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PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. XIV. THE SEASONAL PREVALENCE OF *RHIPICEPHALUS SANGUINEUS* AND *CTENOCEPHALIDES* SPP. ON KENNELLED DOGS IN PRETORIA NORTH

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ABSTRACT

HORAK, I. G., 1982. Parasites of domestic and wild animals in South Africa. XIV. The seasonal prevalence of *Rhipicephalus sanguineus* and *Ctenocephalides* spp. on kennelled dogs in Pretoria North. *Onderstepoort Journal of Veterinary Research*, 49, 63–68 (1982).

The seasonal prevalence of *Rhipicephalus sanguineus* and *Ctenocephalides* spp. on kennelled dogs in Pretoria North was determined by the regular examination of 3, initially, and later 2 dogs from March 1975–January 1977.

Once the ticks had become established in the kennel peak burdens of immature ticks (larvae plus nymphae) were present on the dogs during early summer 1975 and from midsummer–late summer 1976 and early midsummer 1976/77. Peak numbers of adult ticks were present in midsummer 1975/76, from late summer–autumn and during early spring 1976 and during midsummer 1976/77. Few adults and even fewer immature ticks were present on the dogs during winter 1976 and the infestation overwintered in the pens as engorged nymphae.

The flea population took 10 months to become well established. Thereafter, the periods late summer–autumn 1976 and early midsummer 1976/77 (when the survey stopped) were the most favourable and winter–spring 1976 the least favourable for adult fleas.

The immature ticks preferred the sides and bellies, adult ticks the necks, and fleas the bellies of the dogs.

INTRODUCTION

Of the numerous ixodid tick species parasitizing domestic animals the brown dog tick or kennel tick, *Rhipicephalus sanguineus*, has probably the widest distribution, being found in countries around the globe from 50°N–35°S (Hoogstraal, 1956). In the Northern Hemisphere the adult ticks appear to favour the warmer months from March or May–September (Amin & Madbouly, 1973; Dipeolu, 1975). Their seasonal prevalence has not, however, been determined in the Southern Hemisphere.

The dog flea, *Ctenocephalides canis*, is not as widespread in southern Africa as is the cat flea, *Ctenocephalides felis strongylus* (De Meillon, Davis & Hardy, 1961), neither has their seasonal prevalence in this subcontinent been established.

The present paper describes the seasonal prevalence of *R. sanguineus* and *Ctenocephalides* spp. as determined from regular examinations of kennelled dogs during a period of 23 months.

MATERIALS AND METHODS

Survey area

The survey was conducted at a disused kennel situated to the west of Pretoria North in the central regional of the Transvaal. This is a summer rainfall region and the winters in the area in which the kennel was situated are frost-free.

Dogs

Three dogs were used. These were a dachshund (black, short-haired bitch) and 2 mongrels (both brown dogs, 1 with medium-length, coarse hair and the other with medium-length, silky hair), which were housed in separate pens in the kennel. The dachshund died at the beginning of April 1976 as a result of *Babesia canis* infection and the survey was continued with the surviving 2 dogs.

Kennel

The kennel consisted of 2 back-to-back rows of 6 pens each, facing respectively north and south. Each pen was approximately 3 m long by 1 m wide and had a concrete floor. A section, approximately 1 m^2, of each pen was roofed and these sections were separated from each other by walls that did not reach the roof. The other section of each pen was open and separated from adjacent pens by wiremesh. The bedding in the roofed section consisted of sacking.

Management

Initially 8 dogs were housed in the kennel. The 3 survey dogs and 1 other dog served as untreated controls for the remaining 4 dogs, each of which was fitted with an acaricide-impregnated collar which it wore for 70 days (Horak, 1976). During this time the majority of the dogs were rotated through the various pens at 7–10-day intervals. After removal of the collars few of them were moved. During the survey 1 of the survey dogs and 2 of the other dogs died and 2 other dogs were introduced.

The roofed section of each pen was never cleaned, nor was the bedding replaced, though new sacks were added when required. The open section of each pen was cleaned twice daily. No attempt was made to control the rats, mice and lizards in the pens and their surroundings.

