

Seasonal abundance of four *Culicoides* spp. (Diptera: Ceratopogonidae) at Al-Ahsa oasis, Eastern Province, Saudi Arabia

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ABSTRACT

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This report constitutes the first study of *Culicoides* spp. and their seasonal abundance at Al-Ahsa, the largest oasis in the Eastern Province of Saudi Arabia. New Jersey light traps were used to collect the midges at Mastock farm and Al-Mansura village. The mean monthly abundance was determined from October 1993 to October 1994. The mean monthly number per trap reached its minimum value during January 1994, increasing gradually from February to reach its maximum value during September 1994. During the study period, the following species were collected: *Culicoides schultzei* group (September), non-spotted group of *Culicoides* (September), *Culicoides imicola* (May) and *Culicoides newstaedi* (March). The potential importance of the *Culicoides* spp. in relation to arboviral activity in Saudi Arabia is discussed.

Keywords: Arboviruses, *Culicoides*, Saudi Arabia, Seasonal abundance

INTRODUCTION

The genus *Culicoides* consists of a large number of species which are distributed world-wide. They are common ectoparasites of animals and man causing great discomfort through their bites. In addition, some species are intermediate hosts and vectors for filarial worms, protozoan parasites and viruses (Blanton & Wirth 1979; Lane 1983; Boorman 1989; El Sinnary & Hussein 1980; Mellor & Pitzolis 1979; Nevill, Venter & Edwards 1992; Nevill & Nevill 1995;

Mellor 1996). There is little information on the *Culicoides* fauna of Saudi Arabia. In 1983 Lane published an identification key for five species of *Culicoides* and Boorman (1989) reported 34 species from the Arabian Peninsula.

The Kingdom of Saudi Arabia (KSA) constitutes the most extensive area of the Arabian Peninsula (16–32°N, 35–55° 30'E). Most of the area is desert with some low hills and plateaux. There are no running rivers and the climate is generally very hot and dry in summer, and can be cold with low rainfall in winter.

There are several oases in the KSA, where there is an abundance of water throughout the year and some agricultural activities take place. In these areas there are irrigation canals, some stagnant water and marshy areas. Small numbers of cattle, sheep and goats are kept here. Al-Ahsa oasis is the

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largest in Saudi Arabia. Surface irrigation water flows throughout the year and there is intense agricultural activity. In summer, environmental conditions are favourable for the breeding of arthropods and several outbreaks of diseases caused by arboviruses have occurred here in ruminants (Abu Elzein, Gameel, Al-Afaleq, Al Gundi & Bukhari 1997; Abu Elzein, Atchison, Al-Afaleq, El Bashier, Ibrahim & Housawi 1998; Abu Elzein, Al-Afaleq, Mellor, El Bashier & Hassanein 1998; Abu Elzein, Gameel, Al-Afaleq, Al Gundi, El Bashier, Zeedan, Al Mageed & Abu Khadra 1999).

We therefore determined to study the seasonal population dynamics of the different *Culicoides* spp. which are associated with animal operations in Al-Ahsa locality. This is the first such study in this region which we consider will contribute towards an understanding of the epidemiology of insect borne viral infections of livestock in Saudi Arabia.

MATERIALS AND METHODS

New Jersey light traps were used for the collection of *Culicoides* spp. from Al-Ahsa oasis (25°N, 47°E) for 13 months from October 1993 to October 1994. Two localities at Al-Ahsa were chosen as collection sites. One of these, Mastock farm, is a cattle farm located in a semi-arid area of the eastern part of Al-Ahsa. This farm is 20 km north of the main road leading to Qatar. The second site was a cattle-and-sheep farm in Al-Mansura village in the north-eastern part of Al-Ahsa, some 20 km from the city centre. The farm is surrounded by a drainage canal. The traps were operated in each locality from dusk until dawn.

During the study period 53 light-trap collections were made, 26 at Mastock and 27 at Al-Mansura. Each collection was examined in sterile petri dishes with the aid of a stereoscopic microscope. The *Culicoides* collections were sorted into species according to keys provided by Wirth, Ratanaworabhan & Blanton (1974), Lane (1983) and Boorman (1989), and counted. The mean monthly number of midges per trap was calculated to determine midge abundance.

RESULTS

The mean monthly abundance of *Culicoides* species collected from both localities

The meteorological data during the study period is graphically illustrated in Fig. 1–4.

