Seasonal Variations in Ixodid Tick Populations on a Commercial Game Farm in the Limpopo Province, South Africa

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Source: African Invertebrates, 54(2) : 491-498

Published By: KwaZulu-Natal Museum

URL: https://doi.org/10.5733/afin.054.0212

African Invertebrates Vol. 54 (2): 491–498 Pietermaritzburg 28 November 2013

Seasonal variations in ixodid tick populations on a commercial game farm in the Limpopo Province, South Africa

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ABSTRACT

Despite the large number of surveys of ticks that have been carried out, there are almost no recent records of ixodid ticks from the Waterberg area, Limpopo Province, South Africa. Free-living ticks on a commercial game farm in the Thabazimbi District, Limpopo Province, South Africa, were captured via 432 drags in eight sample sites from September 2003 to August 2008. The seasonal variations in occurrence of the ticks and details of their populations on a game farm, are described. Eight tick species have been collected, viz. *Amblyomma hebraeum*, *Haemaphysalis elliptica*, *Hyalomma rufipes*, *Rhipicephalus appendiculatus*, *Rhipicephalus (Boophilus) decoloratus*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus zambeziensis* and *Rhipicephalus* sp. The most abundant was the blue tick *Rh. (B.) decoloratus*. The data on the seasonal variations in tick numbers on the game farm can be used to determine the optimal time for applying tick control.

KEY WORDS: Acarina, Ixodidae, commercial game farm, free-living ticks, infestation, tick-borne diseases, population dynamics.

INTRODUCTION

Ticks are blood-feeding ectoparasites of mammals, birds, and reptiles throughout the world (Vredevoe 2006) and affect wildlife and domestic animal management globally, with approximately 896 species of ticks having been described (Guglielmone *et al*. 2010). Research on South African ticks commenced nearly 200 years ago and since then more than 80 tick species have been identified and documented (Walker 1991).

Ticks are important vectors of animal and human pathogens, and certain tick-borne diseases are of major importance throughout the world (Vredevoe 2006). Tick infestation is considered to be one of the main constraints to successful game ranching in southern Africa (Horak 1980; Lightfoot & Norval 1981; Norval & Lightfoot 1982). Various blood parasites are transmitted by ticks and some of them are considered to be the major cause of death of some wildlife species (Young & Basson 1973; Grobler 1981; Lightfoot & Norval 1981). These tick-borne diseases include, but are not limited to, heartwater disease (*Ehrlichia ruminantium*) transmitted by *Amblyomma hebraeum* (bont tick); red water disease (*Babesia bigemina*) transmitted by *Rhipicephalus (Boophilus) decoloratus* (blue tick); and East coast fever (*Theileria parva parva*) and corridor disease (*Theileria parva lawrencei*) transmitted by *Rhipicephalus appendiculatus* (brown ear tick). Although wild animals native to a specific area are seldom affected by the endemic tick-borne blood parasites/pathogens, translocations of hosts and/or ticks into non-endemic areas can result in severe losses amongst native animals (Lightfoot & Norval 1981). Other direct effects of ticks on their hosts include tick toxicosis, metabolic disturbances, anaemia and tick worry, which can result in production losses and/or deaths (O'Kelly & Seifert 1969). It has been established that tick control can decrease the prevalence of tick-borne diseases (Tatchell 1992).

The present study is continuation of previous research conducted on a commercial game ranch in the Thabazimbi District, Limpopo Province, South Africa (Schroder *et al*. 2006). The control-free areas in the study area range from 450–1100 ha, where there

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are Cape buffalo *Syncerus caffer* (Sparrman, 1779), giraffe *Giraffa camelopardalis* (L., 1758), blue wildebeest *Connochaetes taurinus* (Burchell, 1823), white rhinoceros *Ceratotherium simum* (Burchell, 1817), black rhinoceros *Diceros bicornis* (L., 1758), impala *Aepyceros melampus* (Lichtenstein, 1812), kudu *Tragelaphus strepsiceros* (Pallas, 1766), waterbuck *Kobus ellipsiprymnus* (Ogilby, 1833), gemsbok *Oryx gazella* (L., 1758) and zebra (*Equus quagga burchelli*) (Boddaert, 1785).