Ectoparasite counts

Tick and flea counts were done on each of the 3 survey dogs at approximately 7-day intervals from 15 March 1975–26 March 1976, then the dachshund died as a result of *B. canis* infection. Counts were continued on the 2 surviving dogs until 14 January 1977 when the survey was terminated.

The external surface of each dog was divided into 8 separate areas, not necessarily corresponding to the anatomically recognized regions, as follows: head, ears, neck, shoulders, legs plus feet, back plus tail, both sides, and belly (Fig. 1).

The arthropods seen in each of the 8 areas on the dogs were recorded separately. If the infestation appeared to be light, the whole dog was examined; if severe, only 1 half of the dog was looked at and the number of parasites counted was multiplied by 2. Adult and immature ticks were counted separately, but males and females, and larvae and nymphae, were not differentiated.

On several occasions adult ticks and fleas were collected for specific identification.

Other procedures

At various intervals from 12 September 1975 onwards, 2 engorged female ticks were collected from the dogs, placed in gauze-stoppered glass tubes on the floor of the roofed section of an unoccupied pen and observed

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during each visit for oviposition and larval hatching. Similarly, at various intervals from 14 November 1975 onwards, 5–20 engorged nymphae were collected from the dogs, placed in gauze-stoppered glass tubes in the same roofed section of the pen as the engorged female ticks and observed for moulting during each visit.

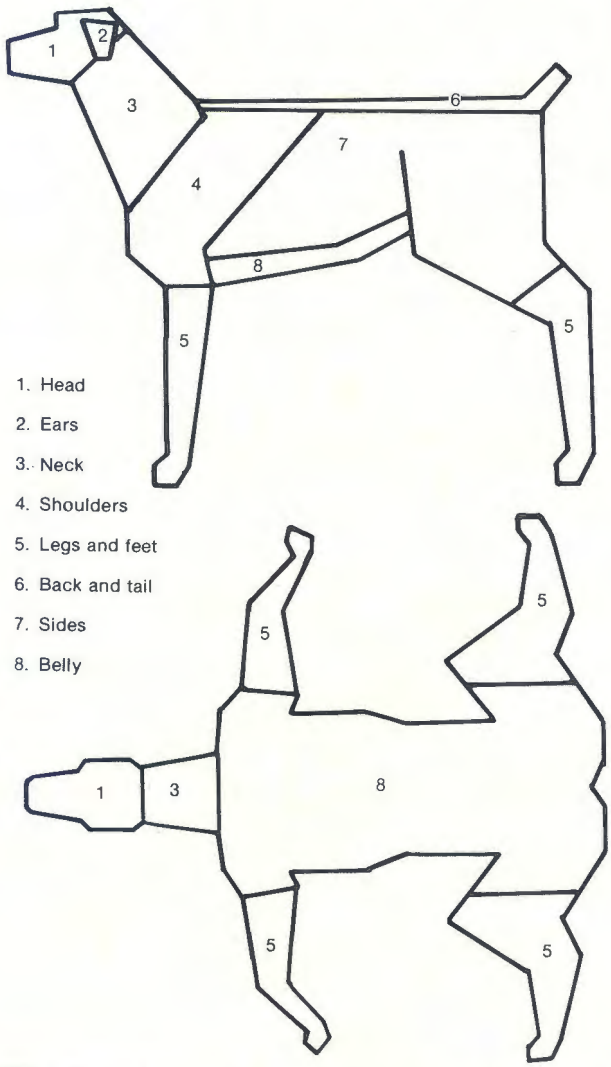

FIG. 1 The body regions of dogs examined for immature and adult *Rhipicephalus sanguineus* and adult *Ctenocephalides* spp.

Climate

Rainfall was measured at the Veterinary Research Institute, Onderstepoort, which is approximately 5 km north of the kennel. Daily maximum and minimum temperatures were measured at the Institute until August, 1975; thereafter they were measured in the roofed section of the same unoccupied pen in which the engorged adults and nymphae had been placed in their gauze-stoppered tubes.

