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Culicoides (Diptera: Ceratopoganidae) Associated with a Household in Gaborone, Botswana

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Abstract: A total of 140 culicoides biting midges were collected from seven trappings around a household located in the suburbs of the city of Gaborone, Botswana. The average catch size was 20 midges per night. Whereas this catch appeared to be low, members of the household complained about the bites which often progressed to painful bullae in two of the children and in one adult. *Culicoides engubandei* accounted for 35.0% n = 49) of the culicoides catch followed by *Culicoides leucosticus* 32.1% (n = 45), *C. imicola* (n = 37), and *C. Schultzei*, 6.4% (n = 9). The public health implications are discussed. This is the first published report on trappings of culicoides in the vicinity of a human habitat in Botswana.

Key words: Culicoides, household, painful, public health, Gaborone, Botswana

INTRODUCTION

Culicoides (Diptera: Ceratopoganidae) commonly known as biting midges are primarily a nuisance in humans, their bites associated with allergic skin reactions which in some individuals may result in urticaria or even systemic symptoms in response to the vasoactive moieties present in the saliva of the arthropod (Arean and Fox, 1953; Bishop *et al*., 2006).

Culicoides species are small biting flies, 1-3 mm in size which usually have grey and white patterned wings. They are obligate blood suckers, attacking mammals including humans and also birds. Anthropohilic haematophagous *Culicoides* species have been previously described in sub-Saharan Africa (Agbolade *et al*., 2006; Dipeolou and Ogunuride, 1977; Jupp *et al*., 1980; White, 1977). Most of the epidemiological studies on anthropophilic *Culicoides* species pertaining to their role as vectors of pathogens have been done in tropical and equatorial regions of the world outside Africa (Kettle, 1965; Shelley and Coscaron, 2001; Sherlock, 1965).

Culicoides serve as vectors of zoonotic pathogens affecting both animals and humans. These insects have been implicated as vectors of human viral diseases such as Oropouche virus, a member of the Simbu group of Bunyavirues associated with *C. paraensis* (Chen *et al*., 2005). *Culicoides* species have also been shown to transmit the filarial nematode, *Mansonella perstans* (Agbolade *et al*., 2006). Their potential to transmit yet another filarial worm, *M. ozzardi* experimentally has also been cited (Lowrie *et al*., 1982). Arthropods capable of penetrating human skin often cause severe dermatitis and systemic reactions. Local reactions consisting of urticarial swelling are due to injection of arthropod saliva (Arean and Fox, 1953; Peelman, 1962).

The study was under taken to establish the presence, species and numbers of culicoides frequenting a human habitat in Gaborone, Botswana. Epidemiological and public health significance of this Culicoides trapping and sustainability of preventive interventions are included in this study.

MATERIALS AND METHODS

Light trap collections: Light trap collections were made at a household in Gaborone district, Botswana. The house was surrounded by lush shrubbery and leafy trees comprising both exotic and indigenous types. Insects were collected daily for 7 days during the month of October, 2009. A 220 V, 8 W ultraviolet light down-drought suction insect trap obtained from Culicoides Laboratory, Parasitology Section of Onderstepoort Veterinary Institute in Pretoria, South Africa was sited in the eaves of a house. Six members of the household, two adults and four children were resident in the house at the time of the study.

Culicoides were made to fall directly into an aqueous solution of 0.5% v/v Savlon (Johnson and Johnson) antiseptic. The savlon acts as a cleansing and bactericidal agent. The light traps were run from dusk until dawn so that both twilight periods were sampled for these insects are nocturnal using a previously descried technique

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(Meiswinkel *et al*., 1994; Mushi *et al*., 1998a, b). After collection, the insects were transferred to 70% alcohol and stored on the bench. Identification at species level was accomplished by examining these insects under a dissecting microscope and comparing the wing patterns as described previously by other workers (Meiswinkel *et al*., 1994). Members of the household were interviewed and their skin examined for evidence of bites and itching sores accompanied by scratching.

RESULTS AND DISCUSSION

Culicoides were collected on all nights when the light trap was set on the eaves of a house sheltering six members of the household, two adults and four children. A total of 140 biting midges were collected from 7 trappings giving an average of 20 culicoides per night (Table 1).

The lowest catch was obtained when the minimum temperature was 18.6°C. Similarly, the highest catch of 23 was obtained when the minimum temperature was 19.3°C. An inverse relationship between the minimum temperature and culicoides catch was deduced. However, no clear cut pattern was observed for the relationship between the maximum temperature and the culicoides catch.

Table 2 shows the nightly culicoides catches from a household in Ginger location, Gaborone. The most commonly recorded species was *Culicoides engubandei* accounting for 35.0% (n = 49) followed by *C. leucosticus*, 32.5% (n = 45); *C. imicola*, 26.4% (n = 37) and *C. schultzei*, 6.4% (n = 9). Female culicoides for all the species, constituted 84.7% of the total catch. The rest, 15.3% (n = 20) were attributed to males (Table 3). This table also shows that as much as 93.8% (n = 45) of the *C. engubandei* were females.

