Arab Gulf J. Scient. Res., Agric. Biol. Sci., **B5** (2), pp. 273-286 (1987)

Ticks (Acari: Ixodidae) Parasitizing Indigenous Livestock in Northern and Eastern Saudi Arabia [1]

Fathi M. Diab, Mohammed S. Al-Khalifa, Hussein S. Hussein and Nasser A. Al-Asgah

Department of Zoology, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia

ABSTRACT. A survey was undertaken in northern and eastern Saudi Arabia to determine the tick species parasitizing indigenous livestock. *Hyalomma schulzei* was the most numerous species but parasitizes only camels in the northern frontier region. *Hyalomma dromedarii* was the most widespread species parasitizing mainly camel throughout the region, except at the far north where it has been replaced by *H. schulzei*. *Rhipicephalus turanicus* was abundant on sheep and goats and the second most abundant species. The study area proved to be one of its main regions of distribution in the Arabian Peninsula. *Hyalomma anatolicum excavatum* was abundant on camels, sheep and goats and *Hyalomma impeltatum* on camels and sheep. *Boophilus kohlsi* is reported for the first time from Dammam whilst *Hyalomma anatoticum anatolicum* and *Hyalomma marginatum rufipes* were represented by a few specimens. Animals in the arid pastoral regions carried far more ticks than those in the cultivated areas, and in all locations cattle were free of ticks. The medical and veterinary importance of collected ticks is discussed.

Compared to the western and central regions of the Kingdom of Saudi Arabia (Banaja and Roshdy 1978, Banaja *et al.* 1980, Abou-Elela *et al.* 1981, Al-Khalifa *et al.* 1983, 1984, Hoogstraal *et al.* 1983, 1984, Al-Khalifa and Diab 1986, and Al-Khalifa *et al.* 1986) the ticks of the northern and eastern regions of the Kingdom have been little studied. The only reports about these particular ticks are those of Hoogstraal *et al.* (1970), Hoogstraal and Bafort (1982) and Al-Asgah *et al.* (1985).

The present study on ticks of northern and eastern regions of Saudi Arabia away from areas of distribution of imported livestocks, is part of a nationwide tick survey.

1 From Research Project No. 10/1402/ZOO. College of Science, King Saud University.

Material and Methods

Ticks were removed at random from at least 10 camels, 10 sheep, 10 goats and 10 cattle from flocks of indigenous animals in the northern and eastern regions of Saudi Arabia. Over a 5-year period (1980-1984) several tick collections were undertaken from the various locations shown in Fig. 1, and all collection sites were within a radius of at least 100 km around each centre. The animals sampled were born and bred there and totally isolated from imported livestock.

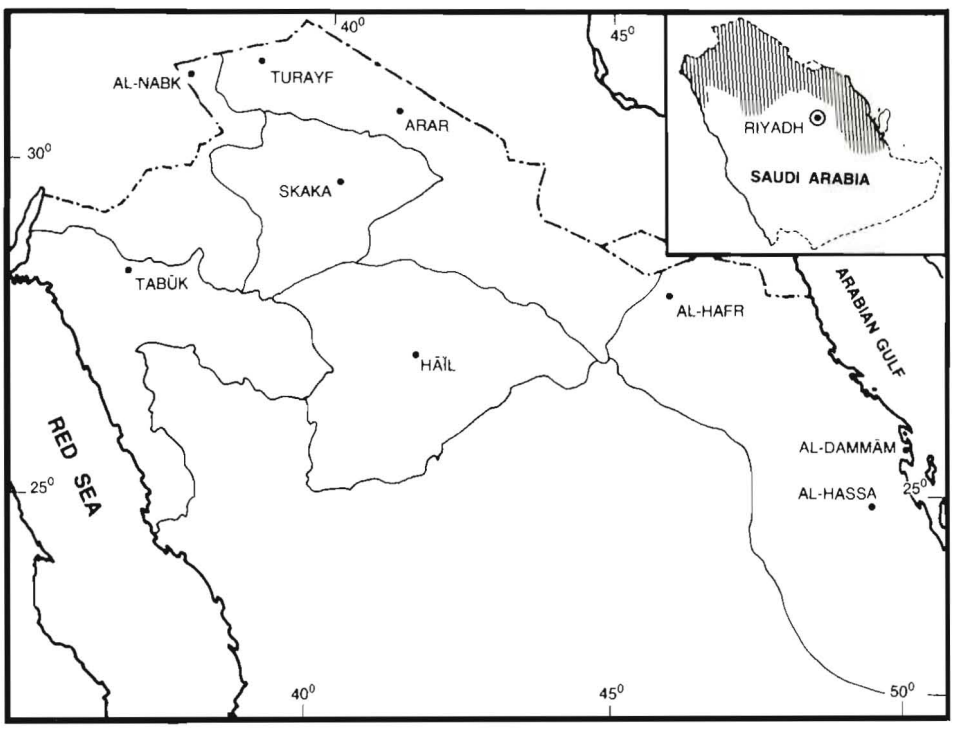

Fig. 1. Map of northern and eastern Saudi Arabia showing areas surveyed for ticks