RESULTS

With the exception of the very occasional presence of 1 or 2 adult *Haemaphysalis leachi*, all the ticks on the dogs that were specifically indentified were *R. sanguineus*. The flea burdens consisted of mixed infestations of *C. canis* and *C. felis*, with the latter predominating.

The monthly mean numbers of adult and immature ticks (calculated from the numbers counted at each visit), the length of the pre-moult period of the nymphae, the monthly mean numbers of fleas and the monthly mean rainfall and minimum and maximum atmospheric temperatures are shown in Fig. 2–4.

Immature tick burdens decreased erratically from autumn 1975 and reached their lowest levels during late winter and spring, thereafter rising rapidly to a peak during early summer. This was followed by a drop in numbers during midsummer 1975 and then a rise to a sustained peak during late summer 1976 and a decline during autumn. Few immature ticks were present from winter until spring, then their numbers rose markedly until midsummer 1976/77.

Adult tick burdens remained at a low level from the start of the survey until late winter 1975, when a slight rise occurred. This rise continued erratically and peak burdens were reached during January 1976. Burdens decreased during February but rose again to reach another peak during late summer. They fell to a comparatively low level during the following months but rose again during late winter and reached a peak during early spring. Thereafter they decreased, then rose to a major peak during January 1977 when the survey was concluded.

The fleas took 10 months to establish themselves in substantial numbers on the dogs. Their numbers rose sharply from January 1976 to reach a peak during late summer, then declined until early spring. Flea burdens increased again from early summer 1976 to reach a peak during January 1977.

The pre-oviposition periods of the engorged female ticks and incubation periods of their eggs are summarized in Table 1.

TABLE 1 The pre-oviposition periods of engorged females and incubation periods of eggs of *Rhipicephalus sanguineus* in kennels in Pretoria North

Date females collected	Pre-oviposition period* (days)	Incubation period* (days)
Early spring		
12 September 1975	4–11	Failed to hatch
Early summer		
14 November 1975	7–11	36–42
Midsummer		
27 December 1975	0–6	34–41
6 February 1976	7–14	29—38
Late summer		
22 March 1976	4–11	Failed to hatch
2 April 1976	7–15	Failed to hatch
Autumn		
28 May 1976	41–48	Failed to hatch
Late winter		
6 August 1976	14–21	Failed to hatch
Spring		
24 September 1976	6–14	57–63
21 October 1976	8–16	42–49
Early summer		
18 November 1976	0–8	39–51
Midsummer		
10 December 1976	7–12	28–35
14 January 1977	0–7	Not observed

* These periods are approximations as the kennels were visited at about weekly intervals

Engorged female ticks laid eggs throughout the year. Pre-oviposition periods, however, varied from 6–7 days or less for ticks collected during December 1975 and January 1977 to between 41–48 days for ticks collected during May 1976.

The eggs, laid by engorged females and collected during the periods 14 November 1975–6 February 1976 and 24 September 1976–10 December 1976, hatched. The incubation periods varied from between 57–63 days for eggs laid during September 1976 to between 28–35 days for eggs laid during December 1976. The eggs laid by females collected on 12 September 1975 and from 22 March–6 August 1976 did not hatch.