The main tick-related problems affecting this semi-intensive commercial game ranching operation are corridor disease (theileriosis) in the buffalo and acute theileriosis in juvenile roan antelope *Hippotragus equinus* (Desmarest, 1804) (Uys, pers. comm. 2003). Despite successful breeding of roan and sable *Hippotragus niger* (Harris, 1838) antelope throughout South Africa, theileriosis is seen as one of the main causes of the high mortality rate in calves and one of the reasons for the population decline of these antelope species (Van der Vegt 2007). The Cape buffalo may be infested with exceptionally large numbers and species of ixodid ticks (Yeoman & Walker 1967); and in respect of cattle, the Cape buffalo is one of the main carriers of corridor disease.

The primary objective of this study was to describe seasonal variations in tick populations. This information can assist game ranchers in deciding upon the best time of year to apply acaricide treatment in the Thabazimbi District.

MATERIAL AND METHODS

Study Area

The wildlife breeding farm Hoopdal KQ96 is 2210 ha and is located in the Thabazimbi district in the Limpopo Province of South Africa. It is bounded by longitudes 24°16'16.07"–24°20'43.56"S and latitudes 27°29'42.89"–27°26'57.85"E, with altitudes ranging from 993 to 1035 m. The farm consists mostly of plains (Van Staden 2002) and is located in the Thabazimbi region in the north-western corner of the Mixed Bushveld (Acocks 1988). The vegetation comprises Mixed Bushveld and Sourish Mixed Bushveld of the Savanna Biome (Low & Rebelo 1996). Rainfall during the 5-year study period amounted to a mean annual precipitation of 826.64 mm. The mean monthly minimum temperature during the study period was 12.8 °C, ranging from 0.5 to 19.0 °C. The mean annual maximum temperature during the same period was 30.1 °C, ranging from 22.0 to 40.5 °C.

Drag-sampling

Drag-sampling with flannel strips was chosen as a means of recovering immature ticks questing on vegetation (Zimmerman & Garris 1985), using a technique described by Petney and Horak (1987). Drag-sampling was performed on a monthly basis at the same time each month (20^{th}–26^{th}) for five years from September 2003 to August 2008. A grassland and a woodland zone, respectively, were selected for dragging in each of the four chosen study sites. Each month, four drag procedures were carried out in the woodland areas and four drag samples were obtained in the grassland areas. The study sites were established far apart in different vegetation localities throughout the study area. Two of these sites were in semi-intensive fenced breeding camps for roan and sable antelope and two study sites were in free-roaming game areas. Ten flannel strips (100×10 cm) were attached with Velcro tape to a 120 cm-long wooden spar. Each collection was made by dragging the spar by a loop of rope attached at either end for a continuous distance of

TABLE 1
Ticks collected on the farm Hoopdal KQ96 from September 2003 to August 2008.

Tick species	Number of ticks collected								
	Larvae	Nymphs	Males	Females	**Total**	Wetter	Drier	Warmer	Cooler
A. hebraeum	1010	2	0	0	**1012**	859	153	798	214
Rh. (B.) decoloratus	4603	0	0	0	**4603**	1898	2705	2101	2502
Rh. appendiculatus	546	111	1	12	**670**	329	341	204	466
Rh. evertsi evertsi	521	0	0	0	**521**	291	230	182	339
Rh. zambeziensis	21	2	0	0	**23**	4	19	0	23
Ha. elliptica	0	0	1	0	**1**	0	1	0	1
Hy. rufipes	4	0	0	0	**4**	1	3	0	4
Rhipicephalus sp.	0	2	0	0	**2**	0	2	0	2
Total	**6705**	**117**	**2**	**12**	**6836**	**3382**	**3454**	**3285**	**3551**
Percentage	**98.08**	**1.71**	**0.03**	**0.18**		**49.47**	**50.53**	**48.05**	**51.95**

300 m over the vegetation. After each drag, all the ticks were removed from the flannel strips using fine-pointed tweezers and placed in 70 % ethanol.