The ticks were collected into vials (25 × 100 mm) containing 70% alcohol and identified according to the keys of Hoogstraal (1956), Hoogstraal and Kaiser (1959a) and Hoogstraal *et al.* (1981). The identifications were confirmed by the late Dr. Harry Hoogstraal.

Meteorological data for the area during the period of study were obtained from the Hydrology Division, Ministry of Agriculture and Water, Riyadh, Saudi Arabia.

Results

Physiography, Climate and Vegetation

The northern region of Saudi Arabia is 770-990 m above sea level, hot and dry in summer and cold with some precipitation in winter. During the period of study, the mean temperature range was 19.7–40.4°C in summer and 2.1–15.6°C in winter. On some winter days, the minimum temperature was well below 0°C especially in the northern frontier region. The mean relative humidity was 17–53% and a total of about 70.7 mm of rain was recorded during the period of study, mainly in winter but some in spring also.

The eastern region is 5–160 m above sea level and is hot and humid in summer, cold with some precipitation in winter. The mean temperature was 23.9–43.1°C in summer and 7.4–19.2°C in winter. The relative humidity was 34–73% and rainfall of about 181.3 mm followed the same pattern as in the northern region.

The study area is mostly sandy desert with several valleys (wadis) and a few oases. The biggest oasis is that of Al-Hassa. Al-Hassa and Hail are cultivated areas, whilst Ṭurayf, Tabuk, Al-Ḥafr and Dammam (Fig. 1) are pastoral regions.

The natural vegetation, though meager and scanty, consists mainly of annuals. These are well-adapted to the harsh arid conditions, wind, soil movements and high soil salinity. However, the wadis and oases where the water table is relatively near to the surface, have relatively luxuriant vegetations. Some of the common plants in the area are: *Artemisia judaica, Anvillea gracini, Cucumis prophetarum, Echinops spinosissimus, Hammada elegans, Helianthemum lippii, Paronychia arabica, Peganum harmala* and *Silene villosa*. A full floral list of the area of study is given by Mijahid (1978).

Tick Species

A total of 1,568 tick specimens were collected from camels, sheep and goats, but none of the cattle examined had ticks. A total of 781 adult ticks and 24 nymphs were collected from camels, 551 adults from sheep and 182 adults and 30 nymphs from goats (Table 1); larvae were not encountered on any of the animals sampled. These ticks represent eight species and subspecies, belonging to the genera *Hyalomma* (six species and subspecies, see Table 2), *Rhipicephalus* (one species, *R. turanicus*), and *Boophilus* (one species, *B. kohlsi*).

Hyalomma schulzei Olenev was the most numerous species (378 adults, Table 2), but it was collected only from camels in the northern frontier region (Ṭurayf centre, Fig. 1) and accounted for 95% of the total for this region. Camels in this

region were far more heavily infested with ticks than anywhere else in the area of study. The infestation was so heavy that this species, which is confined to that single area (apart from 3 ♂ and 2 ♀ collected from a single camel in Tabuk) outnumbered all other tick species collected from all sites in the study area.

Rhipicephalus turanicus Pomerantzev and Matikashvili was the second most numerous species in the sample and was collected only from sheep and goats, 214 from sheep and 117 from goats. The infestation rate was especially heavy at Tabuk but the tick was absent from sheep and goats at Ṭurayf and Hail (Table 3).

Hyalomma dromedarii Koch was the third most numerous species. The tick was taken mainly from camels (269 specimens) throughout the area of study (Table 2) and from sheep (45 specimens) at Tabuk and goats (15 specimens) at Dammam (Table 3). Camels at Tabuk yielded most specimens (106) followed by those at Al-Ḥafr (59), Ṭurayf (42), Dammam (34), Al-Hassa (18) and Hail (10, Table 2).

Hyalomma impeltatum Schulze and Schlottke was fourth in abundance and 249 specimens were collected, mostly from sheep (162) especially at Dammam, camels (82) mainly at Tabuk and only five specimens were taken from goats at Al-Ḥafr (Tables 2, 3).