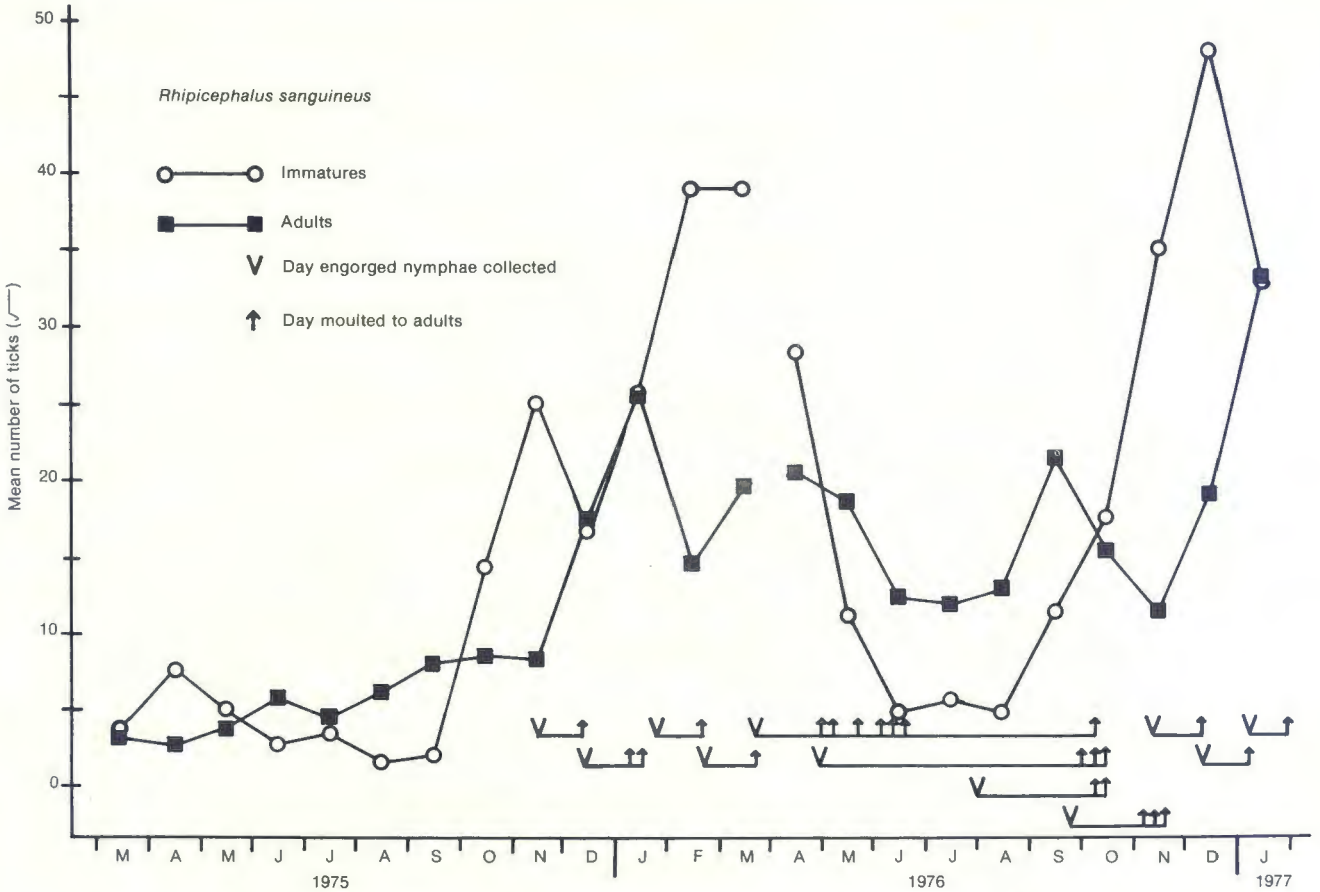

FIG. 2 The monthly fluctuations of immature and adult *Rhipicephalus sanguineus* on dogs in Pretoria North and the lengths of the pre-moulting periods of engorged nymphae

