

## A survey of the *Culicoides* (Diptera: Ceratopogonidae) of the Umlalazi Nature Reserve in Zululand, South Africa, with notes on two species biting man

HILDA NEVILL and E.M. NEVILL

Onderstepoort Veterinary Institute, Private Bag X5, Onderstepoort, 0110 South Africa

### ABSTRACT

NEVILL, HILDA & NEVILL, E.M. 1995. A survey of the *Culicoides* (Diptera: Ceratopogonidae) of the Umlalazi Nature Reserve in Zululand, South Africa, with notes on two species biting man. *Onderstepoort Journal of Veterinary Research*, 62:51–58

*Culicoides* biting midges were intermittently collected between July 1988 and December 1992 in the Umlalazi Nature Reserve on the subtropical eastern coastal margin of South Africa. Altogether 34 species were collected in a diversity of habitats that included a mangrove community, dune forest and mixed thornveld. Most *Culicoides* were collected with the aid of light traps and whilst biting man. The pupae of ten species were collected from substrata in an open salt marsh, as well as from fresh and stagnant groundwater situations. It was the first time that the pupae of six of these ten species were collected. Of the species collected in light traps, the two most abundant species, *C. leucostictus* Kieffer (49,1 % of 16563 identified) and *C. rhizophorensis* Khamala & Kettle (22,3%), were also the two species found biting man. The larval habitat of *C. leucostictus* was widespread except in the more saline, tidal areas, but that of *C. rhizophorensis* appeared to be restricted to the tidal salt-marsh area. Two of the species collected, *C. fulvithorax* Austen and *C. moreli* Clastrier, are new records for South Africa.

**Keywords:** *Culicoides*, *leucostictus*, *rhizophorensis*, Umlalazi, Zululand, biting man

### INTRODUCTION

Worldwide, various species of *Culicoides* biting midges are proven transmitters of certain protozoa, nematodes and viruses to man and animals (Linley, Hoch & Pinheiro 1983; Meiswinkel, Nevill & Venter 1994). The greatest effect of this genus on man himself, however, has been through the irritating and painful bites of swarms of these midges. As reported by Blanton & Wirth (1979), "they bring misery to many a picnicker, bather, fisherman, hunter and camper ... and have played a major role in delaying the development of

some parts of Florida as tourist attractions, recreational areas, and residential areas." *Culicoides* biting midges infest coastal areas of the Carribean, eastern USA, South America and Australia, as well as the Pacific Islands and islands of the Indian Ocean (Kettle 1984).

There are no published records of *Culicoides* biting man in South Africa. However, various workers of the Onderstepoort Veterinary Institute have, over the years, on rare occasions and usually inland, been bitten by a variety of *Culicoides* species. Until 1988, the only knowledge that the authors had of *Culicoides* species biting man along the coast was restricted to single specimens of the *C. schultzei* group from Inhaca

Island, Mozambique and of *C. leucostictus* Kieffer from coastal Zululand. However, during a visit to the Umlalazi Nature Reserve in Zululand in July 1988, the authors were viciously attacked by swarms of *Culicoides* midges from late afternoon to sunset. This experience prompted a more thorough study of the *Culicoides* species of this reserve.

The second reason for this study is that no intensive survey has hitherto been made of the *Culicoides* species that occur along the subtropical eastern coastal margin of South Africa. Since the Umlalazi Reserve includes a mangrove community, coastal-dune forest and also mixed thornveld (Acocks 1988), and since no livestock farming takes place along its immediate boundaries, it was hoped that a survey of this particular reserve would provide an insight into the *Culicoides* species present in a relatively unspoilt situation on the Zululand coast.

