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Research Article

First Record of *Musca crassirostris* Stein, 1903 (Diptera: Muscidae) in Algeria, Confirmed from the Sétif Region, with Notes on Hematophagous Brachycera Diversity

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Abstract

From December 2022 to November 2023, blood-feeding Diptera were studied in the Sétif region (Algeria) using Nzi and Vavoua traps installed at four sites: Beni Fouda, Ain Roua, Ain Azel and Ain Arnat. A total of 4,917 specimens were collected, including *Stomoxys calcitrans* (Linnaeus, 1758), *Haematobia irritans* (Linnaeus, 1758), *Tabanidae* spp. (Latreille, 1802) and *Musca crassirostris* (Stein, 1903). The latter species was identified and confirmed for the first time in Algeria using a dual morphological and molecular approach based on the characterisation of the mitochondrial COI gene, whose sequences have been deposited in GenBank (PV012500-PV012513). Abundance varied significantly according to season and altitude, with higher densities in summer and autumn, particularly in mountainous. The effectiveness of the traps was found to depend on the species: Nzi traps were more effective for *M. crassirostris*, while Vavoua traps captured more *S. calcitrans*. The detection of *M. crassirostris* extends its known range in North Africa and provides the first integrative, morphological and molecular reference for its presence in Algeria. This study provides essential baseline data for entomological vector surveillance and contributes to a better understanding of the diversity of blood-feeding and their potential role in the transmission of pathogens in the Sétif region.

Keywords: Blood-feeding flies, Molecular confirmation, Nzi trap, Vavoua trap, Seasonal dynamics

Introduction

Blood-feeding flies form a diverse and ecologically important group within the order Diptera, including taxa such as horseflies (Tabanidae), stable flies (*Stomoxys* spp.), and related species that are found across a wide range of ecosystems worldwide [1]. Due to their hematophagous feeding habits and frequent interactions with vertebrate hosts, these insects play a significant role in the spread of pathogens and impact ecosystem dynamics [2]. Their populations often reach high densities in areas with intensive livestock farming, particularly in agricultural and rural settings, where they act as vectors for bacterial, viral, and protozoan pathogens of considerable veterinary significance [3]. For example, *Musca* spp. and *Haematobia irritans* have been linked to the dissemination of *Escherichia coli* and *Moraxella bovis*, agents responsible for mastitis in dairy cattle and infectious bovine keratoconjunctivitis (pinkeye) in beef cattle, respectively [4]. Infectious diseases pose significant threats to animal health, productivity, and welfare, thereby underscoring the imperative for rigorous monitoring and effective control strategies.

In the Maghreb region (comprising Algeria, Morocco, Tunisia, Libya, and Mauritania), blood-feeding flies pose persistent challenges to cattle producers and veterinary services [5]. *M. crassirostris* Stein, 1903, commonly known as the African housefly or cattle fly, is widely distributed and has been extensively studied due to its significant impact on livestock health. Like other hematophagous dipterans, *M. crassirostris* is capable of transmitting a diverse array of pathogenic microorganisms, including viruses such as equine infectious anaemia virus and protozoan parasites such as *Trypanosoma* sp. [6]. These infections are associated with substantial economic losses stemming from decreased productivity, increased veterinary expenditures, and, in severe cases, livestock mortality [7]. The species exhibits a high capacity for adaptation to a wide range of environmental conditions, accompanied by an extensive geographic distribution. This adaptability significantly increases its potential to disrupt local ecosystems and adversely affect agricultural economies [6].

Algeria's heterogeneous bioclimatic zones, particularly in the Sétif region of eastern Algeria, provide ideal conditions for diverse hematophagous fly populations. Characterised by semi-arid climates, fertile plains, and mountainous terrain, Sétif represents an understudied yet epidemiologically significant area for vector-borne disease dynamics. Despite the recognised threat of dipteran vectors to livestock health, entomological surveys in this region remain sparse, limiting the development of targeted control strategies. A comprehensive assessment of the hematophagous dipteran fauna in Sétif is therefore essential to enhance our understanding of their ecology, vectorial capacity, and role in disease transmission. This study aims to document the species composition, diversity, and relative abundance of blood-feeding flies across selected sites in the Sétif region, thereby generating baseline data to support future risk assessments and inform targeted vector control strategies.