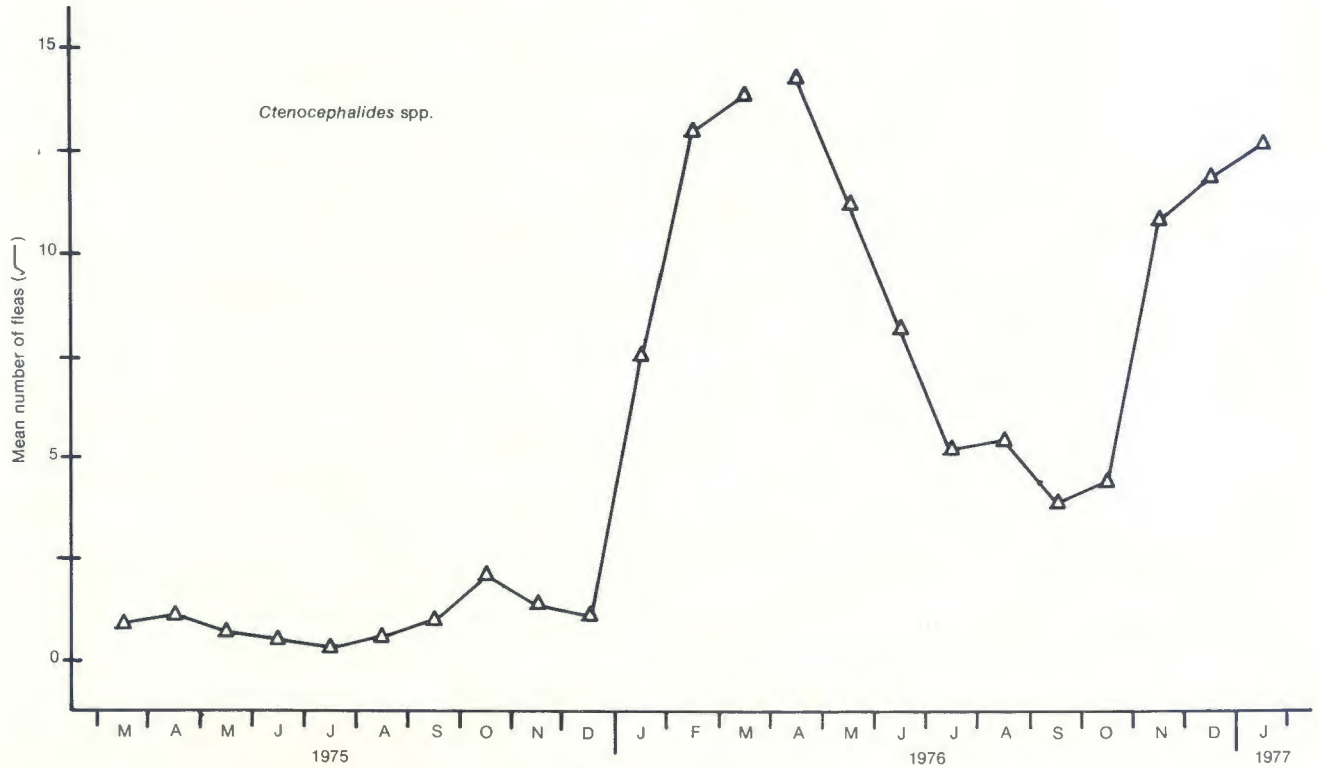

FIG. 3 The monthly fluctuations of *Ctenocephalides* spp. on dogs in Pretoria North

