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Culicoides midges (*Ceratopogonidae*) in some localities of Saudi Arabia and their veterinary significance

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ABSTRACT

Despite reports of severe outbreaks of arboviral diseases in domestic animals in Saudi Arabia, very little effort has been made to study the potential local vectors of these diseases. Diseases such as bluetongue and African horse sickness were reported in Saudi Arabia. Such diseases are internationally known to be vectored by *Culicoides* midges. The present study was undertaken at three localities in Saudi Arabia where arboviral activity had previously been reported. Results revealed the presence of four *Culicoides* species in the three localities. Two of these species were confirmed as vectors of arboviruses of domestic animals in neighbouring countries. The results were discussed in relation to the epidemiology of arboviral diseases in Saudi Arabia.

Key words: *Culicoides* midges, Saudi Arabia

Introduction

The genus *Culicoides* (Diptera: *Ceratopogonidae*) encompasses 1247 species of biting midges (BORKENT and WIRTH, 1997). Some of them bite mammals and transmit viruses, protozoon parasites and filarial worms (LANE, 1983; LINES, 1995). In addition, some species cause considerable

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nuisance to man through their bites (LINLEY et al., 1983; NEVILL and NEVILL, 1995).

In Saudi Arabia, some arboviral diseases were reported. These were manifested either by overt clinical disease such as bluetongue (BT) and epizootic haemorrhagic disease of deer (EHD), (ABU-ELZEIN et al., 1992), African horse sickness (AHS), (ANDERSON et al., 1989; LANE, 1983) and bovine ephemeral fever (ABU-ELZEIN et al., 1999; ABU-ELZEIN et al., 1997), or reflected by seroconversion, as in the case of Akabane (ABU-ELZEIN et al., 1998a; AL-AFALEQ et al., 1998) and BT (ABU- ELZEIN et al., 1998a).

Most of the above-mentioned arboviruses were reported to be transmitted by *Culicoides* midges elsewhere (BOORMAN, 1989). Notwithstanding, very little information is available thus far regarding the *Culicoides* fauna in Saudi Arabia (BOORMAN, 1989; LANE, 1983).

The present study was undertaken to identify *Culicoides* fauna in three localities in which arboviral diseases were previously reported. Resulting information is expected to assist in a better understanding of the epidemiology of animal arboviruses in this country and will open an avenue for further studies of *Culicoides* in Saudi Arabia.

Materials and methods

The Localities under-study. Three localities for the present study (Fig. 1) were chosen because the activity of some arboviruses of domestic animals was previously reported in them (ABU-ELZEIN et al., 1998a; ABU-ELZEIN et al., 1998b; ABU-ELZEIN et al., 1999; ABU-ELZEIN et al., 1997; ABU-ELZEIN et al., 1992; ANDERSON et al., 1989; LANE, 1983).

The first locality was Jazzan, which lies in the south-western region of Saudi Arabia (16°2'N – 42°35'E), along the lowlands of the Red Sea coast (Tuhama strip) and which has a tropical climate. The hottest month of the year is June, with average, minimum and maximum temperatures of 24.1 °C and 45 °C, respectively. The coldest month of the year is January, with average minimum and maximum temperatures of 17.5 °C and 33.2 °C, respectively.

Rainfall in Jazzan occurs in summer and it is brought about by the south-westerly winds which then prevail (AL-SHEIKH et al., 2000). Maximum