Because of the over-dispersed nature of ticks, the tick-drag results were logarithmically transformed [log (x + 1)] (Petney *et al*. 1990) on a monthly basis. The transformation to standard logarithms and not natural logarithms was chosen because the mean to variance ratio approaches one.

RESULTS AND DISCUSSION

Of the 6836 ticks collected, 98.08 % were larvae, 1.71 % nymphs, 0.03 % adult males and 0.18 % adult females (Table 1, Fig. 1). Eight tick species were found: *Amblyomma hebraeum* Koch, 1844; *Haemaphysalis elliptica* (Koch, 1844); *Hyalomma rufipes* Koch, 1844; *Rhipicephalus appendiculatus* Neumann, 1901; *Rh. (B.) decoloratus* (Koch, 1844); *Rh. evertsi evertsi* Neumann, 1897; *Rh. zambeziensis* Walker, Norval & Corwin, 1981; and *Rhipicephalus* sp. The most abundant species was *Rh. (B.) decoloratus*.

A mean number of 15.82 ticks were recovered per drag-sample per month over the 5-year study period. This is lower than the 168 ticks collected with monthly dragging in the Kruger National Park by Horak (1998), the 138 ticks collected per drag in Zambia by Zeiger *et al*. (1998), and the 80 ticks collected per drag in Hoopdal KQ96 by Schroder *et al*. (2006). Species and numbers of ticks recovered by drag-sampling depend on many factors, such as microclimatic conditions, host numbers at the site, host species favourability and host utilization of the habitat. Thus, variations are to be expected between sites and even at the same sites over the years.

There are two distinctive time periods which affect seasonal variations as regards ticks. These are the wetter (November–April) versus drier months (May–October) and the warmer (October–March) versus cooler months (April–September).

More ticks were collected in the drier/cooler months than in the wetter/warmer months (Table 1). All the identified tick species were more prevalent during the drier months,

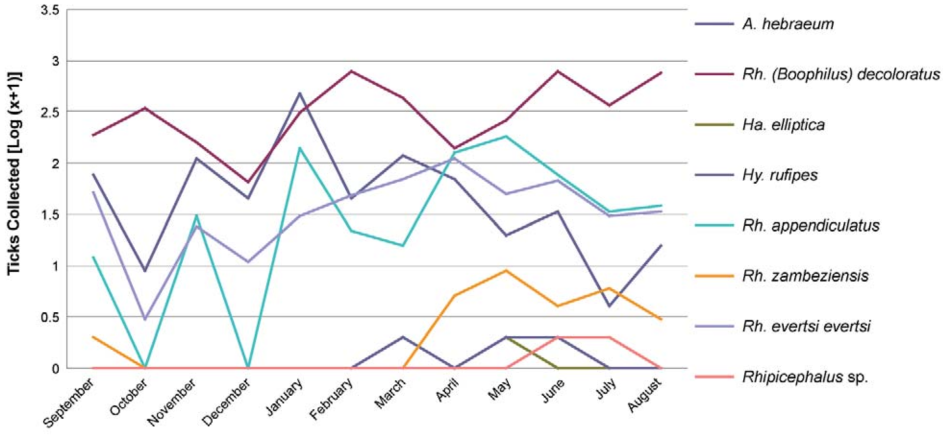


Fig. 1. Tick species and the total monthly tick numbers collected during the 5-year study period.

