,<sup>10</sup> KwaZulu-Natal, South Africa,<sup>6,25,26,27</sup> Zimbabwe,<sup>28</sup> Nigeria,<sup>6</sup> with *C. engubandei* as vectors of *Haemoproteus* and fowl pox in poultry<sup>11</sup> and BTV in buffalo, elephant, rhinoceros, and impala herds<sup>25</sup> while *C. bolitinos* has generally been reported as the most competent vector of BTV amongst the Afro-tropical fauna besides transmitting AHSV, EEV, and EHDV in sub-Saharan Africa.<sup>2</sup>

Catches in this study were evenly spread amongst all the locations sampled. Oke *et al.*<sup>19</sup> reported that the distribution and activity of *Culicoides* species depends on the availability of suitable hosts, abundance of suitable breeding habitats, and climatic conditions that support large populations.

Based on catch points, drinking troughs, leaking pipes, animal dung, gutters, plant shades, and decomposing grass heaps all had catches in this study. Researchers have established that major breeding/resting sites for *Culicoides* species are present all through the year though significantly more during the wet than the dry season and include leaking pipes, cattle dung, decomposing grass heaps, underneath short grasses, large fallen tree leaves and that they utilize areas in the vicinity of animal populations, and whereas they dislike hot dry conditions and prefer humid and calm weather.<sup>7,29,30</sup>

However, the abundance of adult *Culicoides bolitinos* is variable but proportional to the amount of animal dung available which is in turn determined by animal biomass/unit area.<sup>6</sup> Generally, prevailing climatic conditions and abiotic factors may be responsible for variations in the distribution, abundance, and diversity of dipterid species in a region.<sup>31</sup> Over 1400 species of *Culicoides* biting midges have been documented throughout the world, but only a few species act as disease vectors in both humans and animals. The veterinary and public health impact of *Culicoides* biting midges in the study area. Avian haemosporidia parasites have been detected in birds from Gombe and Yobe states,<sup>18, 32</sup> and these states share geographical boundary with Borno state and this may imply the likely presence of these parasites in the study area. Haemosporidians comprising *Haemoproteus* and

*Leucocytozoon* are transmitted by *Culicoides* midges. Therefore, further studies are thus warranted to unravel the current status of this infection in birds in the study area.

## Conclusion

Conclusively, this study has documented the incidence of two species of *Culicoides* namely *C. bolitinos* and *C. engubandei* from Maiduguri, Nigeria. However, due to the short period of the study, the number of catches was low. Hence, we recommend that future studies should be undertaken for a longer period across several farms.

## Conflict of Interest

The authors declared no conflicts of interest

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