Hyalomma anatolicum excavatum Koch was represented by 184 specimens, 108 from sheep, 46 from camels and 30 from goats. Sheep and goats at Al-Ḥafar were the main hosts, followed by camels at the same locality (Tables 2 and 3).

Hyalomma anatolicum anatolicum Koch was represented by only 8 ♂ and 1 ♀; 6 ♂ were from goats at Al-Ḥafr (Table 3), 2 ♂ and 1 ♀ from camels at Al-Hassa.

Boophilus kohlsi Hoogstraal and Kaiser was represented by only 5 ♂ and 4 ♀ collected from goats at Dammam.

Hyalomma marginatum rufipes Koch was represented by 3 ♂ from a camel at Tabuk and 2 ♂ from a sheep at Al-Ḥafr.

A total of 54 partially engorged nymphs, all belonging to the genus *Hyalomma;* 30 from goats at Al-Ḥafr and 24 from camels at Tabuk were collected. Since these immature stages were not fully engorged, no attempt was made to rear them in the laboratory for definitive identification. Superficially, they all resembled nymphs of *H. dromedarii.*

Table 1. Total number of ticks parasitizing 10 indigenous livestock hosts in northern and eastern Saudi Arabia

Region	Locality	Adult ticks			Nymphs			Total	Regional total
		Camels	Sheep	Goats	Camels	Sheep	Goats		
Northern	Ṭurayf	429	0	0	0	0	0	429	
	Tabuk	155	244	60	24	0	0	463	905
	Hail	13	0	0	0	0	0	13	
Eastern	Al-Ḥafr	102	127	75	0	0	30	334	
	Dammam	56	188	44	0	0	0	288	663
	Al-Hassa	26	12	3	0	0	0	41	
Total		781	551	182	24	0	30	1568	

Table 2. Number of ticks infesting samples of 10 indigenous camels in northern and eastern Saudi Arabia

Region	Locality	*Hyalomma dromedarii*		*Hyalomma impeltatum*		*Hyalomma anatolicum excavatum*		*Hyalomma schulzei*	
		♂	♀	♂	♀	♂	♀	♂	♀
Northern	Ṭurayf	36	6	11	3	0	0	273	100
	Tabuk[a]	73	33	28	4	7	3	3	2
	Hail	7	3	1	2	0	0	0	0
Eastern	Al-Ḥafr	32	27	16	9	11	7	0	0
	Dammam	24	10	3	4	7	7	0	0
	Al-Hassa[b]	6	12	1	0	3	1	0	0
Total		178	91	60	22	28	18	276	102

a = 3 ♂ *Hyalomma marginatum rufipes* and 24 *Hyalomma* nymphs were collected at Tabuk.
b = 2 ♂ and 1 ♀ *Hyalomma anatolicum anatolicum* were collected at Al-Hassa.

Table 3. Number of ticks parasitizing samples of 10 each of indigenous sheep and goats in northern and eastern Saudi Arabia

Region	Locality	*Hyalomma dromedarii*				*Hyalomma impeltatum*				*Hyalomma anatolicum anatolicum*				*Hyalomma anatolicum excavatum*				*Rhipicephalus turanicus*			
		Sheep		Goats		Sheep		Goats		Sheep		Goats		Sheep		Goats		Sheep		Goats	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Northern	Ṭurayf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tubuk	30	15	0	0	5	10	0	0	0	0	0	0	12	7	0	0	85	60	35	25
	Hail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern	Al-Ḥafr[a]	0	0	0	0	25	15	0	5	0	0	6	0	55	20	10	10	5	5	15	20
	Dammam[b]	0	0	0	15	87	40	0	0	0	0	0	0	6	8	0	0	35	12	12	7
	Al-Hassa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	2	1
Total		30	15	0	15	117	65	0	5	0	0	6	0	73	35	10	10	130	84	64	53

a = 2 ♂ *Hyalomma marginatum rufipes* were collected from sheep and 30 *Hyalomma* nymphs from goats at Al-Ḥafr.
b = 5 ♂ and 4 ♀ *Boophillus kohlsi* were collected from goats at Dammam.

Discussion

The tick species and subspecies collected from indigenous domestic animals in the present study are representatives of populations established in the area for a long period. The collection sites were carefully selected away from areas where imported livestock occur, to avoid possible mixing with ticks of imported animals. The heaviest tick infestations occurred on animals in the arid pastoral regions, whilst the animals in the two cultivated areas (Al-Hassa and Hail), yielded few ticks (41 from Al-Hassa and 13 from Hail). This could be due to the fact that tick activity in the arid pastoral regions is more or less continuous throughout the year, whereas in the cultivated areas, the activity is disrupted by agricultural practice such as ploughing and tilling of the land, which rank high amongst methods of tick control (Soulsby 1982) as well as by irrigation, which makes conditions less suitable for these xerophilic ticks.