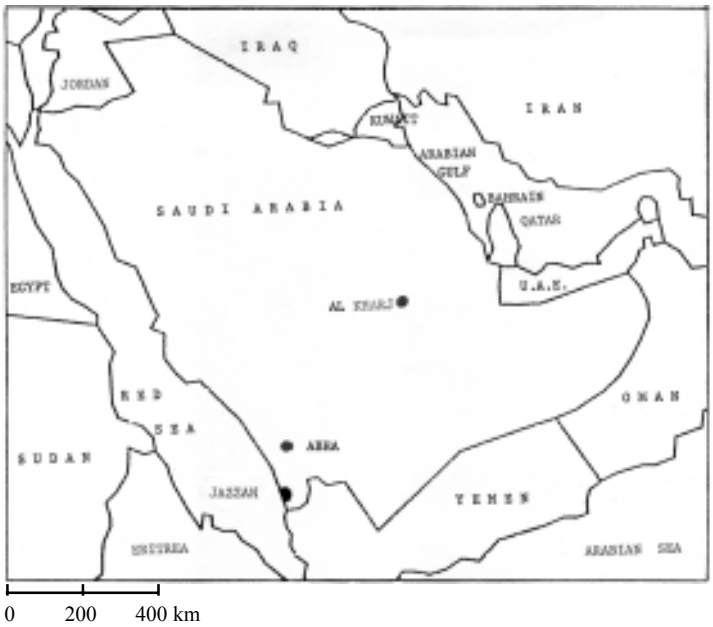

Fig. 1. Map of Saudi Arabia showing the localities of sampling

rainfall is in September, with an average of 21.1 mm; minimum rainfall is in February, with an average of 3.3 mm (AL-SHEIKH et al., 2000).

Average relative humidity in Jazzan reaches 96.9% in December and falls to 14.7% in October (AL-SHEIKH et al., 2000). Jazzan contains ponds of stagnant water and there are boggy areas of land.

The second locality in the study was Abha, which lies in the highlands of the Asseer region in the south-western part of Saudi Arabia (18°15'N: 42°30'E) (Fig. 1). It is an attractive tourist area. In summer the hottest month of the year is July, when average maximum and minimum temperatures are 31.5 °C and 12.9 °C, respectively. The coldest month of the year is January, which has average maximum and minimum temperatures of 21.8 °C and 2.3 °C, respectively. (AL-SHEIKH et al., 2000).

Rainfall in Abha occurs in winter. The maximum amount of rainfall is usually in April, which averages 60.5 mm, while the minimum average amount is in September, when it reaches 5.9 mm (AL-SHEIKH et al., 2000).

Average relative humidity at Abha is at its maximum in February, when it reaches 95%. Its minimum average value is in September, when it drops to 18%.

Arboviral activity was detected in summer at Abha, as confirmed by the presence of clinical AHS (ANDERSON et al., 1989; MELLOR et al., 1990); and by seroconversion to BT virus when sentinel ruminants were used (ABU-ELZEIN et al., 1997).

The third locality in this study was Al-Kharj, which lies in the midlands of Saudi Arabia (24 degrees 9'N : 47 degrees 19'E). Al-Kharj is an oasis with large animal production schemes and contains some of the largest dairy farms in the world. Previous establishment of sentinel ruminants at Al-Kharj confirmed the existence of arboviral activity in the area (ABU-ELZEIN et al., 1998a; ABU-ELZEIN et al., 1998b; AL-AFALEQ et al., 1998).

The hottest month of the year at Al-Kharj is July, when average maximum and minimum temperatures are 50.2 °C and 38 °C, respectively. The coldest month of the year is January, when average maximum and minimum temperatures are 20.9 °C and 9.4 °C, respectively (AL-SHEIKH et al., 2000).

Rainfall at Al-Kharj occurs in winter. Average maximum rainfall is 19.9 mm and occurs in April. The minimum average rainfall is experienced in August - 0.02 mm (AL-SHEIKH et al., 2000).

Highest average relative humidity at Al-Kharj is 100% and is usually recorded during the period October to May. Between April and August, average relative humidity drops to 0.0% (AL-SHEIKH et al., 2000).

Collection of Culicoides midges. Insects were collected in CDC light traps (NEVILL and NEVILL, 1995; SUDIA and CHAMBERLAIN, 1962) with 18-W incandescent lamps at Al-Kharj and Abha. New Jersey traps were used at Jazzan (KETTLE, 1984). All traps were operated from dusk to dawn.

The sampling sites at Al-Kharj were close to cattle and sheep pens. At Abha, the traps were installed near sheep and horse pens. At Jazzan the traps were set in a cattle farm which lies in a suburb outside Jazzan city. The farm is surrounded by plantation. A large water trough was placed in the middle of the farm. Spilled water was present around the trough.

