Acta Veterinaria(Beograd), Vol. 45. No. 2-3, 147-154, 1996.

UDK 619:616.995.7.574.32

A STUDY OF THE SEX RATIO OF THE TICKS (ACARINA, IXODIDAE) OF SERBIA

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(Received, 25. January 1996.)

A study of the sex ratio of the ten tick species in West, East and South-East Serbia between 1984. and 1990. revealed the following: the relative number of each sex was significantly different from the expected one (1:1) testing to unequal distribution in the total number of collected ticks and within individual species, with the exception of Dermacentor pictus.

Key words: Acarina tick, species, sex ratio.

INTRODUCTION

Ticks are a hazard to human health through direct effects as well as through the transmission of viral, rickettsial, bacterial, fungal and protozoan diseases. Their capacity as vectors for the transmission of human diseases is surpassed only by mosquitoes. In addition, ticks play a major role in the human economy by causing significant losses in animal production through their own direct effects, as well as by transmission of diseases to domestic stock.

As haemathophagous athropods, ticks in all stages of development feed after attaching to the host. Males move more than females and their stage of parasitsm is shorter. Once on the host animal many tick species will not probe until they have arrived at the preferred feeding site and are out reach of grooming by the host. On the few occasions that male ticks climb on to unsuitable hosts, they may probe immediately, Female ticks appear to avoid or reject inappropriate hosts more than males, but may engorge in expectional cases (Honzakova et al., 1980).

In most tick species mating takes place on the host. Engorged female ticks drop from the host, lay eggs on the ground or in vegetation and then die. Male ticks stay on the host waiting for another female. (Gray, 1987).

The aim of this study was to determine the relative number of each sex and assess if it was significantly different from expected values (1:1) in order to evaluate tick populations as a whole and within individual species.

MATERIAL AND METHODS

The technigue of collecting ticks and the method of processing them have been reported previously (Milutinović et al., 1989).

The significance of differences in the distribution of frequencies of males and females was tested by using the t-test. (Petz, 1981).

RESULTS

The sex ratio of tick species was monitored for the total number of specimens collected (15921) and within individual species in 67 places in West, East and South-East Serbia between 1984. and 1990. Entire collections were classified as the *Ixodidae* family. Ten species were detected, namely *Ixodes ricinus, Dermacentor marginatus, Dermacentor pictus, Haemaphysalis punctata, Haemaphysalis sulcata, Haemaphysalis inermis, Rhipicephalus bursa, Rhipicephalus sanguineus, Boophilus calcaratus and Hyalomma savignyi.*

The species *Hyalomma savignyi* and *Boophilus calcaratus* were not detected in the region of West Serbia. The species *Dermacentor pictus* was not found in East and South-East Serbia.

Analysis of the sex ratio in the nine tick species detected in East and South-East Serbia revealed the following.The most numerous were females of the species *Dermacentor marginatus* (25,40%). The second place was taken by males of the same species (17,44%). This was followed by females of the species *Rhipicephalus bursa* and *Ixodes ricinus* (9,42% and 8,70%, respectively). and *Rhipicephalus bursa* males (7,56%). *Ixodes ricinus* males 5,51% came immediately after *Haemaphysalis punctata* and *Rhipicephalus sanguineus* females (6,36% and 6,04%, respectively), and so on successively to females and males of *Haemaphysalis inermis* (0,32% and 0,11%). Out of the total number of collected specimens, 58,21% were females and 41,79% males. Namely, the overall percentage of each sex was very different from the expected one (1:1, $p<0,001$). However, the sex ratios within individual species were different, because in six species *(Ixodes ricinus, Dermacentor marginatus, Haemaphysalis punctata, Haemaphysalis inermis, Rhipicephalus bursa* and *Rhipicephalus sanguineus)* a larger number of females was found, while in three species *(Haemaphysalis sulcata, Hyalomma savignyi* and *Boophilus calcaratus)* a larger number of males was detected. The percentages of each sex within individual species were significantly different from the expected one (1:1, $p<0.001$) (Table 1).