Moreover ploughing and tilling destroys also the run and burrow systems of rodents and thus drive away these major hosts of immature tick stages (Hoogstraal 1956; Hoogstraal *et al.* 1981). These factors could also explain the absence of ticks from cattle in the present study, as the cattle examined were sedentary animals kept by farmers in and around their cultivated land. These are localities in which tick activities must have been depressed greatly by the agricultural methods employed. On the other hand, camels, sheep and goats examined in such areas are herded animals that roam about and presumably pick up the ticks during their wanderings.

Within the arid pastoral localities in the area of study, however, variation in tick infestation would be governed by the generally accepted factors of temperature, rainfall, relative humidity, altitude and natural vegetational cover (Hoogstraal 1956, Morel 1980, Hoogstraal *et al.* 1981, and Pegram *et al.* 1981, 1982). Excluding the infestation by *H. schulzei* and *B. kohlsi,* both of which are highly specialized and require special conditions (Hoogstraal *et al.* 1981), about the same number of ticks was collected from the arid pastoral localities of both the northern (519 ticks) and the eastern (613 ticks) sectors (Table 1).

Apart from the sheep and goat parasites, *R. turanicus* and *B. kohlsi,* all tick species collected belong to the genus *Hyalomma.* This pattern of distribution, however, could have been created by long distance transport on camels, the preferred hosts of several *Hyalomma* species (Hoogstraal 1956). The most abundant species in the present study was *H. schulzei,* but *H. dromedarii* was the most widely distributed species that was taken from camels in all biotopes, as well as from sheep and goats from some localities (Tabuk and Dammam, respectively).

The specialized large camel hyalommine, *H. schulzei,* though most numerous in the sample, would have never been represented if the small northern frontier

region of the Kingdom (Turayf, Fig. 1) had been excluded from the present survey. This small trinagle form the southernmost limit of its range (Al-Asgah *et al.* 1985). Within its distribution area, *H. schulzei* is known to infest its preferred host, the camel, so heavily as to exclude other tick species, even *H. dromedarii* (Hoogstraal 1956, Hoogstraal *et al.* 1981 and Al-Asgah *et al.* 1985). This was confirmed in the present study where *H. schulzei,* though collected only from a single small locality within the area of study, outnumbered all other tick species collected throughout the study area. Moreover, the cold conditions and altitude in the northern frontier region were not in favour of *H. dromedarii* which is known to thrive better in hot lowlands (Hoogstraal 1956, Hoogstraal *et al.* 1981, and Pegram *et al.* 1982). Hence, few specimens were collected from camels in that area. Elsewhere in the area of study and throughout the Kingdom, the tick is well-represented. It has also been reported from Yemen (Hoogstraal and Kaiser 1959b, and Pegram *et al.* 1982) and from Oman (Hoogstraal 1981), and the Arabian Peninsula is a part of the range of its distribution which includes the deserts, semideserts and steppes from northwestern India to north Africa (Hoogstraal 1956, and Hoogstraal *et al.* 1981).

Hyalomma impeltatum was widely distributed and well represented in samples taken from camels, sheep and goats except at the cultivated areas of Hail (north) and Al-Hassa (east). This is also true for the subspecies *H.a. excavatum* which together with *H.a. anatolicum,* though poorly represented in the present collection, are considered to be amongst the most widely distributed tick species in the Arabian Peninsula (Hoogstraal *et al.* 1981).

The African subspecies, *H.m. rufipes* was represented in the present study by only 5 ♂. This is understandable as the tick is known to thrive better in cooler higher altitudes in its native habitat, the higher altitude areas of East Africa (Hoogstraal 1956). In Arabia where it has been introduced on migrating birds and imported animals (Hoogstraal *et al.* 1981, and Pegram *et al.* 1982), and has thrived well in the higher altitudes of Yemen (Pegram *et al.* 1982), and has already established itself in Oman (Hoogstraal 1981). The circumspiracular setae and scutal punctuations of the collected males are less dense than in the African samples. This might confirm the observations of Hoogstraal *et al.* (1981) and Pegram *et al.* (1982) that Arabia is an area of intergradation between *H. m. rufipes* and *H. m. turanicum* or an area of hybridisation between introduced stocks of both subspecies.