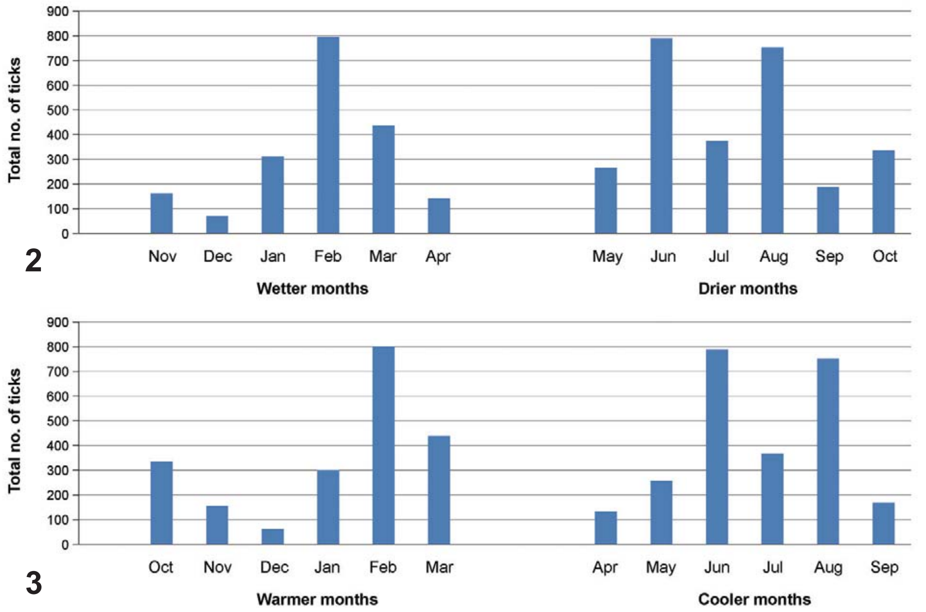
except for *A. hebraeum* and *Rh. evertsi evertsi*, which were more prevalent during the wetter months. The only tick species in the study area that was more prevalent during the warmer months was *A. hebraeum*.

Rhipicephalus (Boophilus) decoloratus

Larvae of *Rh. (B.) decoloratus* were present throughout the year but more prevalent in the study area during the drier and cooler months (Table 1). Of the 6836 ticks collected, 4603 (67.34 %) were *Rh. (B.) decoloratus*, which was most abundant from January to March and again from June to August (Figs 2, 3). A similar pattern of seasonality has been recorded by MacLeod (1970), Rechav (1982) and Zeiger *et al*. (1998). *Rhipicephalus (B.) decoloratus* was found in larger numbers in the woodland areas during the months with a higher temperature and was more prevalent in the grassland areas during the cooler months. This finding could be associated with the fact that during the summer months, *Rh. (B.) decoloratus* require shade, i.e. a woodland area. They also require grass for optimal survival, thus a grassland habitat in winter months (Horak *et al*. 2006). This is a one-host tick, which parasitizes ungulates (Sonenshine *et al*. 2002), and consequently it is only the larvae that will be collected from vegetation. All stages of development are found on cattle, large wild ruminants and zebras, on which animals the ticks attach to the sides of the body, dewlap, shoulders and neck.

Rhipicephalus appendiculatus

The largest numbers of *Rh. appendiculatus* larvae were collected in the drier and cooler months of the year (Table 1, Fig. 1). *Rhipicephalus appendiculatus* represented 9.80 % of all the ticks collected (Table 1). *Rhipicephalus appendiculatus* is a three-host tick and its preferred hosts include cattle, Cape buffalo, eland, waterbuck and various tragelaphine antelope (Norval *et al*. 1982; Horak *et al*. 1983). *Rhipicephalus appendiculatus* is responsible for the transmission of corridor disease via the cattle–buffalo association (since 1989, the different forms of the parasite are referred to as *Theileria parva* buffalo-associated – buffalo to cattle transmission; and *Th. parva* cattle-associated – cattle to cattle transmission). A high infection rate of suspected *Th. parva* in the buffaloes on the



Figs 2, 3. Numbers of *Rhipicephalus (Boophilus) decoloratus* collected in wetter and drier months (2), and in warmer and cooler months (3).

farm Hoopdal KQ96 has recently been reported (Uys, pers. comm. 2003). The collection of only very few *Rh. appendiculatus* does not explain the high incidence of the disease in the resident buffalo population. This indicates a need for further studies concerning this aspect and in regard to numbers of *Rh. appendiculatus* on the game farm.