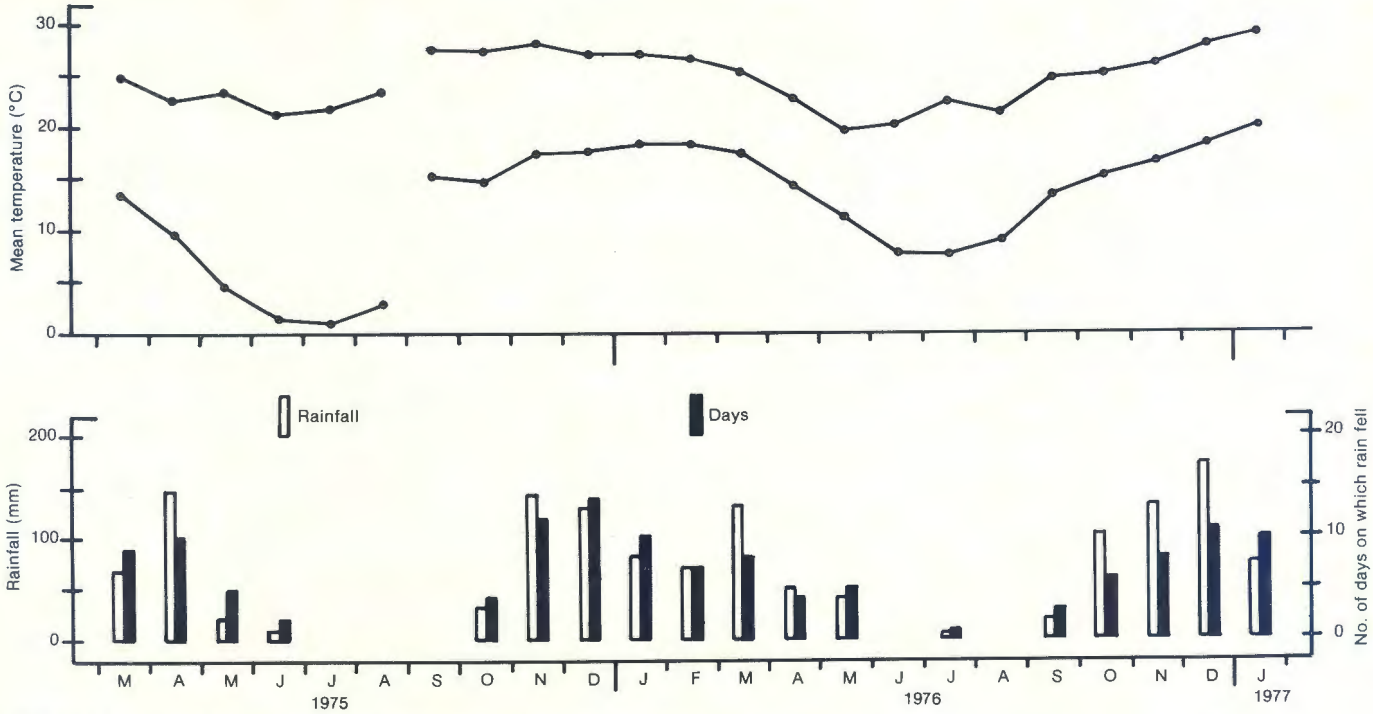

FIG. 4 Monthly mean minimum and maximum (a) atmospheric temperatures at Onderstepoort (March–August 1975) and in the kennels (September 1975–January 1977), and (b) rainfall at Onderstepoort

TABLE 2 The pre-moulting periods of engorged nymphae of *Rhipicephalus sanguineus* in kennels in Pretoria North

Date nymphae collected	No. collected	Pre-moulting periods*
Early summer		
14 November 1975	10	19–28 days, 2 moulted. No further observations
Midsummer		
12 December 1975	20	21–28 days, 1 moulted; 35 days, all moulted
23 January 1976	7	21–28 days, all moulted
Late summer		
21 February 1976	10	21–30 days, all moulted
22 March 1976	12	32–38 days, 1 moulted; 38–46 days, 1 moulted; 53–60 days, 3 moulted; 67–74 days, 1 moulted; 74–81 days, 1 moulted; 81–88 days, 1 moulted; 192–200 days, 1 moulted; remainder failed to moult
Autumn		
29 April 1976	10	148–154 days, 2 moulted; 154–162 days, 1 moulted; 162–169 days, 2 moulted; remainder failed to moult
Winter		
30 July 1976	6	62–70 days, 2 moulted; 70–77 days, all moulted
Spring		
24 September 1976	12	35–43 days, 1 moulted; 43–49 days, 8 moulted; 49–55 days, 2 moulted; remaining 1 failed to moult
Early summer		
12 November 1976	5	20–28 days, all moulted
Midsummer		
10 December 1976	10	17–29 days, all moulted
8 January 1977	10	13–20 days, 5 moulted; no further observations

* These periods are approximations as the kennels were visited at about weekly intervals

The pre-moult periods of the engorged nymphae are summarized in Table 2.

Some of, and frequently all, the engorged nymphae collected from 14 November 1975–8 January 1977 moulted to adult ticks. The pre-moult period was 20 days or less for some of the nymphae collected on 8 January 1977 and was generally less than 30 days for nymphae collected from 14 November 1975–21 February 1976 and between 12 November 1976 and 8 January 1977. The pre-moult periods of nymphae collected on 22 March 1975 ranged from approximately 35 days to approximately 196 days. During the period 24 September–8 October 1976 the last viable nymph of the batch collected on 22 March 1976 moulted, as did the 1st nymphae of the batches collected on 29 April and 30 July 1976.