Several viruses such as the Crimean-Congo haemorrhagic fever virus (Bunyaviridae) which causes a serious human disease as well as Kadam virus (Togaviridae), Thogoto virus (Bunyaviridae) and Wanowrie virus (unclassified) have been isolated from the *Hyalomma* ticks reported in the present study (except *H.a. excavatum*), collected from various parts of the world including Saudi Arabia (Hoogstraal 1973, Williams *et al.* 1973, Hoogstraal 1979, Darwish and Hoogstraal 1981, and Wood *et al.* 1982). Moreover, *H.a. anatolicum, H.a. excavatum* and *H.*

dromedarii are known vectors of animal theileriosis (Barnett 1977, Schein *et al.* 1975, Schüler 1979, and Cheema *et al.* 1986) and babesiosis (Donnelly *et al.* 1980, Purnell 1981, and Hoogstraal 1981) in various parts of the world including Saudi Arabia. *H. domedarii* is also known to transmit *Coxiella burneti*, the agent of Q fever and *H.m. rufipes* to transmit *Rickettsia conori* the agent of boutonneuse fever (Hoogstraal *et al.* 1981).

Rhipicephalus turanicus is the only truely xerophilic species of the sanguineus group (Morel and Vassiliades 1963, and Hoogstraal *et al.* 1981). It is mainly distributed in the Mediterranean sub-region and extends eastwards into India and China. It is a typical species of the dry subtropics and is a common representative of the tick fauna living in Eurasian deserts (Pomerantzev 1950, Dhanda and Rao 1969, Hoogstraal 1981 and Hoogstraal *et al.* 1981). The tick is absent from the Ethiopian faunal region, the origin and centre of distribution of the genus *Rhipicephalus* (Hoogstraal 1956, Morel 1980, and Pegram *et al.* 1981). The tick is probably absent from Yemen (Pegram *et al.* 1982), and in Saudi Arabia, it has recently been reported in abundance from Makkah Province (Al-Khalifa *et al.* 1986) and a few specimen have been collected elsewhere (Hoogstraal *et al.* 1981, Al-Khalifa and Diab 1986) including the Sultanate of Oman (Hoogstraal 1981). Hence, the present results indicate that the northern and eastern regions of Saudi Arabia constitute one of the main areas of distribution of *R. turanicus* in the Arabian Peninsula. In these regions and elsewhere in Saudi Arabia (Al-Khalifa *et al.* 1986), the tick was found only on sheep and goats which are considered by Morel and Vassiliades (1963) to be its natural hosts. However, Hoogstraal *et al.* (1981) were more cautious about the host range of adults of this species and suggested that the question of host range should await the final settlement of the identity of *R. turanicus* and other sibling species.

Rhipicephalus turanicus is of medical and veterinary importance as it is known to carry several viruses including the Crimean-Congo haemorrhagic fever, Manawa and Tomdy viruses (Bunyaviridae), tick-borne encephalitis and West Nile viruses (Togoviridae) and Chim virus (Unclassified, Hoogstraal *et al.* 1981). Some of these such as the Crimean-Congo haemorrhagic fever and tickborne encephalitis viruses causes serious human diseases. Moreover, Morel and Vassiliades (1963) are of the opinion that pathogens of small ruminants belonging to the genera *Babasia*, *Theileria*, *Anaplasma* and *Rickettsia* whose transmission has been attributed to *Rhipicephalus sanguineus* (Latréille), are in fact transmitted by *R. turanicus*. A *Theileria* sp. (Possibly *T. ovis*) was detected in blood smears of sheep and goats infested with this tick at Al-Hafr and Dammam during the present study. However, the transmission by this tick of the *Theileria* sp. of sheep and goats in Saudi Arabia remains to be verified, though elsewhere, the tick is a proven vector of *Theileria ovis* and *Anaplasma ovis* as well as of equine and swine piroplasmosis (Morel and Vassiliades 1963).

Boophilus kohlsi was originally described from samples taken from several localities between the sea of Galilee and the Dead Sea in Jordan by Hoogstraal and Kaiser (1960) and Hadani *et al.* (1964) have reported heavy infestations of goats and sheep in and around Wadi Ara near the Jordanian-occupied Palestine border. Since then many specimens have been collected from several localities in Jordan, Dohuk in the Mosul District of Iraq, in the Ta'izz and Sana'a Districts of Yemen as well as from Asir and Makkah Provinces of Saudi Arabia (Hoogstraal *et al.* 1981, and Pegram *et al.* 1982). This tick was considered to be ecologically restricted to relatively humid, vegetated hill and valley biotopes and in Saudi Arabia to be confined to the southwestern foothills and Asir escarpement (Hoogstraal *et al.* 1981). In a recent collection from the Al-Sarawat Mountains at Taif, several specimens were taken from goats (unpublished data). However, in the present study, the tick was taken only from goats at Dammam, a hot, humid and bare lowland area well away from its mountainous region of distribution in Saudi Arabia. Moreover, the tick seems to be well-established in the Dammam area as well as in the Eastern Province of Saudi Arabia as several collections were made from goats in that region (unpublished data). Further work is needed to elucidate the ecological relationships of *B. kohlsi* in this hot and humid lowland area.