Material and Methods

Sampling Sites and Insect Identification

Sampling was conducted monthly from December 2022 to November 2023 at four sites: Beni Fouda and Ain Roua (mountainous areas), Ain Azel (low-lying plains), and Ain Arnat (upper plains). The region covers 6.549 km^2 with a semi-arid climate characterised by cold winters (–9.5°C) and hot summers (40°C), as well as an annual rainfall of 200-500 mm, concentrated in winter and spring. Nzi and Vavoua traps were used. Insects were preserved in 70% ethanol and identified at the Higher National Veterinary School of Algiers (ENSV), Laboratory of Parasitology, Rabie-Bouchama, Issad Abbes, Oued Smar, Algiers, Algeria, using Afrotropical dipteran keys. Diagnostic characters (wing venation, coloration, and proboscis morphology) were photographed using a LEICA EZ4W stereomicroscope equipped with a digital camera, connected to a computer, and image acquisition and processing were performed using Leica Application Suite LAS EZ software (version 3.3.0).Specimens were stored at –20°C before undergoing molecular analysis.

Molecular Characterisation

Each sample was placed in a tube containing liquid nitrogen and crushed. DNA was isolated using a mixture of phenol, chloroform, and isoamyl alcohol [8]. After centrifugation, the DNA in the upper aqueous phase was collected and precipitated with ethanol in the presence of sodium acetate, following the protocol of the same authors. Confirmation of the species was performed by amplifying and sequencing the mitochondrial COI gene [9], using the primers LCO-1490-sense (GGTCAACAAATCATAAAGATATTGG) and HCO-2198-antisense (TAAACTTCAGGGTGACCAAAAAATCA) . Amplification products were visualised on 2% agarose gels with MIDORI intercalating agent, then sequenced. The amplicons were purified with Exo-SAP-IT (USB Corporation, Cleveland, Ohio, USA) and sequenced in both directions using the same PCR primers at a concentration of 3.2 µM, employing BigDye™ chemistry in a PCR analyser. ABI 3500 sequences (Applied Biosystems, California, USA). Sequence chromatograms of each strand were examined with 4Peaks software and compared with published sequences in the GenBank database using the Basic Local Alignment Search Tool (BLAST; *www.ncbi.nlm.nih.gov/blast)*

Statistical Analysis

Variations in the number of flies caught were assessed according to season (winter, spring, summer, autumn), study site, and type of trap used. Descriptive statistics (mean, standard deviation, median, minimum, and maximum values) were calculated for each factor.Statistical analyses were performed using R software (RStudio, version 2026.01.0+392). Group comparisons were conducted using one-way analysis of variance (ANOVA), applied separately for each factor (season, study site, and trapping method). When significant differences were detected ($P<0.05$), post-hoc pairwise comparisons were performed using the Wilcoxon-Mann-Whitney test to identify differences between groups.

Results

In the Sétif region, a total of 4,917 flies were collected. Our analysis showed significant differences in the number of flies captured ($P=0.001$) across different species. We identified several bloodsucking fly species, including *Stomoxys calcitrans,* Tabanidae sp, and *Hematobia irritans*. A notable finding was the presence of *M. crassirostris* among these species.

Species Identification

The captured hematophagous Diptera specimens were identified to species level through morphological examination under 10-40x magnification, following established taxonomic protocols for Afrotropical Diptera. *M. crassirostris* features four dark longitudinal stripes on the thorax. Its sturdy, bulbous proboscis includes a shiny black chitinous structure called the mentum or haustellum, bearing 6 to 8 long setae and 20 to 28 short setae. The M vein (M1+2) forms a sharp angle, bending nearly at a right angle to reach the costa before the wing apex, close to the third longitudinal vein (R4+5). The forehead is generally broader in females and narrower in males. In females, the ovipositor is slender and terminates in two dark cerci, and the legs exhibit a characteristic seta located at approximately two-thirds of the distal tibia *(Fig. 2-A1,2,3,4,5,6)*. *S. calcitrans (Fig. 1-B1,2,3)* was identified by its stiff, forward-extending proboscis and a checkerboard pattern on the abdomen. The abdomen is wider than it is long, featuring a median brown spot and two lateral spots on the second and third segments, along with an angled wing vein (M1+2). *Haematobia irritans (Fig.1-C1,2,3)* specimens (body length 2.5 to 3.5 mm) exhibited a grey colouration with dark thoracic stripes and a gently curved wing vein (M1+2), unlike related species, which display a more steeply angled curvature. Specimens of Tabanidae *(Fig. 1-D1,2,3)* have been classified at the genus level due to their partially globular heads and prominent compound eyes that occupy most of the head capsule. Their sizes vary from 5 mm to 30 mm, depending on the species and developmental conditions. Bicoloured wing venation patterns are observable.