## MATERIALS AND METHODS

### Study area

The 1028-ha Umlalazi Nature Reserve, which is run by the Natal Parks Board, is situated near Mtunzini (28° 57' S, 31° 47' E) on the Zululand coast, 130 km north of Durban. This reserve includes a number of different plant and animal communities, and is bordered by the Umlalazi River in the north, which flows eastwards into the warm Indian Ocean (Fig. 1). At high tide, sea water pushes up the estuary and causes flooding of lower levels where black mangrove (*Bru-guiera gymnorrhiza*) and white mangrove (*Avicennia marina*) occur. At spring tide, the water rises still higher to flood higher-lying salt-marsh areas which eventually dry out almost entirely, before the next spring tide 14 d later. On the eastern side, the reserve is protected from the sea by permanent dunes covered by coastal-dune forest. A fresh-water stream flows through a grove of raphia palms (*Raphia australis*) and a small sugar-cane field bordering the reserve; inside the reserve it enters a reed swamp, dominated by *Phragmites australis* and sedge (*Juncus* spp.), and finally joins the Umlalazi River (Fig. 1). The dry land on the western boundary of the reserve is grassed and has patches of indigenous thorn and other trees.

The climate is subtropical with hot, humid summers, mild winters and a mean annual rainfall of > 1 000 mm. At Richards Bay (35 km north), the mean maximum temperature for the hottest month (January) is 30.0 °C, the mean minimum for the coldest month (July) is 11.4 °C, and the mean annual rainfall is 1 102 mm (Weather Bureau 1986). The largest mammals found in the reserve are bushpig (*Potamochoerus porcus*), bushbuck (*Tragelaphus scriptus*) and various duiker species (*Cephalophus* and *Sylvicapra* spp.), as well

as vervet monkeys (*Cercopithecus aethiops*) and thick-tailed bushbabies (*Otolemur crassicaudatus*), all of which are confined mostly to the dune forest. A great variety of bird life is present, in both the dune forest and the reeds. Abundant mud-dwellers such as fiddler crabs (*Uca* spp.) and mud-skippers (*Periophthalmus kalolo*) are found in the littoral zone. Cattle are present north of the reserve, across the Umlalazi River.

### Light-trap collections

At each site 220-volt ultraviolet down-draught suction light traps were used to collect *Culicoides* midges for identification and counting. The collections were preserved in 80% ethanol. During the periods 18–28 July 1988 and 16–19 September 1990 and on 15 December 1991, a total of 19 collections were made at five sites (Fig. 1, sites 1–5). They were:

- Kiosk – on fringe of dune forest overlooking the Umlalazi River near its mouth and a black mangrove community (Fig. 1 and 2)
- Cabin 8 – on fringe of dune forest (Fig. 3), facing a vlei covered with swamp reed, sedges and bordered by white mangroves (Fig. 1, 3 and 4)
- Cabin 3 – similar to cabin 8 (Fig. 1)
- Cabin 5 – similar to cabin 8 (Fig. 1)
- Gate – at entrance, overlooking a brackish- to fresh-water reed-bed (Fig. 1 and 5).

As the latter site displayed the greatest species diversity, a trap was operated monthly at this site on nine further occasions, from November 1991 to February 1992 and again from August to December 1992. The larger collections were subsampled for identification according to the method of Van Ark & Meiswinkel (1992).

### *Culicoides* biting man

During the period 18–28 July 1988, in and adjacent to the Nature Reserve (Fig. 1, sites A–D), adult *Culicoides* were collected by hand into 80% alcohol, while feeding off man, mainly at sunset. A male swarm was sampled once (Fig. 1, site C).

### *Culicoides* pupae

During the periods 18–28 July 1988 and 16–19 September 1990, pupae were collected from mud samples taken from littoral and terrestrial zones in and adjacent to the Nature Reserve (Fig. 1, sites a–h). The littoral or intertidal zone contains alluvium from both the terrestrial and marine zones (Berjak, Campbell, Hockett & Pammenter 1977). The pupae were recovered by sugar flotation, link-reared to adults and mounted for identification according to the method of Nevill & Dyce (1994).

## RESULTS

### Light-trap collections

The species analysis of 16563 *Culicoides*, representing 34 species, is shown in Table 1. The three most abundant species were *C. leucostictus* (49,1 % of 16563 identified), *C. rhizophorensis* Khamala & Kettle (22,3%) and *C. neavei* Austen (15,4%). The adults of eight species which have yet to be described, were also present. These are referred to by use of the numbering system of R. Meiswinkel (OVI) (Table 1). Two species, namely *C. fulvithorax* Austen and *C. moreli* Clastrier, were recorded in South Africa for the first time.