Table 1: Details of total culicoides light trap collections

Days	No. of culicoides	Maxi temp. (°C)	Mini temp. (°C)	Rainfall(mm)
1	22	32.50	17.20	0
2	23	33.70	18.60	0
3	19	32.40	18.60	0
4	19	32.30	17.20	0
5	18	33.30	16.80	0
6	19	34.80	17.70	0
7	20	32.10	19.30	0
Total	140	231.10	125.40	0
Mean	20	33.01	17.91	0

Table 2: Nightly culicoides catches from a household

Species	Numbers	Percentages
Imicola sp.	37	26.4
Leucosticus sp.	45	32.1
Engubandei sp.	49	35.0
Schultzei group	9	6.4
Total numbers	140	100.0

Interviews conducted with members of the household revealed that all the six members of the household experienced insect bites in the evening whose severity was more pronounced in the four children resident in the house. Insect bites experienced by members of the household in the evening were most likely due to culicoides. All the children complained about being bitten by small non-mosquito like insects whose description conformed to that of culicoides.

Visual examination of the integument of the children showed that the bites were in the form of painful bullae on exposed areas of the body mainly, legs, arms and to a lesser extent, face. The most consistent feature of this lesion was the associated intense pruritis. The children intimated that they bore black scars on the legs as sequelae to the persistent scratching of urticarial lesions from previous bites from haematophagous insects.

The size of the catch could be classified as relatively high since there was neither rain, irrigated pastures nor stagnant water in the vicinity at the time of the trapping. The latter terrain is conventionally associated with high densities of culicoides.

Whereas there was a preponderance of *C. imicola* in the catches reported by some workers previously around horse stables (Dipeolou and Ogunuride, 1977) and dairy cows (Hoch *et al*., 1990) in the present study, *C. engubandei* followed by *C. leucosticus* were predominant. According to some workers (Jupp *et al*., 1980; Langner *et al*., 2007), these latter species of *Culicoides* are ornithophilic. The trees surrounding this house were teeming with various species of birds providing hosts for the culicoides. It is possible that members of this household were accidentally bitten during the host seeking activity. The main anthropophilic *Culicoides* species described in the inhabited world include *C. latrielle latrielle*, *C. paraensis* and *C. fulvithorax* (Mercer and Castillo-Pizango, 2005; White, 1977).

The role of culicoides as vectors of arboviruses has been discussed previously by some researchers (Mellor *et al*., 2000) alluding to the recently characterised Itacaunas and Curionopolis viruses in Equitorial areas, Brazil. Admittedly, these are emerging arboviruses whose partial nucleotide sequence of the N protein has shown that the two viruses constitute a separate dade in the

Table 3: Gender of culicoides caught in light traps

	Female		Male	
Species	Number	Percentage	Number	Percentage
Imicola sp.	28	77.77	8	22.22
Leucosticus sp.	37	84.09	7	15.90
Engubandei sp.	45	93.75	3	6.25
Schultzei group	10	83.33	2	16.66
Total numbers	120	84.74	20	15.25

family Rhabdoviridae and hence the proposed nomenclature, Bracorhabdoviridae. The results of the interviews conducted with the members of the household showed that culicoides could cause allergic dermatoses. Culicoides no doubt cause insect worry and allergic dermatoses particularly in children. Bites of culicoides sometimes results in urticaria with inflammation and vesiculation. Descriptions of the histopathological lesion caused by culicoides bites has been described previously by several researchers (Arean and Fox, 1953; Sherlock, 1965). Subsequent studies on the biochemical properties of these vasoactive moieties in salivary gland extracts of these biting midges has also been studied (Bishop *et al*., 2006). The allergic reactions among humans in this study may have been elicited by any of the trapped *Culicoides* species.

The saliva of *Culicoides* species, a haematophagous arthropod is known to contain bioactive factors that may provoke a cutaneous allergic response. The bioactive moities in the saliva of *Culicoides* species have been shown to exert an immune modulatory effect on the host's immune defences (Kettle, 1965). The latter phenomenon has been shown to facilitate transmission of pathogen into the host's general blood circulation.

CONCLUSION

The present study showed a positive relationship between temperatures, rainfall and the numbers of culicoides caught. There was a preponderance of *C. leucosticus* and *C. egubandei*. This finding concurred with the findings of some workers in South Africa (Venter and Meiswinkel, 1994) who registered absence of *C. imicola* from their trappings in the cold, high lying areas of that geographical area and host preference was alluded to by the South African researchers (Nevil and Anderson, 1972). Since, the present study in Botswana was only for a seven day period, the influence of warmer temperatures experienced during the warmer summer months on the composition of the trapping was not investigated.

With the imminent climatological changes, potential increase in vector competence may occur. Although, it has been argued that transmission of arbovirses between invertebrates and vertebrates imposes constraints on evolution and dispersals reflected in their phylogenetic relationship, instigating factors such as transportation of animals, plants arthropods, non-existent arthropod control programs, deforestation and reforestation, human movement among other exacerbate the emergence of viruses or their vectors in new areas. Furthermore, emergence of novel zoonotic insect borne pathogens is not a remote possibility.

RECOMMENDATIONS

It is recommended that an awareness campaign on the potential of *Culicoides* species to transmit viruses be launched by public health officers to protect the human and animal population from these haematophagous insects. Debushing around residential properties to remove the breeding areas of culicoides and use of fly screens around houses should be reinforced. Since, culicoides have been associated with the transmission of some infectious diseases in humans, further focus should be on the transmission potential of the *Culicoides* species collected in Botswana. The potential of the species of culicoides obtained in this study to support transmission of zoonotic pathogens warrants a separate study.

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