The predilection of *B. kohlsi* for goats is, however, well documented (Hoogstraal and Kaiser 1960, Hadani *et al.* 1964, Hoogstraal *et al.* 1981, and Pegram *et al.* 1982) and in the present, as well as in other collections made in our nationwide survey, the tick was taken only from goats. Moreover, when equal numbers of goats and sheep were examined in the same locality, more than 93% of the infestation occurred on goats (Pegram *et al.* 1982).

Acknowledgements

We are deeply indebted to the Amirs (Governers) of Turayf and Al-Qaysumah for rendering facilities and transportation during the period of study. Dr. Harry Hoogstraal helped us considerably in the planning and execution of the tick survey and by confirming the identity of the tick species recorded in the study and we are deeply saddened by his untimely death in Feb. 1986. Thanks are also due to Mr. Y.Y. Abu-Jaafar for typing the manuscript.

References

Abou-Elela, R.G., Taher, M.O. and **Diab, F.M.** (1981) Studies on ticks infesting camels, sheep and goats in Riyadh area (Saudi Arabia), *J. Coll. Sci.. Univ. Riyadh* **12:** 385-399.

Al-Asgah, N.A., Hussein, H.S., Al-Khalifa, M.S. and **Diab, F.M.** (1985) *Hyalomma schulzei* (the large camel tick): distribution in Saudi Arabia, *J. Med. Entomol.* **22:** 230-231.

Al-Khalifa, M.S., Al-Asgah, N.A. and **Diab, F.M.** (1984) Ticks (Acari: Ixodidae) infesting common domestic animals in Al-Qasim Province, Saudi Arabia, *J. Med. Entomol.* **21:** 114-115.

Al-Khalifa, M.S., Al-Asgah, N.A. and **Diab, F.M.** (1986) *Hyalomma (Hyalommina) arabica*, the Arabian goat and sheep tick: distribution and abundance in Saudi Arabia, *J. Med. Entomol.* **23:** 220-221.

Al-Khalifa, M.S., Diab, F.M. and **Al-Asgah, N.A.** (1983) A checklist of ticks (Ixodoidea) infesting local farm animals in Saudi Arabia. I. Ticks of Al-Qasim Region, *J. Coll. Sci., King Saud Univ.* **14:** 335-339.

Al-Khalifa, M.S. and **Diab, F.M.** (1986) A checklist of ticks (Acari: Ixodidae) infesting local farm animals in Saudi Arabia. II. Ticks of Riyadh Province, *J. Coll. Sci., King Saud Univ.* **17:** 151-157.

Banaja, A.A., Madbouly, M.H. and **Roshdy, M.A.** (1980) Ticks of Saudi Arabia. I. Ticks (Ixodoidea) infesting imported and local breeds of domestic animals at Jeddah, *4th Symp. Biol. Asp. S.A. Biol. Soc.* (Riyadh, March 1980), pp. 339-346.

Banaja, A.A. and **Roshdy, M.A.** (1978) Observations on ticks (Acarina-Ixodoidea) of Saudi Arabia, *Bull Fac. Sci. K.A.U.*, Jeddah **2:** 119-122.

Barnett, S.F. (1977) Theileriosis. *In:* **J.P. Kreier** Ed., *Parasitic Protozoa*, vol. 4, pp. 77-113, Academic Press, New York.

Cheema, A.H., El-Bihari, S., Fayed, A.A. and **Ali, A.S.** (1986) Theileriosis in cattle in Saudi Arabia *(Abstract). 9th Symp. Biol. Asp. S.A. Biol. Soc.* (Riyadh, 24-27 March, 1986), p. 85.

Darwish, M.A. and **Hoogstraal, H.** (1981) Arboviruses infecting humans and lower animals in Egypt: A review of thirty years of research, *J. Egypt. Publ. Hlth. Assoc.* **56:** 112 p.

Dhanda, V. and **Rao, T.R.** (1969) The status of *Rhipicephalus sanguineus* (Latreille, 1806) and *R. turanicus* Pomerantzev, 1940 (Acarina: Ixodidae) in India, *J. Bombay nat. Hist. Soc.* **66:** 211-214.