The mean monthly number per trap of *Culicoides* from both localities at Al-Ahsa (Fig. 5) varied from month to month. Most were caught during August to October 1994, with peak numbers occurring during September 1994. The mean number of midges caught varied from 10.7 flies per trap in January to 1 286.5 flies per trap in September.

At Al-Mansura small numbers of *Culicoides* spp. were caught during October 1993, and even fewer during the following three months (Fig. 6). From February 1994 numbers gradually increased to reach a peak in August 1994 after which they declined again. The mean monthly abundance of *Culicoides* spp. at Mastock (Fig. 7) followed the pattern described above for both localities.

Identification and differentiation of *Culicoides* spp. collected

The following *Culicoides* spp. or groups of *Culicoides* spp. were identified from the capture sites: *Culicoides schultzei*, the non-spotted group of *Culicoides*, *Culicoides sahariensis*, *Culicoides imicola* and *Culicoides newstaedi*. The data obtained from both localities were combined to give a clearer picture of the overall abundance of *Culicoides* spp. at Al-Ahsa.

THE *CULICOIDES SCHULTZEI* GROUP

A large number of the *C. schultzei* group was collected during October 1993 (Fig. 8) but few were caught from November 1993 to May 1994. The midge population started to increase during June 1994 to reach a peak in September 1994 and then declined during October 1994.

THE NON-SPOTTED GROUP OF *CULICOIDES* MIDGES

The population of the non-spotted group of *Culicoides* midges showed a pattern similar to that of the *C. schultzei* group, and peak numbers were also collected in September 1994 (Fig. 9).

CULICOIDES SAHARIENSIS

The monthly numbers of *C. sahariensis* were comparatively much smaller than those of the *C. schultzei* group and the non-spotted group (Fig. 10). They were also found in smaller numbers during the period October 1993 to December 1994.

CULICOIDES IMICOLA

During the entire period *C. imicola* was rarely collected (Fig. 11). Only low numbers were found dur-

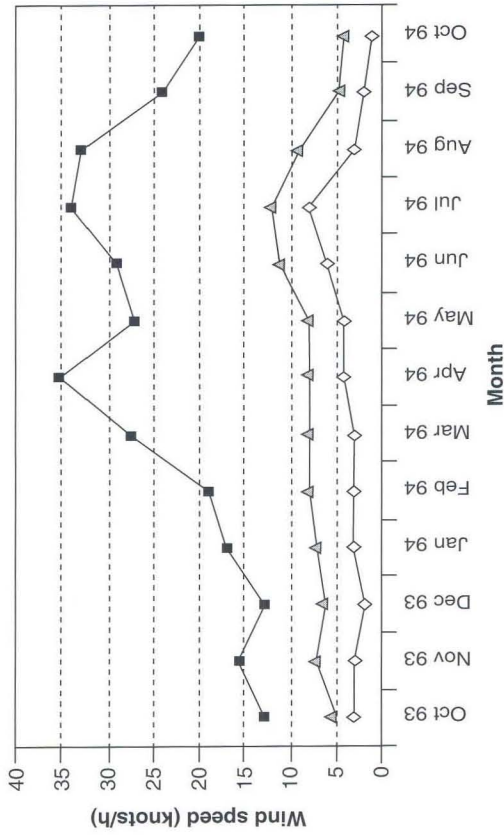


FIG. 3 Variation in the mean monthly wind speed at Al-Ahsa from October 1993 to October 1994

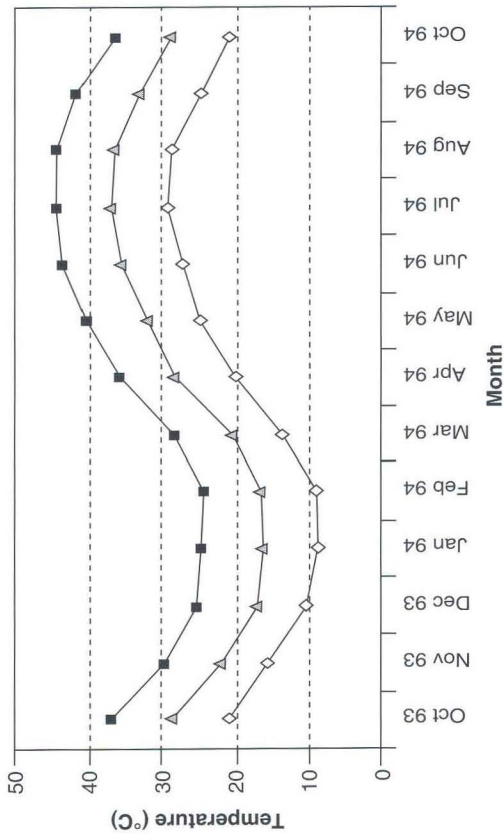


FIG. 1 Variation in the mean monthly temperature at Al-Ahsa from October 1993 to October 1994