Rhipicephalus evertsi evertsi

A total of 521 *Rh. e. evertsi* larvae were collected, of which the majority were present in April during the study period. This tick prefers a wetter/cooler climate (Table 1). *Rhipicephalus e. evertsi* is a two-host species and its preferred wildlife hosts include zebras and eland *Taurotragus oryx* (Pallas, 1766) (Norval 1981). This tick has been reported as transmitting *Theileria* spp. in roan antelope (Steyl *et al.* 2012).

Rhipicephalus zambeziensis

Twenty-three ticks were collected (Table 1). A survey of ixodid ticks undertaken on crested francolin *Dendroperdix sephaena* (Smith, 1836) on the farm Sandspruit in the Waterberg, showed evidence of this species being prevalent in this area (Uys & Horak 2005). Sandspruit is situated approximately 30 km from the farm Hoopdal KQ96. The mean annual rainfall and temperature as well as the altitude of the survey area all meet the requirements for a transitional habitat between *Rh. appendiculatus* and *Rh. zambeziensis.* The latter species prefers an altitude generally below 900 m, with an annual rainfall of 400–700 mm (Norval *et al*. 1982). The high rainfall during the study period could be the cause of the low numbers of *Rh. zambeziensis* collected. This was also recorded by Madder *et al*. (2005): "low rainfall favoured *Rh. zambeziensis*, whereas in years with above average rainfall, mainly *Rh. appendiculatus* were collected". Speybroeck *et al*.

(2004) collected *Rh. zambeziensis* ticks in the Swartwater area of the Limpopo Province, which shows that the species occurs in this area. *Rhipicephalus zambeziensis* is a three-host tick species and their preferred hosts include cattle, impala, lions *Panthera leo* (L., 1758) and kudu (Norval *et al.* 1982). *Rhipicephalus zambeziensis* can transmit *Theileria parva* and other *Theileria* species.

Amblyomma hebraeum

The largest numbers of *A. hebraeum* were present during January (Fig. 1). *Amblyomma hebraeum* was the only species collected which had a preference for wetter and warmer months during the study period (Table 1). *Amblyomma hebraeum* is a three-host tick and the preferred hosts of its adults are large herbivorous mammals, including cattle, eland, buffalo, giraffe and white rhinoceros. This tick is restricted to southern Africa and is the chief vector for *Ehrlichia ruminantium*, the causative organism of heartwater in several of the tick's ruminant host species (Walker 1991).

Haemaphysalis elliptica, *Hyalomma rufipes* and *Rhipicephalus* sp.

These ticks were recorded in very low numbers. They were all more prevalent in the drier and cooler months.

CONCLUSIONS

It is clearly evident that of the eight tick species collected on the game farm during the 5-year study period, seven species were more prevalent during the drier and cooler months. The only species which was more prevalent during the warmer and wetter months was *A. hebraeum*. This suggests that the best time to implement more stringent acaricide control methods in the study area would be during the drier and cooler months of the year, which would be from April to October annually. This includes control of *Rh. (B.) decoloratus*, which is present in large numbers all year round. It is not recommended that acaracides be used throughout the year as ticks have been known to become resistant to acaricides in South Africa, resulting in financial loss (Mekonnen 2002).

Tick populations should be monitored on a regular basis to determine the prevalence of ticks on game farms, which will then allow for implementation of more effective tick control measures, acaricide use and confirmation of the best times of the year to undertake tick control on individual game farms. This should result in enhanced animal productivity and financial gain.

ACKNOWLEDGMENTS

We would like to thank Dr A.C. Uys and Prof. I. Horak (Faculty of Veterinary Science, University of Pretoria, South Africa) for their help with the identification of the ticks. We are also grateful to two referees, who provided useful comments on the manuscript.

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