Donnelly, J., Joyner, L.P., Graham-Jones, O. and **Ellis, C.P.** (1980) A comparison of the complement fixation and immunofluorescent antibody tests in a survey of the prevalence of *Babesia equi* and *Babesia caballi* in horses in the Sultanate of Oman, *Trop. Anim. Hlth. Prod.* **12:** 50-60.

Hadani, A., Cwilich, R. and **Aharoni, H.** (1964) On the occurrence of *Boophilus kohlsi* on sheep and goats in Israel, *Refuah Vet.* **21:** 138-141.

Hoogstraal, H. (1956) African Ixodoidea. I. Ticks of the Sudan (with special reference to Equatoria Province and with preliminary reviews of the genera *Boophilus*, *Margaropus* and *Hyalomma*), 1101 p. U.S. Department of the Navey, Washington D.C..

Hoogstraal, H. (1973) Viruses and ticks. *In:* **J.A. Gibbs,** Ed., *Viruses and Invertebrates*, pp. 349-390, North-Holland Publishing Company, Amsterdam.

Hoogstraal, H. (1979) The epidemiology of tick-borne Crimean-Congo haemorrhagic fever in Asia, Europe and Africa, *J. Med. Entomol.* **15:** 307-417.

Hoogstraal, H. (1981) Ticks (Ixodoidea) from Oman, *J. Oman Stud.* (Spec. Rep. No. 2): 265-272.

Hoogstraal, H. and **Bafort, J.M.** (1982) Ticks of Saudi Arabia: *Ornithodoros (Alectorobius) muesebecki* (Acarina: Fam. Argasidae) parasitizing marine birds in the Arabian Gulf, Saudi Arabia. *Fauna of Saudi Arabia*, **4:** 23-28.

Hoogstraal, H., Buttiker, W. and **Wassef, H.Y.** (1983) Ticks of Saudi Arabia: *Hyalomma (Hyalommina) arabica* (Fam. Ixodidae), a parasite of goats and sheep in Saudi Arabia, *Fauna of Saudi Arabia*, **5:** 117-120.

Hoogstraal, H. and **Kaiser, M.N.** (1959a) Observations on Egyptian *Hyalomma* ticks (Ixodoidea, Ixodidae). 5. Biological notes and differences in identity of *H. anatolicum* and its subspecies *anatolicum* Koch and *excavatum* Koch, among Russian and other workers. Identity of *H. lusitanicum* Koch, *Ann. ent. Soc. Amer.* **52:** 243-261.

Hoogstraal, H. and **Kaiser, M.N.** (1959b) Ticks (Ixodoidea) of Arabia, with special reference to Yemen, *Fieldiana Zool.* **39:** 297-322.

Hoogstraal, H. and **Kaiser, M.N.** (1960) *Boophilus kohlsi* n.sp. (Acarina: Ixodidae) from sheep and goats in Jordan, *J. Parasitol.* **46:** 441-448.

Hoogstraal, H., Oliver, R.M. and **Guirgis, S.S.** (1970) Larva, nymph and life cycle of *Ornithodoros (Alectorobius) muesebecki* (Ixodoidea: Argasidae), a virus-infected parasite of birds and

petroleum industry employees in the Arabian Gulf, *Ann. Ent. Soc. Amer.* **63:** 1762-1768.

Hoogstraal, H., Wassef, H.Y. and **Buttiker, W.** (1981) Ticks (Acarina) of Saudi Arabia: Fam. Argasidae, Ixodidae. *Fauna of Saudi Arabia*, **3:** 25-110.

Hoogstraal, H., Wassef, H.Y., Diab, F.M., Al-Asgah, N.A. and **Al-Khalifa, M.S.** (1984) Acarina of Saudi Arabia: *Ornithodoros (Alveonasus) lahorensis* (Fam. Argasidae) in Saudi Arabia: biological, veterinary and medical implications, *Fauna of Saudi Arabia*, **6:** 165-169.

Migahid, A.M. (1978) *Flora of Saudi Arabia* vol. I, II, 2nd ed., Riyadh University Publication, 939 p.

Morel, P.C. (1980) A Study on Ethiopian Ticks (Acarida, Ixodida) Maisons-Alfort, France, 332 p.

Morel, P.C. and **Vassiliades, G.** (1963). Les *Rhipicephalus* du groupe *sanguineus:* èspeces Africaines (Acarines, Ixodoidea). *Rev. Elev. Med. Vet. Pays Trop. n.s.* **15:** 343-386.