The mean numbers of immature and adult ticks and of fleas recovered during the entire survey period and the mean percentages of these ectoparasites present on the various sites on the dogs are summarized in Table 3.

The dogs harboured a mean of 452 immature and 207 adult ticks and 51 fleas. More than 76% of the immature ticks were recorded from the sides (27,5% mainly larvae), bellies (19,3%, mainly larvae), shoulders (15,0%) and legs and feet (15,0%). More than 66% of the adult ticks were present on the ears, necks and shoulders of the dogs, the majority (29,7%) preferring the neck. The necks, sides and bellies of the dogs harboured more than 69% of the fleas, the belly being the preferred site.

DISCUSSION

A shortcoming of this survey is the fact that tick larvae and nymphae were not counted separately. Despite this drawback it is apparent that once the infestation had become firmly established in the pens all parasitic stages of development of *R. sanguineus* preferred the warmer months from October–April to the cooler months of June–August. Admittedly fairly large numbers of adult ticks were present during the latter period, but the immature stages were markedly reduced. In Egypt Amin & Madbouly (1973) found peak numbers of adult *R. sanguineus* on dogs during spring and summer and, in Nigeria Dipeolu (1975) collected peak numbers during summer. In Egypt very few adults were present in autumn and early winter, while in Nigeria, as in the present survey, adult burdens remained at a fairly high level during winter.

TABLE 3 The distribution of immature and adult *Rhipicephalus sanguineus* and of *Ctenocephalides* spp. on kennelled dogs in Pretoria North

Ectoparasite	Stage of development	Item	Site								Mean totals
			Head	Ears	Neck	Shoulders	Legs & Feet	Back	Sides	Belly	
R. sanguineus	Immature	Mean No.	27,4	58,0	6,5	67,8	68,0	13,3	124,4	87,2	452,6
		%	6,1	12,8	1,4	15,0	15,0	2,9	27,5	19,3	100
	Adult	Mean No.	25,6	40,0	61,6	35,8	10,5	20,5	3,3	10,1	207,4
		%	12,4	19,3	29,7	17,2	5,1	9,9	1,6	4,8	100
Ctenocephalides spp.	Adult	Mean No.	2,3	1,3	9,8	3,3	5,2	3,3	9,6	16,3	51,1
		%	4,6	2,6	19,2	6,4	10,2	6,4	18,7	31,9	100

The source of adult ticks during winter in the present survey is probably engorged nymphae which had dropped from the dogs during the last weeks of March. These continued to moult to adults till the 3rd week of June, but thereafter no more moulted until the 1st week of October. Although the eggs laid by female ticks, collected from 22 March–6 August 1976 and kept in glass tubes, failed to hatch, it is probable that some eggs laid by the hundreds of engorged females dropped in the kennels during April and May 1976 did give rise to the larvae present during winter. Some larvae must also have moulted during winter to produce the winter nymphal burdens.

Although a number of ticks were present during winter, the considerably reduced burdens indicate that *R. sanguineus* overwinters in a developmental stage rather than a parasitic phase. In some cases overwintering was probably achieved by engorged females with extended pre-oviposition and oviposition periods followed by an extended incubation period for the eggs. The absence of a marked larval peak during spring indicates, however, that this is not an effective method of overwintering. Sweatman (1967) found that temperatures below 20 °C markedly extended both the pre-oviposition and oviposition periods of *R. sanguineus* and Heath (1979) noted that eggs of *R. sanguineus* failed to hatch when exposed to constant temperatures below 18 °C. The mean monthly mean temperatures in the kennels fell below 18 °C from May–August and this could explain the failure of the eggs in the gauze-stoppered tubes (and in the kennels) to hatch when laid during the period March–August (Table 1).

In Egypt, Amin & Madbouly (1973) noted that overwintering immatures gave rise to increasing numbers of adults in the early spring. In the present study adult tick numbers also increased in the early spring (September) in both years (Fig. 2).