### *Culicoides* biting man

Two species, *C. leucostictus* and *C. rhizophorensis*, were collected at the following sites:

- Site A – under light inside cabin 8 (Fig. 1 and 3) (one collection; 55 ♀♀ *C. leucostictus*)  
 Site B – on bank of the Umlalazi River adjacent to small vlei, with abundant *Phragmites* reeds bordered by open salt marsh (Fig. 1) (one collection; 63 ♀♀ *C. leucostictus* + 30 ♀♀ *C. rhizophorensis*)

Site C – in black mangrove forest near kiosk (Fig. 1 and 2) (one collection; 110 ♀♀ *C. leucostictus*)

Site D – on boardwalk in raphia palm grove adjacent to nature reserve (Fig. 1) (one collection; 5 ♀♀ *C. leucostictus*)

At site C, a second collection, this time from a swarm above a stationary person, yielded 35 ♂♂ 3 ♀♀ *C. leucostictus*.

### *Culicoides* pupae

Eight sites yielded a total of 72 pupae of ten species of which the pupae of *C. rhizophorensis*, *C. neavei*, *C. brucei* Austen, *C. sp. # 9*, *C. sp. # 65* and *C. sp. # 69* were previously unknown to mankind. The sites were:

Site a – open salt marsh with standing patches of muddy water, herbaceous plant *Arthrocnemum perenne* present, fortnightly tidal action, full sunlight (Fig. 1) (2 ♀♀ 1 ♂♂ *C. rhizophorensis*)

Site b – small, open patches of moist, fine clay amongst short sedges in vlei, partly shaded by sedges; crabs and snails present (Fig. 1 and 4) (2 ♀♀ 2 ♂♂ *C. leucostictus*, 8 ♀♀ 4 ♂♂ *C. neavei*)