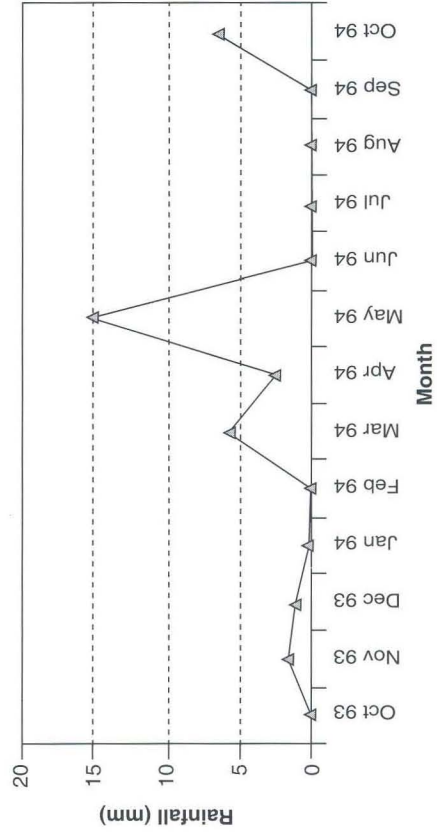


FIG. 4 Variation in the mean monthly rainfall at Al-Ahsa from October 1993 to October 1994

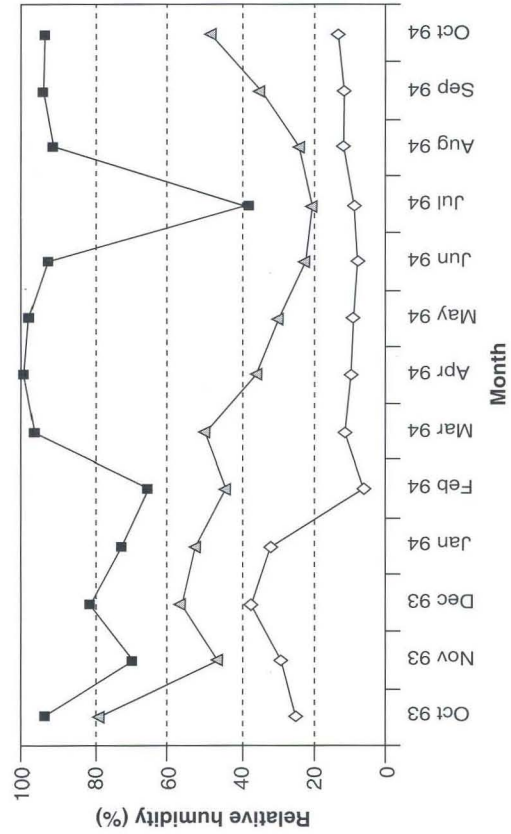


FIG. 2 Variation in the mean monthly relative humidity at Al-Ahsa from October 1993 to October 1994