Sampling from Alkharj and Abha extended from March 1993 to September 1993, and for Jazzan from January to June 1995.

Sixty-six insect collections were carried out during the study period: Al-Kharj 24, Abha 34, and Jazzan 8. The collected insects were preserved in 10% formol saline until sent to our laboratory at Al-Ahsa for sorting and preliminary identification. Each insect was then slide-mounted and examined under a stereomicroscope. Preliminary identification was performed in Saudi Arabia and the slides were then sent to Britain for confirmation as described (BOORMAN and MELLOR, 1982), by comparison with type specimens in the British Museum (Natural History).

Results

Culicoides species recorded in the present study are shown in Table 1.

Abha. Three species of *Culicoides* midges were recorded at Abha. From the traps near to the sheep pens, *C. imicola* (80%), *C. schultzei* group (16%) and *C. navaiae* (4%) were caught. From the pens near to the horses, *C. imicola* (80%), *C. schultzei* group (20%) were caught.

Table 1. *Culicoides* species collected from Jazzan, Abha and Al-Kharj

Locality	Animals	N° of traps	Total N° of *Culicoides*	*Culicoides* species	
				Total N°	Identification of species
Abha	Sheep	22	25	20 (80%) 4 (16%) 1 (4%)	*C. imicola* *C. schultzei* group *C. navaiae*
Abha	Horse	12	10	8 (80%) 2 (20%)	*C. imicola* *C. schultzei* group
Al-Kharj	Cattle and Sheep	24	12	4 (33%) 4 (33%) 2 (17%) 2 (17%)	*C. schultzei* group *C. imicola* *C. navaiae* *C. punctatus*
Jazzan	Sheep and goats	8	20	3 (15%) 17 (85%)	*C. imicola* *C. schultzei* group

Al-Kharj locality. Four species of *Culicoides* were caught at Alkharj. These were: *C. imicola* (33%), *C. schultzei* group (33%), *C. navaiae* (17%) and *C. punctatus* (17%).

Jazzan Locality. Two species of *Culicoides* were recorded. These were: *C. imicola* (15%) and *C. schultzei* group (85%).

Table 2 shows the percentage of distribution of the *Culicoides* caught species in the three localities. *C. schultzei* group and *C. imicola* were predominant in all three districts. To a lesser extent, *C. navaiae* was recorded at both Abha and Al-Kharj. *C. punctatus* was only recorded at Al-Kharj at a rate similar to that of *C. navaiae* in that locality.

Discussion

The Kingdom of Saudi Arabia is situated in the Arabian Peninsula (16° to 31°N; 35° to 55°E) of which it comprises 80%. Saudi Arabia's terrain is varied but on the whole fairly barren and harsh with salt flats, gravel plains and sand dunes, with few oases.

Although there are no running rivers in the country, still there is an abundance of water in the oases, which has enabled the establishment of certain agricultural activities, as manifested by plantations and dairy farms. In the oases there is semi permanent running water in irrigation canals and some water may become stagnant, resulting in the formation of boggy land.

The climate in Saudi Arabia is continental. There are two climatic seasons, summer and winter. The hottest month of the year is July when average maximum and minimum temperatures are 50.1 °C and 24 °C, respectively.

Rainfall in the Kingdom occurs in winter, except in the south-western coastal lowlands, when it occurs in summer. Average annual rainfall is 5.0 inches.

Despite the arid conditions of Saudi Arabia, the ecological conditions in the oases, which could be manifested by the presence of stagnant water, boggy land, irrigation canals with cultivated margins, along with the summer climatic conditions, were expected to support the breeding of *Culicoides* midges in large numbers (MEISWINKEL et al., 1994; MELLOR and

LEAKE, 2000; NEVILL and NEVILL, 1995). However, this did not seem to match the low number of *Culicoides* caught during the present study. This could have been due to unforeseen adverse conditions, such as an unsuitable breeding environment at the habitat of larvae, such as the existence of predators preying on *Culicoides* larvae, or the presence of residual insecticides or other toxic chemicals. On the other hand, the optimum breeding conditions might not have been available to assist in the establishment of numerous breeding sites.