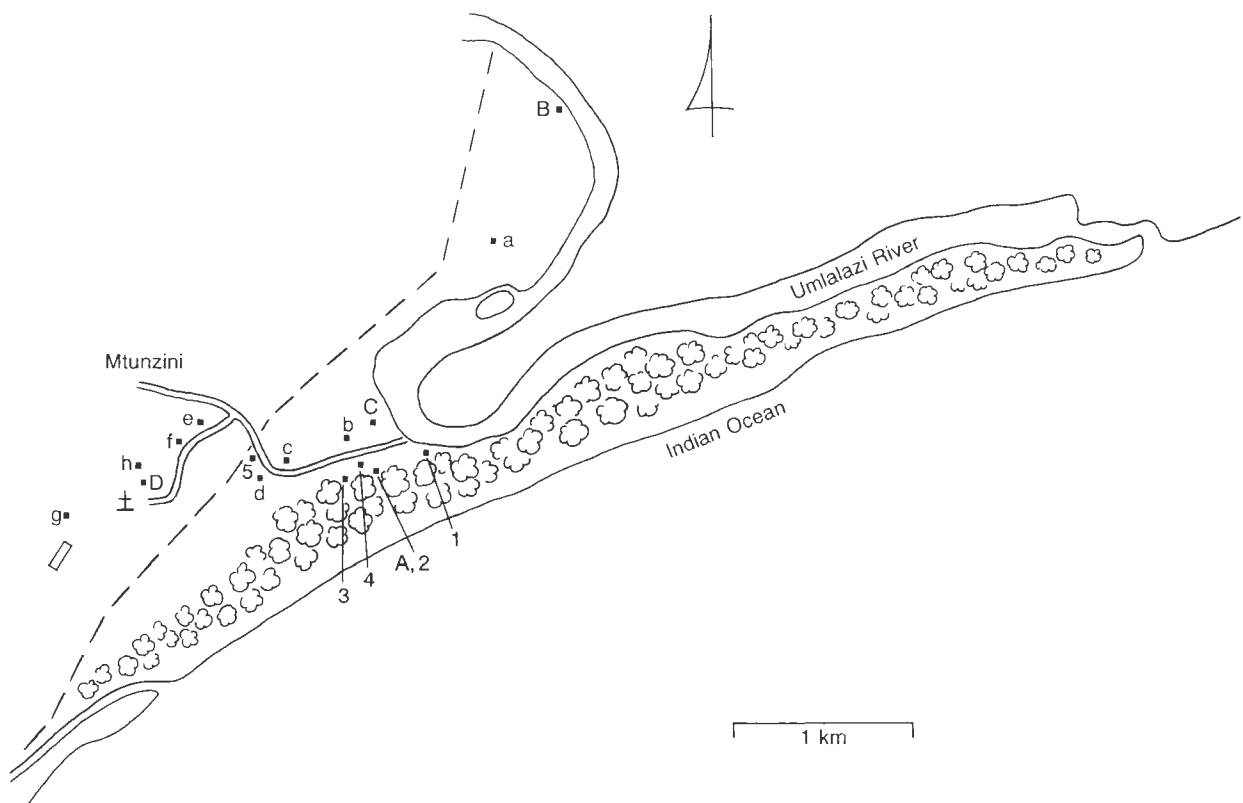


FIG. 1 Map of Umlalazi Nature Reserve, indicating 17 *Culicoides* collection sites: sites 1–5, light trap (1 = kiosk, 2 = cabin 8, 3 = cabin 3, 4 = cabin 5, 5 = entrance gate); sites A–D biting man; sites a–h pupae

TABLE 1 The relative abundance of *Culicoides* species in the Umlalazi Nature Reserve as determined by light-trap collections made between July 1988 and December 1992. Species abundance, at different trap sites for various trapping periods, is expressed as a percentage of either the total number of *Culicoides* collected or of a large subsample. The overall relative abundance of each *Culicoides* species is expressed as a percentage of the total *Culicoides* identified in 28 light-trap collections

Species	Relative abundance at various light-trap sites								Overall relative abundance	
	18–26 July 1988			16–19 Sept.1990			15 Dec. 1991	29 Nov.1991– 22 Dec. 1992	Total identified	%
	Kiosk	Cabin 8	Gate	Kiosk	Cabin 3	Gate	Cabin 5	Gate		
<i>C. leucostictus</i>	49,7	63,1	14,9	43,5	43,6	32,9	70,3	51,8	8126	49,06
<i>C. rhizophorensis</i>	48,3	33,2	72,2	13,6	0,7	36,5	3,8	22,9	3689	22,27
<i>C. neavei</i>	0,1	1,9	0,2	39,5	47,8	11,9	19,3	3,7	2551	15,40
<i>C. sp. # 69</i> (Accraensis group)	0,2	0,4	0,2	0,4	5,6	3,8	5,0	5,7	641	3,87
<i>C. imicola</i>	0,2	0,2	4,6	0,3		0,4	0,2	2,6	227	1,37
<i>C. onderstepoortensis</i>		0,5	0,4	0,1	1,5	0,8	0,6	2,3	213	1,29
<i>C. brucei</i>	0,1	0,1	1,4	0,8	0,1	2,4	0,1	1,2	154	0,93
<i>C. similis</i>	0,1	0,1	0,4	*	*	0,3		1,9	144	0,87
<i>C. nivosus</i>								2,0	136	0,82
<i>C. trifasciellus</i>	0,1		0,2	0,3	0,2	4,6		0,4	113	0,68
<i>C. sp. # 53</i>					0,1	2,0		0,9	94	0,57
<i>C. sp. # 2</i>						1,9		0,9	93	0,56
** <i>C. expectator/kobae</i>				*	0,2	0,1		0,9	65	0,39
<i>C. milnei</i>		0,1	2,7	0,3		1,3		0,2	59	0,36
<i>C. tropicalis</i>	0,2		0,4	*	*	0,1		0,7	53	0,32
<i>C. sp. # 110</i> (Schultzei group)	0,2		0,2		*			0,5	36	0,22
<i>C. bedfordi</i>				0,2		0,3	0,1	0,4	34	0,21
<i>C. bolitinos</i>	0,4	0,2	0,2	0,6				0,2	32	0,20
<i>C. sp. # 3</i> (Schultzei group)							0,1	0,3	25	0,15
<i>C. dekeyseri</i>			0,2		*	0,1	0,3	0,2	23	0,14
<i>C. sp. # 9</i> (Schultzei group)			0,5	*		0,1		0,1	12	0,07
<i>C. dutoiti</i>			0,5			0,4			9	0,05
<i>C. sp. # 30</i> (Imicola group)		0,1					0,1	0,1	8	0,05
<i>C. fulvithorax</i>	0,1	0,1	0,2	*	*		*	*	8	0,05