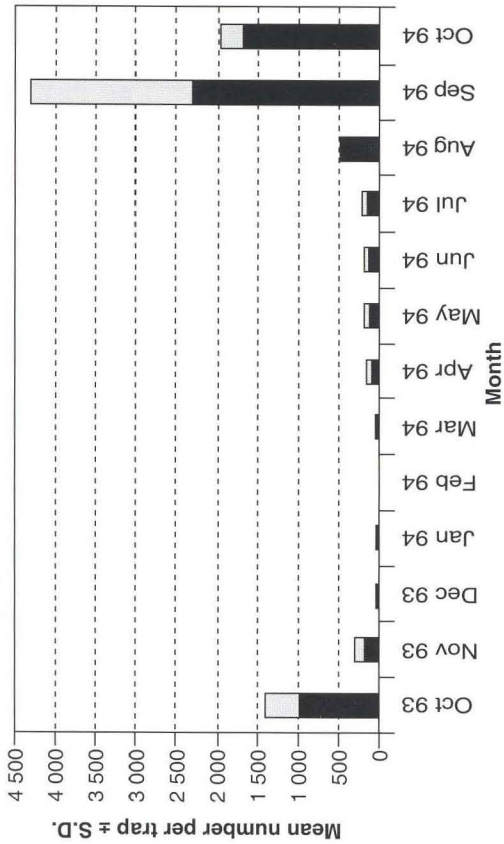


FIG. 7 Mean monthly numbers of *Culicoides* spp. collected at Mastock farm from October 1993 to October 1994

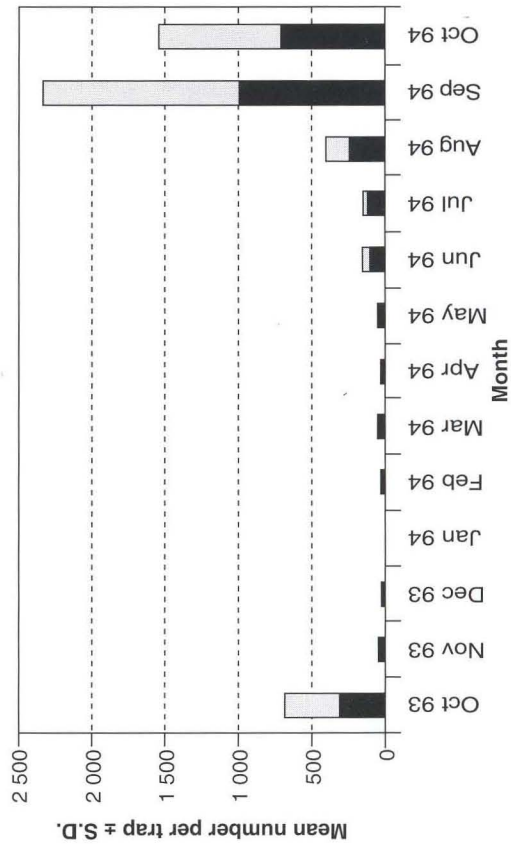


FIG. 8 Mean monthly numbers of the *Culicoides schultzei* group collected at Al-Ansa from October 1993 to October 1994

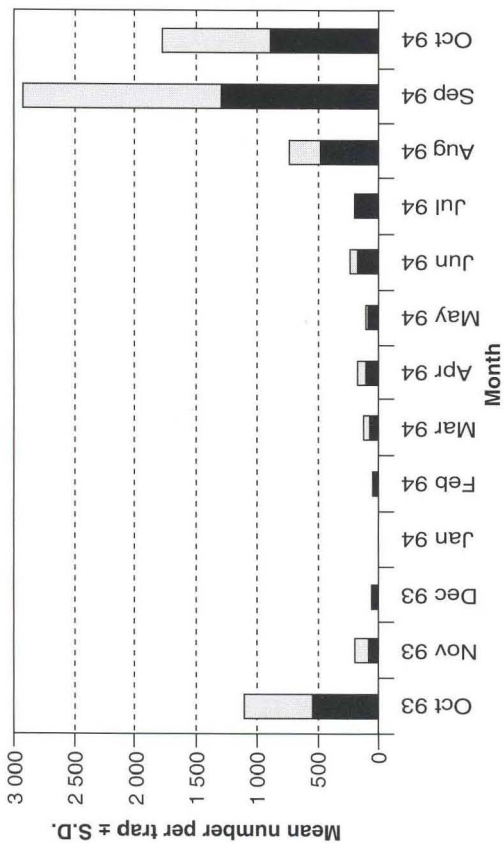


FIG. 5 Mean monthly numbers of *Culicoides* spp. collected at Al-Ansa from October 1993 to October 1994