Molecular Confirmation

The sequences obtained were submitted to the GenBank database under accession numbers PV012500-PV012513, corresponding to *M. crassirostris* Stein, 1903**.** This constitutes the first molecular reference for this fly in Algeria and will support future entomological, taxonomic, or epidemiological studies on this species in the region.

Trap Performance and Species Specificity

Overall Catches and Trap Efficacy: A total of 4,917 flies were captured across all sites, seasons, and trap types. Nzi traps accounted for 51.7% (2,542/4,917) of the total catches, while Vavoua traps captured 48.3% (2,375/4,917). No significant difference was detected between the two trapping methods in terms of overall abundance (one-way ANOVA, P>0.05). However, clear differences in species composition were observed between trap types. Nzi traps captured a higher number of *M. crassirostris* individuals (1.786 specimens; 70.3% of all Nzi catches), whereas Vavoua traps showed higher captures of *S. calcitrans* (1.328 specimens; 55.9% of all Vavoua catches). Although these patterns suggest species-specific preferences, the differences were not statistically significant when analyzed separately for each insect group (one-way ANOVA, P>0.05). Both trap types were less effective for Tabanidae spp. and *H. irritans*, which together represented only a small proportion of the total catches *(Fig. 3-A,B)*.

Spatial and Seasonal Variation: Our study revealed significant disparities in hematophagous fly populations between regions, particularly when comparing mountainous areas (Beni Fouda and Ain Roua) with plain areas (Ain Azel and Ain Arnat) **(***Fig. 4-A,B***).** Statistical analysis confirmed a highly significant difference in insect abundance between these two geographical settings (P=0.00065). Seasonal dynamics also showed a marked influence on fly captures (P=0.01), with higher abundances recorded during summer and autumn compared to winter and spring **(***Fig. 5-A,B***).** However, no significant difference was detected between summer and autumn captures (p = 0.1784). These results emphasise the importance of including topographical, environmental, and climatic factors in entomological surveillance and vector control strategies, as they greatly affect fluctuations in fly populations throughout the year.

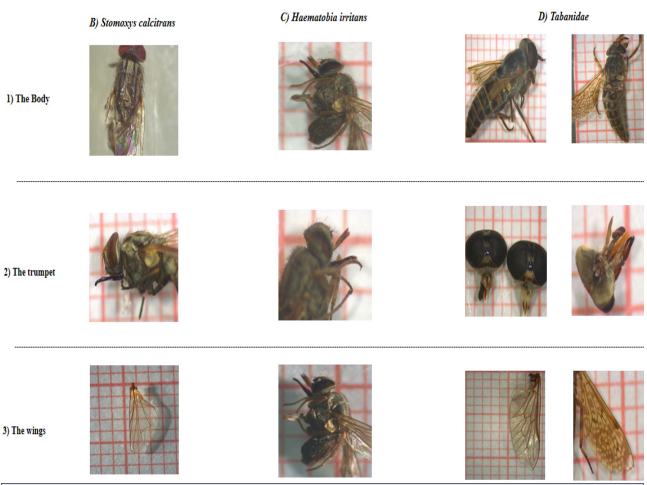

Fig 1. Morphological description of hematophagous flies: *Stomoxys calcitrans*, *Haematobia irritans*, and Tabanidae