In the follow up of the dynamics of females and males in the nine species detected in the mentioned region in each year of investigation (Figures 1,2,3 and 4), it was noted that the percentages of females and males in the species *Dermacentor marginatus* were 35,61% and 64,39%, respectively in 1988. and

76,15% and 23,85%, respectively in 1990. For *Rhipicephalus bursa* females accounted for 45,76% and 68,99% in 1986. and 1990, respectively.

Table 1. Sex ratio of tick species found in East and South-East Serbia from 1984. to 1990.

Tick species	In total			Within individual species				TOTAL
	F	%	M	F	%	M	%	
I. r.	8,70		5,51	1095	61,24	693	38,76	1788
D. m.	25,40		17,44	3196	59,30	2194	40,70	5390
Hae. p.	6,36		4,13	800	60,61	520	39,39	1320
Hae. s.	0,73		1,62	92	31,19	203	68,81	295
Har. i.	0,32		0,10	40	75,47	13	24,53	53
Rh. b.	9,42		7,56	1185	55,48	951	44,52	2136
Rh. s.	6,04		2,87	760	67,80	361	32,20	1121
Hy. s.	0,33		0,79	41	29,08	100	70,92	141
B. c.	0,91		1,77	115	34,12	222	65,88	337
TOTAL	58,21		41,79	7324		5257		12581

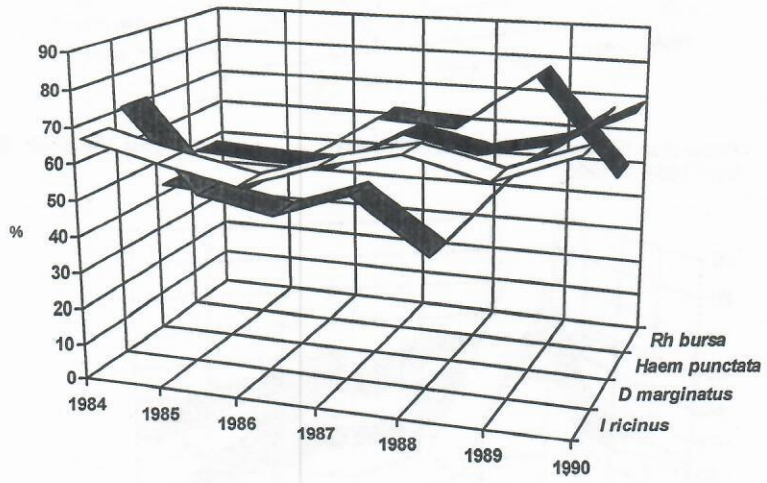

Figure 1. Population dynamics of females of four tick species found in East and South-East Serbia from 1984. to 1990.

The distribution of ticks found in West Serbia within the period 1989-1990. (Table 2) indicated that males of the species *Haemaphysalis sulcata* were predominant 22,84%. This was followed by females and males of *Ixodes ricinus* (16,97% and 12,10%, respectively). *Haemaphysis sulcata* females came immediately after males of the species *Ixodes ricinus* with an abundance of 10,93%. This was followed by females of the species *Haemaphysalis punctata* and *Dermacentor marginatus* (the third and the fourth place) with abundances of 10,78% and 8,86%, respectively. The frinding of *Haemaphysalis inermis* was 0,03% males and 0,39% females. Out of the total number of ticks collected, 51,95% were females

and 48,05% males. Namely, the percentage of each sex was significantly different from the expected one (1:1, $p<0,025$).