TABLE 1 (continued)

Species	Relative abundance at various light-trap sites								Overall relative abundance	
	18–26 July 1988			16–19 Sept. 1990			15 Dec. 1991	29 Nov. 1991– 22 Dec. 1992	Total identified	%
	Kiosk	Cabin 8	Gate	Kiosk	Cabin 3	Gate	Cabin 5	Gate		
<i>C. pycnostictus</i>				0,1			0,1	*	5	0,03
<i>C. punctithorax</i>						0,1	0,1	*	3	0,02
<i>C. huambensis</i> ?			0,2					*	2	0,01
<i>C. gulbenkiani</i>			0,2					*	2	0,01
<i>C. moreli</i>			0,2						1	0,01
<i>C. magnus</i>			0,2						1	0,01
<i>C. perettii</i>		0,1							1	0,01
<i>C. micheli</i>							0,1	*	2	0,01
<i>C. sp. # 65</i>								*	1	0,01
No. of catches	1	6	2	3	3	3	1	9	28	
Mean subsample size (%)	10,0	15,0	10,0	17,0	38,2	44,0	10,0	53,2		
No. identified	815	1 085	562	2 353	1 797	1569	1 546	6 836	16 563	

\* Present but constituting &lt; 0,05% of catch

\*\* Both species present, but indistinguishable when not mounted

Site c – permanent, fast-flowing, clear, fresh water through pipe under road, light-coloured sandy soil, swamp reeds, full sunlight to semi-shade (Fig. 1) (1 ♀ 4 ♂♂ *C. leucostictus*, 1 ♂ *C. neavei*, 3 ♀♀ 2 ♂♂ *C. similis* Carter, Ingram & Macfie, 1 ♀ *C. sp. # 69*)

Site d – stagnant puddles among reeds on edge of fresh-water trickle near entrance gate, bacterial film on water, rotting plant material in water, semi-shade (Fig. 1) (1 ♀ *C. leucostictus*)

Site e – fast-flowing, clear, fresh stream through sugar-cane field adjacent to nature reserve, fine, dark silty soil, full sunlight (Fig. 1) (1 ♀ 5 ♂♂ *C. brucei*, 1 ♂ *C. dekeyseri* Clastrier, 3 ♀♀ 4 ♂♂ *C. neavei*, 1 ♀ *C. onderstepoortensis* Fiedler, 2 ♀♀ *C. sp. # 9*, 1 ♂ *C. sp. # 65*, 2 ♀♀ 2 ♂♂ *C. sp. # 69*)

Site f – stagnant puddle adjacent to road in sugar-cane field adjacent to nature reserve, water covered with bacterial film, full sunlight (Fig. 1) (2 ♀♀ 5 ♂♂ *C. leucostictus*)

Site g – stagnant puddle from seepage off road bank near stream at station adjacent to nature reserve, red sandy soil, bacterial film on water,

tadpoles present, full sunlight (Fig. 1) (4 ♀♀ 6 ♂♂ *C. leucostictus*)

Site h – fine, sandy soil washed against a rotting stump in clear, fresh, slow-flowing stream in raphia palm grove adjacent to nature reserve, filtered sunlight (Fig. 1) (1 ♀ *C. sp. # 65*)

## DISCUSSION

These observations reveal that *Culicoides* biting midges may well be a nuisance to man in certain coastal areas of South Africa. The main culprit at Umlalazi was *C. leucostictus*. All blood-meal identifications to date indicate that this species feeds solely on birds (Meiswinkel *et al.* 1994), therefore man-feeding must be opportunistic. This species was found breeding in a variety of wet terrestrial situations at Umlalazi. Since such habitats as well as an abundance of bird life are common in many areas along the eastern coast of South Africa, further cases of man-biting by this species are anticipated. Of lesser importance at Umlalazi (as a man-biter) was *C. rhizophorensis* which was recorded as biting man only near its larval habitat in the salt marsh.