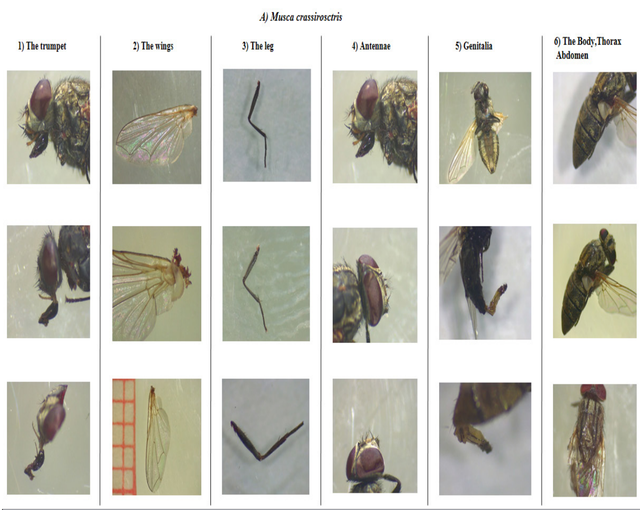

Fig 2. Morphological description of *Musca crassirostris* Stein, 1903

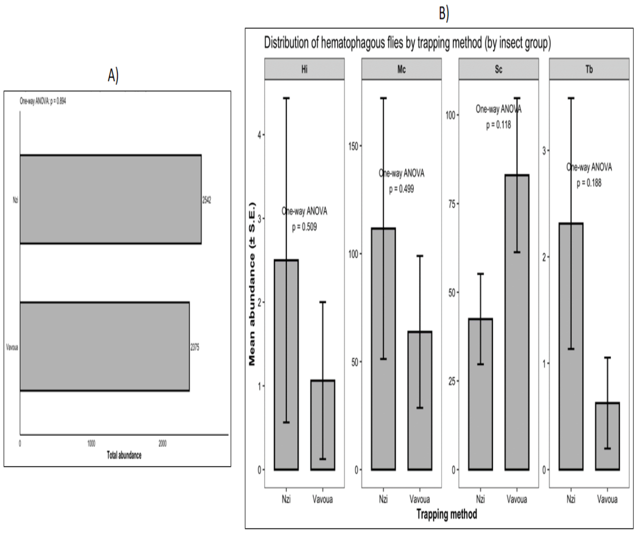

Fig 3. Distribution of hematophagous flies by trapping method (HI: *Haematobia irritans*; Mc: *Musca crassirostris*; Sc: *Stomoxys calcitrans*; Tb: *Tabanidae)*

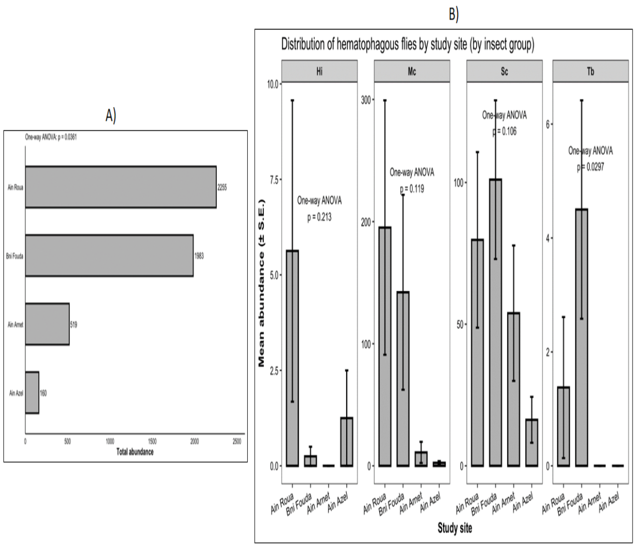

Fig 4. Distribution of hematophagous flies by study site (HI: *Haematobia irritans*; Mc: *Musca crassirostris*; Sc: *Stomoxys calcitrans*; Tb: *Tabanidae*)

Discussion

This study provides the first integrated survey of hematophagous Diptera in Sétif and confirms the presence of *M. crassirostris* in Algeria. The results highlight significant differences in species composition, seasonal dynamics, and site-specific abundance, which can be attributed to both ecological conditions and methodological factors.

Horseflies (Tabanidae*)* were rare in our captures. They were completely absent in the spring, appeared only sporadically in the summer, and showed a small increase in the autumn. This result contrasts with findings from El Tarf, where peaks occur in spring [10]. The discrepancy

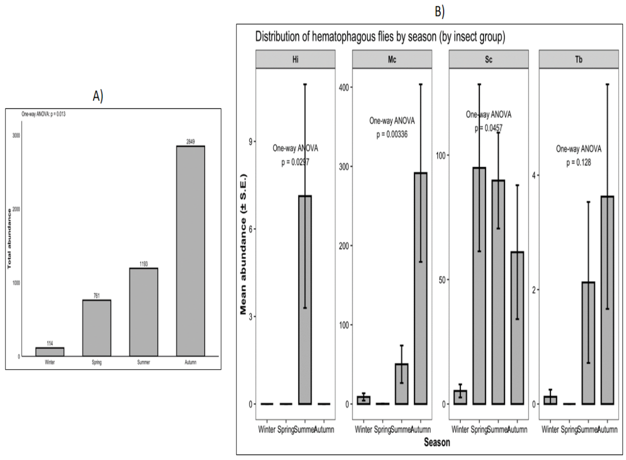

Fig 5. Distribution of hematophagous flies by season (HI: *Haematobia irritans;* Mc: *Musca crassirostris*; Sc: *Stomoxys calcitrans*; Tb: *Tabanidae*)