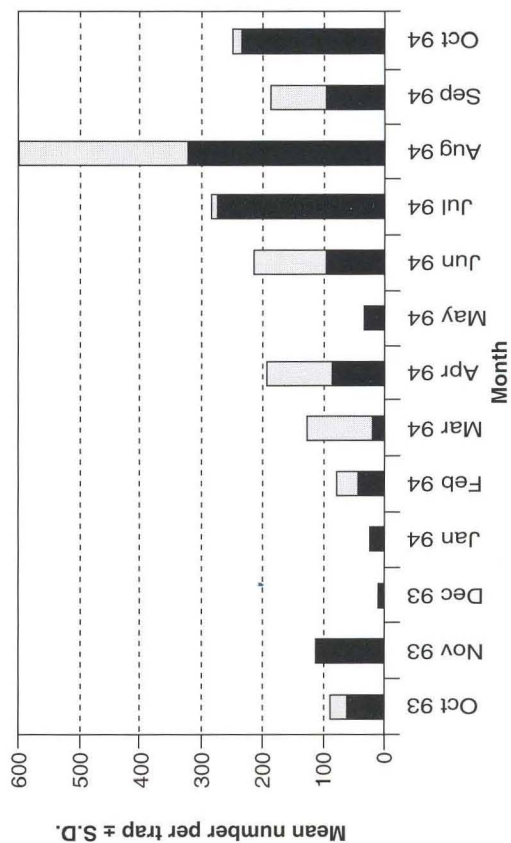


FIG. 6 Mean monthly numbers of *Culicoides* spp. collected at Al-Mansura from October 1993 to October 1994



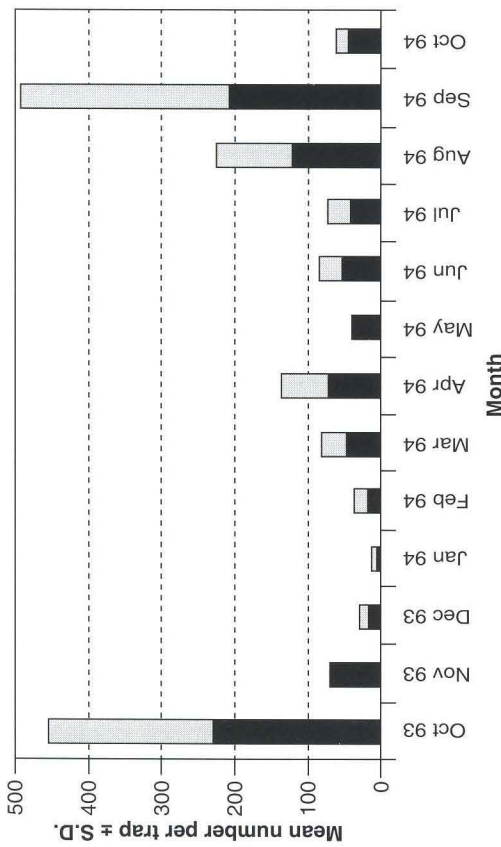


FIG. 9 Mean monthly numbers of the non-spotted group of *Culicoides imicola* collected at Al-Ahsa from October 1993 to October 1994

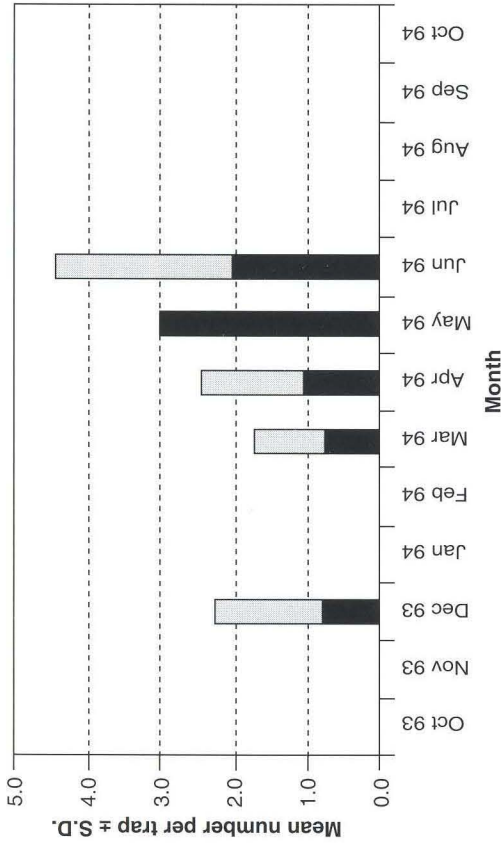


FIG. 11 Mean monthly numbers of the spotted group of *Culicoides imicola* collected at Al-Ahsa from October 1993 to October 1994