FIG. 2 View from kiosk (Fig. 1, site 1) on edge of dune forest overlooking black mangrove community (site C) and the Umlalazi River  $\pm$  4 km from its mouth



FIG. 3 Cabin 8 (Fig. 1, sites 2 and A) on fringe of dune forest and overlooking vlei (Fig. 1, site b; Fig. 4). Light trap was hung at corner of cabin

In the entire South Africa, only about 115 *Culicoides* species have ever been recognized. Many of these are rare and restricted in their distribution. During this survey, however, 34 *Culicoides* spp. were collected in and adjacent to Umlalazi Nature Reserve, an area

slightly over 1 000 ha. This is an impressive number of species for such a small area and must be attributed to the great variety of larval habitats available. This survey also yielded the first collection of *C. fulvithorax* Austen and *C. moreli* Clastrier in South Africa. These





FIG. 4 Vlei (Fig. 1, site b) with small, open patches of moist, gritty clay amongst sedge in foreground, with swamp reeds and mangroves behind. *C. leucostictus* and *C. neavei* pupae were collected here



FIG. 5 Main entrance gate (Fig. 1, site 5). Light trap was hung in leafless tree overlooking vlei (Fig. 1, sites c and d). Dune forest in background

two species are more common in tropical Africa. Furthermore, the pupae of six *Culicoides* species were collected for the first time and their larval habitats recorded. They were *C. rhizophorensis*, *C. neavei*, *C. brucei*, *C. sp. # 9*, *C. sp. # 65* and *C. sp. # 69*.

Pupal characters are now also being used to differentiate between *Culicoides* species (Nevill & Dyce 1994). Unpublished studies (H. Nevill 1992) revealed that the posterolateral processes of the caudal segment of *C. rhizophorensis* differ radically in form from those of

other local species of this subgenus (*Remmia*), but not from those of *Culicoides* species of various subgenera which develop in tidal situations throughout the world. The present study showed that, contrary to what the name implies, *C. rhizophorensis* is not associated directly with mangrove communities, but breeds in salt-marsh situations created by periodical flooding with sea water, due to tidal activity. This finding explains the presence of this species in light-trap collections made as far south as Knysna (34° 03' S; 23° 03' E), Cape Province (E.M. Nevill, unpublished data 1971), where there is a tidal lagoon but no mangroves.

Because of the limited number of livestock around the reserve, many of the species normally associated with livestock farming in South Africa (Nevill, Venter & Edwardes 1992) were either absent (*C. zuluensis*, *C. ravus*, *C. engubandei*) or they were present only in low numbers (*C. imicola*, *C. bolitinos*, *C. gulbenkiani*, *C. pycnostictus*, *C. nivosus*, *C. schultzei* group, *C. magnus*, *C. milnei*, *C. similis*, *C. tropicalis*, *C. bedfordi*, *C. onderstepoortensis*). These results support the contention that livestock farming actually creates larval habitats, and provides a readily available source of the blood-meals needed to produce large populations of certain *Culicoides* species; these in turn may act as vectors of the viruses of livestock diseases such as bluetongue and African horsesickness (Nevill *et al.* 1992).

The large numbers of *C. leucostictus*, *C. rhizophorensis* and *C. neavei* at Umlalazi are considered to be due to the presence of natural larval habitats and it is very likely that their main source of blood-meals is birds, which are abundant in the reserve.

## ACKNOWLEDGEMENTS

The authors wish to thank the Natal Parks Board for granting permission to collect at the Umlalazi Nature

Reserve. We are grateful to Mr J. Maltby for making monthly collections for us during 1992 and to Mr R. Meiswinkel for identifying the less common species and for criticizing the manuscript.

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