is likely explained by climatic differences. El Tarf's humid Mediterranean climate provides abundant larval habitats, while Sétif's semi-arid climate and harsh winters limit survival [11-13]. Interestingly, the autumnal increase observed in Sétif is more consistent with results from Sudan [14] and Mauritania [15], where populations rise after the rainy season. On the other hand, this pattern differs from that of Croatia [16,17] and El Tarf [10], where peaks occur earlier in the year. Together, these comparisons suggest that rainfall, temperature, and latitude strongly shape Tabanidae activity [17]. Trap efficiency is another factor. Both Nzi and Vavoua traps yielded very low numbers of horseflies. In fact, specialized devices such as the H-Trap have been shown to capture far more individuals-up to 53% of captures compared to only 9% for the Nzi and 4% for the Vavoua [18]. Using only two trap types, therefore, represents a methodological limitation of this study.

The stable fly *(S. calcitrans)* exhibited a more pronounced seasonal trend, with higher numbers during summer and autumn. This agrees with earlier studies in both temperate and tropical regions [19,20]. We also observed that captures rose sharply after rainfall, which underlines the importance of humidity for larval development. In terms of trap performance, Nzi traps consistently outperformed Vavoua traps, particularly at Beni Fouda and Ain Roua, confirming earlier reports of their efficiency for this species [21,22]. However, trap results are not the whole story. Environmental conditions, such as vegetation cover, livestock density, and local microclimate, likely also contributed to the variations observed between sites. Because our study covered only one year and four sites, broader patterns should be interpreted with caution.

By contrast, *H. irritans* was rarely captured only 57 individuals in total, all of which were captured in the summer. This low abundance can be explained in two ways. First, the traps we used are poorly suited for this fly, which rarely leaves its cattle host. Higher capture rates are achieved with baited Nzi traps [23], direct collections from cattle [24], or walk-through traps with aspiration [25]. Second, environmental constraints play a role. Reproduction of *H. irritans* requires warm, humid conditions [26], and the species undergoes diapause in winter, which limits its activity in temperate climates. In tropical areas, by contrast, populations persist throughout the year [27]. In Sétif, the combination of a semi-arid climate and cold winters almost certainly explains why the species was so scarce [11].

In striking contrast, *M. crassirostris* was abundant, especially at mountain sites during summer and autumn. Although Nzi traps caught more individuals than Vavoua, the difference was not statistically significant. This dominance is consistent with reports from Southeast Asia, where *M. crassirostris* accounted for 73% of hematophagous Diptera on dairy farms in Thailand [28]. Similar patterns have been reported in India and South Africa, where the species made up 17–20% of captures [29,30]. Its absence in winter is consistent with known physiological limits: the species thrives at 21-30°C but declines outside this range [31,32]. The present study provides the first molecular confirmation of *M. crassirostris* in Algeria. Its long-standing presence has likely been overlooked mainly due to the absence of entomological surveys. Given its abundance and veterinary importance, this species should be systematically included in national vector monitoring programmes.

The strong differences between sites deserve attention. Mountainous areas, such as Beni Fouda and Ain Roua, supported significantly higher populations than lowland sites. The cooler and more humid conditions clearly favour insect development. In Ain Azel, on the other hand, the population was much lower. This was not only due to its drier climate but also to livestock management practices. Farmers in the area reported frequent use of insecticides, such as thiamethoxam and pyrethroids, as well as citronella oil as a repellent [33,34]. By contrast, no chemical interventions were applied at Beni Fouda or Ain Roua. These observations underline that Diptera populations are shaped not only by climate and topography, but also by human activities. Any interpretation of abundance data should therefore take local management into account.

In conclusion, this study documents the diversity and dynamics of hematophagous Diptera in Sétif, Algeria, and provides the first molecularly confirmed record of *M. crassirostris*. Abundance varied with season, altitude, and livestock practices. Despite the limitations (two trap types and a one-year sampling period), these results provide a baseline for surveillance and vector control in the Sétif region. Further research should focus on the pathogens carried by these ectoparasites, particularly their role in the transmission of bacterial, viral, and protozoan agents affecting cattle. Complementary epidemiological studies on local herds are also needed to clarify the impact of these vectors on animal health and productivity in the region. Such work will provide an essential bridge between entomological surveys and applied veterinary interventions.

Declarations

Availability of Data and Materials: The data that support the findings of this study are available from the corresponding author (K. Dekkiche) upon reasonable request.

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