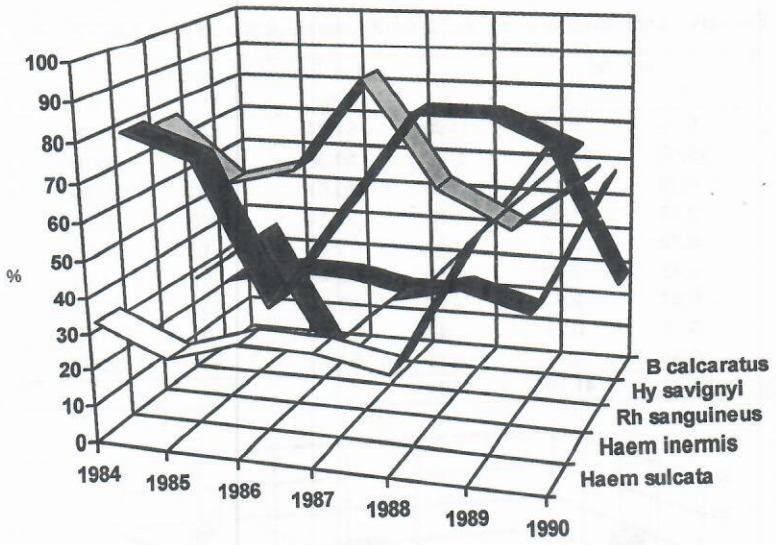

Figure 2. Population dynamics of females of five tick species found in East and South-East Serbia from 1984. to 1990.

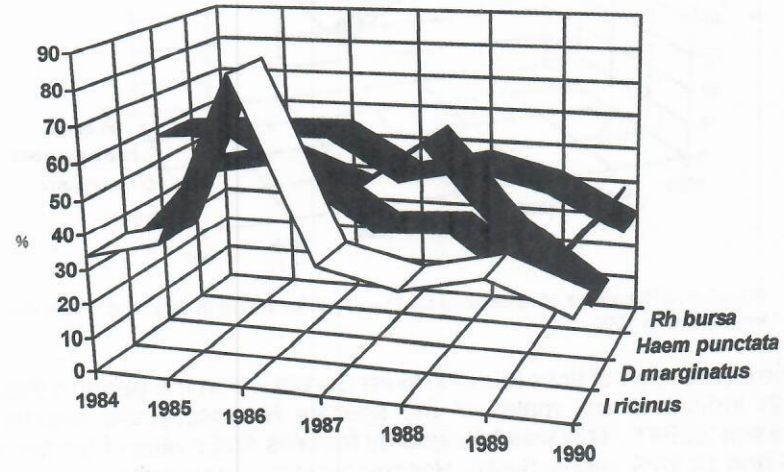

Figure 3. Population dynamics of males of four tick species found in East and South-East Serbia from 1984. to 1990.

Moreover, the sex ratio within individual species showed a larger number of females in five species: *Ixodes ricinus, Haemaphysalis punctata,*

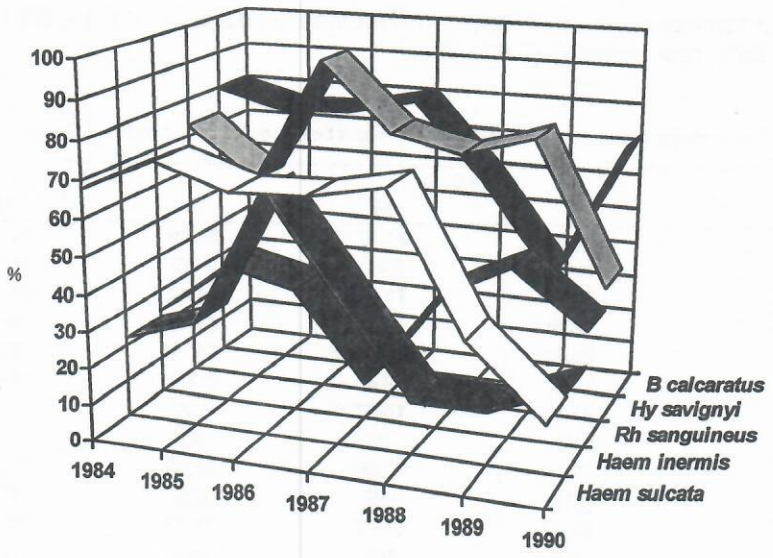

Figure 4. Population dynamics of males of five tick species found in East and South-East Serbia from 1984. to 1990.