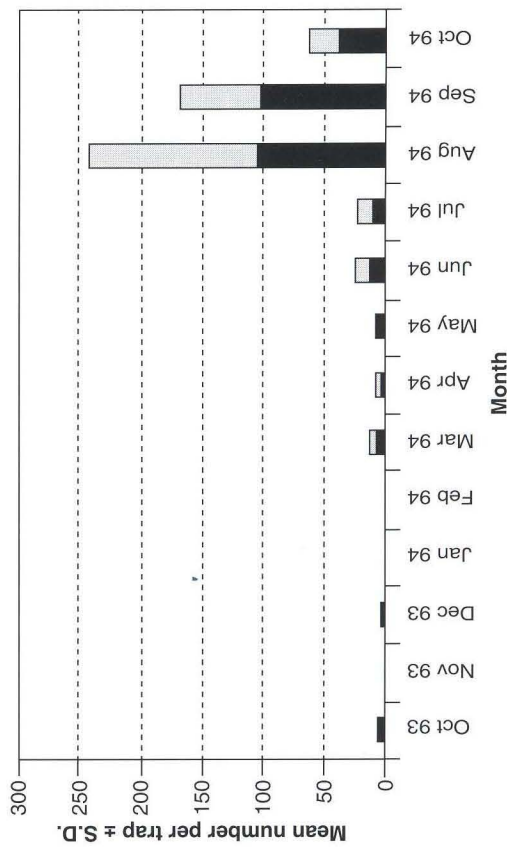


FIG. 10 Mean monthly numbers of the Saharais group of *Culicoides shultzei* collected at Al-Ahsa from October 1993 to October 1994

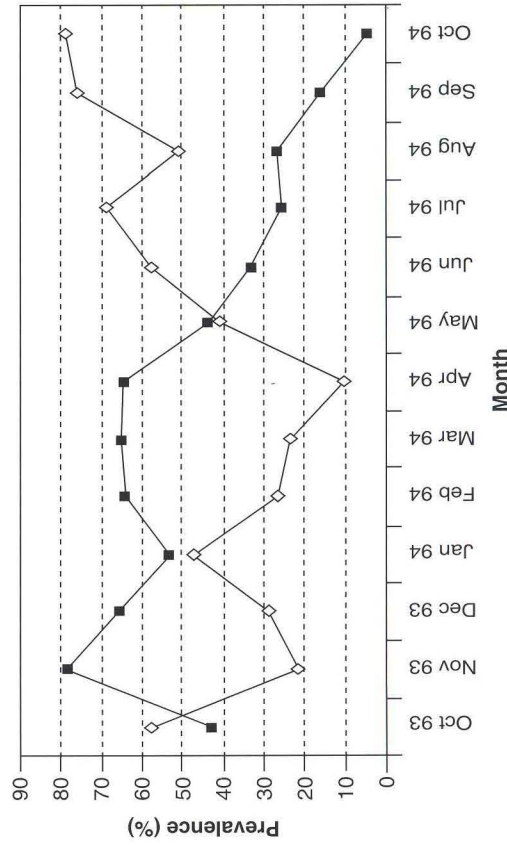


FIG. 12 Relative prevalence of the Saharais group and the non-spotted group of *Culicoides* from the total number of *Culicoides* captured



ing December 1993, and between March and June 1994.

CULICOIDES NEWSTEADI

Only one specimen of *C. newsteadi* was collected in March 1994.

Relative percentage of the different species of *Culicoides* from the total number of *Culicoides* collected from Al-Ahsa

The percentage of the different species of *Culicoides* relative to the total number of *Culicoides* collected was calculated during each month of the study period. The results of this study showed that the *C. schultzei* group predominated over the non-spotted group of *Culicoides* during October 1993 and again from June 1994 to October 1994 (Fig. 12). However, during the period of the lowest population density of *Culicoides* captured (November 1993 to May 1994) the situation was reversed.

DISCUSSION

At the study sites, winter extended from November to March, and summer commenced in May and extended to October, when the temperature dropped. The rainy season was during winter and no rain fell during the summer. From the meteorological data and results obtained, it is apparent that the hot, dry summer at Al-Ahsa is the favoured for breeding season of the *Culicoides* spp.. Being an oasis, Al-Ahsa has an abundance of surface water throughout the year, and the environmental conditions for the breeding of *Culicoides* midges are optimal.