Pegram, R.G., Hoogstraal, H. and **Wassef, H.Y.** (1981). Ticks (Acarina, Ixodoidea) of Ethiopia. I. Distribution, ecology and host relationships of species infesting livestock, *Bull. ent. Res.* **71:** 339-359.

Pegram, R.G., Hoogstraal, H. and **Wassef, H.Y.** (1982) Ticks (Acari: Ixodoidea) of the Yemen Arab Republic. 1. Species infesting livestock, *Bull. ent. Res.* **72:** 215-227.

Pomerantzev, B.I. (1950) Ixodidae. In *Fauna of The USSR.* Moscow, vol. 4, 224 p.

Purnell, R.E. (1981) Babesiosis in various hosts. *In:* **M. Ristic** and **J.P. Kreier,** (Eds.) *Babesiosis*, pp. 25-63. Academic Press, New York.

Schein, E. Buscher, G. and **Friedhoff, K.** (1975) Lichtmikroskopische Untersuchung über die Entwicklung von *Theileria annulata* (Dschunkowsky and Luhs, 1904) im *Hyalomma anatolicum excavatum* (Koch, 1844). I. Die Entwicklung in Darm vollgesogener Nymphen, *Z. Parasitenkd.* **48:** 123-136.

Schuler, E. (1979) Untersuchungen zur Wirtgkeit und zur Ubertragerrolle verschiedener beim Rind vorkommender Zecken der Gattung Hyalomma, Inaug. Diss. Doct. Med. Vet., Tierarztliche Hochschule, Hannover, 46 p.

Soulsby, E.J.L. (1982) *Helminths, Arthropods and Protozoa of Domesticated Animals*, 7th Ed., Bailliere Tindall, London, 809 p.

Williams, R.E., Hoogstraal, H. Casals, J., Kaiser, M.N. and **Moussa, M.I.** (1973) Isolation of Wanowrie, Thogoto and Dhori viruses from *Hyalomma* ticks infesting camels in Egypt, *J. Med. Entomol.* **10:** 143-146.

Wood, O.L., Moussa, M.I., Hoogstraal, H. and **Buttiker, W.** (1982) Kadam virus *(Togaviridae, Flavivirus)* infesting camel-parasitizing *Hyalomma dromedarii* ticks (Acari: Ixodidae) in Saudi Arabia, *J. Med. Entomol.* **19:** 207-209.

(Received 08/09/1985;
in revised form 08/09/1986)

القراد المتطفل على الحيوانات الأليفة المحلية في شمال وشرق المملكة العربية السعودية

فتحي مسلم دياب و محمد صالح الخليفة و حسين سر الختم حسين
و ناصر عبدالله الأصقة

قسم علم الحيوان ـ كلية العلوم ـ جامعة الملك سعود ـ ص. ب ٢٤٥٥
الرياض ١١٤٥١ ـ المملكة العربية السعودية

تم مسح شامل للحيوانات المستأنسة المحلية في شمال وشرق المملكة العربية السعودية للتعرف على أنواع القراد الجامد الذي يتطفل على تلك الحيوانات. ولقد جمعت الأنواع الآتية:

Hyalomma schulzei حيث كان الأكثر عدداً في المجموعة، ولكنه جمع من الجمال فقط في منطقة الحدود الشمالية وحدها، ولكن النوع *Hyalomma dromedarii* هو الأكثر انتشاراً حيث وجد بكميات كبيرة على الجمال في كل المناطق عدا منطقة الحدود الشمالية التي طغى عليها نوع *H. schulzei*. أما النوع *Rhipicephalus turanicus* فكان الأكثر شيوعاً على الأغنام والماعز، كما تبيّن أن منطقة الدراسة الحالية من المناطق الرئيسة لإنتشار هذا النوع من القراد في كل الجزيرة العربية، ولقد كان النوع *Hyalomma anatolicum excavatum* منتشراً بين الجمال والأغنام والماعز، أما النوع *Hyalomma impeltatum* فهو أكثر انتشاراً بين الجمال والأغنام.

أما النوع *Boophilus kohlsi* فقد سجل للمرة الأولى في منطقة الدمام، بينما جمعت كمية قليلة من الأنواع

Hyalomma anatolicum anatolicum, *Hyalomma marginatum rufipes*.

ولقد لوحظ أن الحيوانات في المناطق الرعوية الجافة بها كميات كبيرة جداً من القراد وذلك بالمقارنة بالحيوانات التي فحصت في المناطق المزروعة، ولم يشاهد أي قراد على كل الأبقار التي فحصت.

كما تمت الإشارة أيضاً إلى الأهمية الطبية والبيطرية لأنواع القراد التي جمعت خلال الدراسة.