At Pretoria North an important method of overwintering is as engorged nymphae. A striking feature with the nymphae kept in glass tubes was the virtual synchronization of adult emergence during the last week of September and the 1st 2 weeks of October, irrespective of whether these nymphae had been collected during March, April or July. The newly-hatched adults would be responsible for the rise in adult tick counts on the dogs during September (Fig. 2).

The fact that the overwintered nymphae in the gauze-stoppered tubes only moulted to adults during the last week of September and the first weeks of October, while the adult tick populations on the dogs already started rising in September, can possibly be explained by the fact that the former nymphae were kept in an unoccupied pen and hence were deprived of the moisture and heat generated by the dogs, while the nymphae responsible for the rise in adult tick burdens had probably completed their life cycles in the pens with the dogs.

Feldman-Muhsam (1981) states that in Jerusalem the preservation of *R. sanguineus* from 1 active season to the the next is ensured mainly by hibernating unengorged adults. It is possible that a similar phenomenon occurred at the kennels in Pretoria North and that these ticks together with the newly-moulted adults would then be responsible for the rise in adult burdens in spring.

The rise in adult tick burdens during spring was followed by a rise in immature tick burdens in early summer, presumably the offspring of the adults. These immature ticks gave rise to the midsummer peak of adults, which in turn were responsible for the late summer peak of immatures. Some of these immature ticks gave rise to the late summer–autumn increase in adult numbers (Fig. 2), while others overwintered as engorged nymphae. The late summer–autumn peak of adults seems to play only a minor role in the continuation of the life cycle and in the overwintering of the infestation at Pretoria North. In warmer climates this peak may well be followed by a further peak of immature ticks and the presence of even this peak in adult numbers in the present survey is probably a reflection of the high temperatures prevailing in Pretoria North until April.

This patten of seasonal occurrence suggests that 3 peaks of adult *R. sanguineus* activity a year in Pretoria North were produced by 2 peaks of immature ticks. This implies that there are only 2 effective complete generations of ticks a year, one lasting 13–15 weeks from the adult peak in September or October to the adult peak in January, and the other lasting 36–38 weeks fron the January peak until the September or October peak. The immature ticks resulting from the January adult peak can give rise either to a non-productive adult peak during March–May, 10–16 weeks after the previous adult peak, to small numbers of adult ticks during winter, or to a productive adult peak during September/October. Thus the adult peaks in March–May and September–October do not represent 2 separate generations but rather originate from the same peak of immature ticks, some of which mature before winter, others during winter, and the remainder after winter. The seasonal abundance of *R. sanguineus* on dogs in Egypt also suggests that 2 generations a year occur there (Amin & Madbouly, 1973).

The fact that comparatively few ticks were present on the dogs during the winter months and that the infestation overwintered in the pens as engorged nymphae has important implications for the control of *R. sanguineus*. If acaricidal control measures are employed on the dogs in spring when tick infestations are low, they will not only kill those ticks already present as well as the new infestation resulting from overwintered nymphae, but will also thus disrupt the life cycle and prevent the build-up of large populations of ticks during summer.

Once the flea population had become established, the period November–May (summer–autumn) appeared to be most favourable for adults, with July–October (winter–spring) the least favourable. The decrease in flea burdens during the winter months was probably due to

the prevailing lower temperatures and dry conditions which were unfavourable for the development or survival of the free-living stages. Although the temperatures rose during September and October, conditions were probably still too dry for development and it was only after substantial rainfall during October 1976 that burdens started to rise.

In Cairo, Amin (1966) found that *C. felis felis* had 2 periods of peak abundance on dogs; one, in spring, followed a rise in temperature after winter, and the other, in autumn, followed an increase in relative humidity after the dry summer.

No attempt was made to determine the stage of development in which fleas overwinter.

Control measures concentrated in the months September–November would prevent the post-winter increase in flea burdens and this in turn should considerably reduce the summer build-up of fleas which are the offspring of the earlier burdens.

Although the tick and flea burdens were at times very large, they did not appear to affect all the dogs deleteriously other than cause irritation. One of the 2 dogs had gained 0,5 kg and the other 1,2 kg when their masses were determined during February 1976 compared with their masses 11 months previously at the start of the survey. The dachshund bitch however, had lost 1,6 kg.

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