During the study period the mean monthly numbers of *Culicoides* population at Al-Ahsa varied greatly from the lowest numbers in January to a peak number in September. The *Culicoides* population in various countries has been found to be influenced by the atmospheric temperature, wind speed, rainfall and light intensity (Khamala 1975; Kettle 1977; Greiner & Rawlin 1987).

The mean total numbers of flies per trap was significantly higher at Mastock farm than at Al-Mansura village. In addition, at Mastock farm peak numbers occurred during September, while at Al-Mansura the peak occurred during August. These findings may be due to environmental variations between the localities. It is possible that optimal breeding conditions prevailed at Mastock farm but not at Al-Mansura village. The larval habitat of *Culicoides*

constitutes one of the main factors contributing to the density of *Culicoides* population. A diversity of breeding sites has been determined for a number of species in different countries. These breeding sites include vegetated margins of ponds and irrigation canals, small drainage ditches, muddy areas in pastures, leaks from irrigation pipes, small seepages with little free surface water, and animal dung pats, mainly of cattle, sheep, goats and equids (Braverman 1978; Mellor & Pitzolis 1979; Kline & Greiner 1992). All these breeding sites are present except for the absence of a drainage canal which was present at Al-Mansura village. Examination of water from the drainage canal revealed large numbers of mosquito larvae which are predacious and feed on small living animals including insect larvae. It is possible that *Culicoides* larvae constituted a significant amount of their food. This could explain the smaller numbers of the *Culicoides* population at Al-Mansura as compared with Mastock farm.

The second factor which could contribute to such a decrease in the *Culicoides* population is the contamination of water in the drainage canal with pollutants such as detergents and sewage. These might render the medium unsuitable for maintained breeding of the *Culicoides* midges.

The population of *C. schultzei* fluctuated during the different months, but it was always present throughout the study period. In Kenya, the *C. schultzei* group persisted in stable populations throughout the year (Walker 1977). In our study the population of *C. schultzei* group commenced to increase in February 1994 to reach peak numbers in September 1994. In addition, *C. schultzei* constituted a significant population of the total number of *Culicoides* collected during the period from May 1994 to October 1994. Walker (1977) found that the *C. schultzei* group can persist in high numbers to the end of long dry spells at some sites in Kenya.

The *C. schultzei* group included *C. oxystoma* which was incriminated by Braverman (1978) and Kurogi (1986) as being able to transmit Akabane virus, and by Du Toit (1944), Walker (1977) and Braverman, Linley, Marcus & Frish (1985) to transmit blue-tongue virus.

In the present study, *C. imicola* was collected from Al-Ahsa in small numbers during the month of December 1993 and from March to June 1994. This species is known to breed in wet soil containing organic material and can spread over an extensive area (Braverman 1978). It is possible that the breeding sites of *C. imicola* are rather remote and its

presence at the collection sites is just marginal. *Culicoides imicola* was incriminated in the transmission of bluetongue and African horse sickness (AHS) by Du Toit (1944), Walker (1977), and Braverman *et al.* (1985). Neither of the two non-spotted *Culicoides* species, *C. sahariensis* and *C. newsteadi* have been reported to transmit any pathogens.

The presence of several species of *Culicoides* midges at Al-Ahsa is of great interest because many of them have been shown, in different countries, to be vectors of certain arboviruses and microfilaria. Their competence as vectors of viral or other diseases of livestock at Al-Ahsa or in Saudi Arabia in general was not investigated but many of them are indeed potential if not actual vectors of certain viral diseases of livestock in Saudi Arabia. This is substantiated by the fact that several outbreaks of arboviral diseases have occurred at Al-Ahsa. Bluetongue of sheep and epizootic haemorrhagic disease of deer (Abu Elzein, Gameel, Al-Afaleq & Hassanein 1991; 1998), Akabane infection as reflected by a serological study of a sentinel herd (Abu Elzein *et al.* 1998a; Al Afaleq, Abu Elzein & Mellor 1998) and bovine ephemeral fever (Abu Elzein *et al.* 1997; 1999) were all reported at Al-Ahsa during the last decade.

In addition, it could be speculated that Al-Ahsa oasis, being ideal for breeding of arthropods in summer, could be a possible source of *Culicoides* midges for the arid zones of Saudi Arabia as they can be dispersed by the wind. Such a situation could result in the spread of those arboviral diseases transmitted by *Culicoides* midges throughout the KSA.

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