The period of collection at Abha and Al-Kharj was chosen to avoid winter, when temperatures could fall to below 0 °C in both localities, (average temperatures for the coldest month in each locality are shown above). However, a few days of below zero temperatures do not kill the *Culicoides* larvae.

In Jazzan, the average temperature in the hottest month (June) ranges between 24.1 °C and 45 °C, while in the coldest month (January) the average temperature ranges between 17.5 °C and 33.2 °C (AL-SHEIKH, 2000).

As we were intending to look for the local *Culicoides* fauna in Jazzan, we chose the months of January through June. This was because during the months of July through October Jazzan is directly exposed to the prevailing south-westerly monsoons from Africa (AL-SHEIKH, 2000). Therefore, collection of *Culicoides* during that period might not reflect the local *Culicoides* fauna in that locality. Similar studies in which *Culicoides* collections were performed in specific months of the year (JENNINGS et al., 1983; KRAMER et al., 1985; MELLOR and JENNINGS, 1988) in which the climatic conditions were optimum for breeding of *Culicoides* were reported by Boorman and Mellor (BOORMAN and MELLOR, 1982; JENNINGS et al., 1983) and reviewed by MELLOR and LEAKE (2000).

The present study recorded for the first time in the respective localities the existence of four *Culicoides* species. *C. imicola* and *C. schultzei* group were caught at the three localities and were predominant (Fig. 1). *C. navaiae* was caught at Al-Kharj and Abha. *C. punctatus* was caught only at Al-Kharj.

Although *C. schultzei, C. imicola* and *C. navaiae* been previously recorded in Saudi Arabia (BOORMAN, 1989; LANE, 1983), *C. punctatus* was recorded for the first time in the country.

Some of the presently recorded *Culicoides* species, namely *C. imicola* and the *C. schultzei* group, have been confirmed elsewhere as vectors for some arboviruses, causing disease in domestic animals (LINES, 1995; MELLOR and LEAKE, 2000). To the best of our knowledge no information is available to suggest that *C. navaiae* is involved in, or suspected with, having transmitted any virus.

With regard to *C. punctatus*, it belongs to the pulicaris group of midges. In fact, it is very similar indeed to *C. pulicaris* itself (Dr. Richard Lane considered that they might even be con-specific – personal communication with Dr. P. Mellor). MELLOR et al. (1990), isolated AHS virus serotype 4 from mixed pools of *C. obsoletus* and *C. pulicaris* in Spain during the 1988 outbreak. MELLOR and JENNINGS (1988) also showed that BTV-1 and BTV-4 could infect and multiply to high titre in *C. pulicaris* after oral infection. These two papers suggest that *C. pulicaris*, and probably its close relatives such as *C. punctatus*, should be considered suspect vectors of BTV and AHSV. On the other hand, and according to BOORMAN (1989), *C. punctatus* is also responsible for an allergic reaction in horses.

As the present paper and previous studies confirmed the presence of several *Culicoides* species (BOORMAN, 1989; LANE, 1983) in the Kingdom of Saudi Arabia, and since arboviral activity has also been described in some localities of the Kingdom, then further studies on the *Culicoides* fauna in relation to the epidemiology of arboviral diseases of domestic livestock in Saudi Arabia are expected to provide valuable information.

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SAŽETAK

Usprkos pojave teških arbovirusnih zaraza u domaćih životinja u Saudijskoj Arabiji, vrlo malo pozornosti posvećuje se istraživanjima mogućih vektora. U Saudijskoj Arabiji javljaju se bolesti kao što su bolest plavog jezika i konjska kuga. Poznato je da njih prenose komarčići roda *Culicoides*. Istraživanje je poduzeto na trima područjima u Saudijskoj Arabiji na kojima je već prethodno dokazana aktivnost arbovirusa. Dokazane su četiri vrste komarčića. Potvrđeno je da dvije od tih vrsta služe kao vektori arbovirusa u domaćih životinja. Rezultati su razmatrani u sklopu epizootiologije arbovirusnih bolesti u Saudijskoj Arabiji.

Ključne riječi: *Culicoides*, Saudijska Arabija