Haemaphysalis inermis, *Rhipicephalus sanguineus* and *Dermacentor marginatus*, a greater number of males in two species: *Rhipicephalus bursa* and *Haemaphysalis sulcata* and an equal number of each sex in one species, *Dermacentor pictus*. Namely, the percentage of males and females was significantly different from the expected one (1:1, $p<0,001$), for all species with the exception of *Dermacentor pictus* (Table 2).

Table 2. Sex ratio of tick species found in West Serbia from 1989. to 1990.

Tick species	In total			Within individual species				TOTAL
	F	%	M	F	%	M	%	
I. r.	16,97		12,10	567	58,39	404	41,61	971
Hae. p.	10,78		4,28	360	71,57	143	28,43	503
Hae. s.	10,93		22,84	365	32,36	763	67,64	1128
Hae. i.	0,39		0,03	13	92,86	1	7,14	14
Rh. b.	1,50		3,17	50	32,05	106	67,95	156
Rh.s.	2,28		0,78	76	74,51	26	25,49	102
D.m.	8,86		4,61	296	65,78	154	34,22	450
D. p.	0,24		0,24	8	50	8	50	16
TOTAL	51,95		48,05	1735		1605		3340

Analysis of the percentage of males and females in the eight detected tick species in different years of investigation, revealed the following. In the most numerous species, *Haemaphysalis sulcata*, males accounted for 71,06% and 65,58% and females 28,94% and 34,42% in 1989, and 1990 respectiwely. Females

were predominant in *Ixodes ricinus* and *Haemaphysalis punctata* in 1989. (65,63% and 57,86%, respectively) (Table 3).

Table 3. Percentage of females and males in the eight tick species found in West Serbia

Tick species	1989.		1990.	
	F	M	F	M
I. r.	65,63 (441)	34,37 (231)	57,86 (126)	42,14 (173)
Hae. s.	28,94 (123)	71,06 (302)	34,42 (242)	65,58 (461)
Hae.p.	79,24 (187)	20,76 (49)	64,79 (173)	35,21 (94)
Hae.i.	83,33 (5)	16,67 (1)	100 (8)	—
Rh.b.	38,10 (24)	61,90 (39)	27,96 (26)	72,04 (67)
Rh. s.	69,23 (27)	30,77 (12)	77,77 (49)	22,23 (14)
D. m.	65,24 (137)	34,76 (73)	66,25 (159)	33,75 (81)
D. p.	66,66 (6)	33,34 (3)	28,57 (2)	71,43 (5)

It is noteworthy that the ratio of females whose digestive organs were filled with blood to unfed forms varied. In three species, i. e. in *Dermacentor marginatus, Ixodes ricinus* and *Rhipicephalus bursa*, fed females were predominant (80-90%), where in the remaining seven species differences in the numbers of fed and unfed females were not significant.

DISCUSSION

The sex ratio in the species *Ixodes ricinus* showed female prevalence (61,24%) so that these females accounted for of the total (8,70%) number of collected ticks in the region of East and South-East Serbia. In West Serbia the values were 58,39%: 41,61% and 16,97%: 12,10% for the sex ratio of this species respectiwely. A greater number of females was also reported by Mekuli (1952), Petrović and Bordjoški (1955) and Muftić (1965). Moreover, some authors, such as Babenko and co-workers (1977) determined the sex ratio in *Ixodes ricinus* in natural and experimental populations and found that in more cases a greater number of females appeared and survived to maturity than males. However, Zolotov (1981) found female predominance in *Ixodes persulcatus* and male predominance in *Ixodes ricinus* populations during several years monitoring the tick populations. Our investigation revealed that the greatest percentage of females in comparison with males was in East Serbia in 1990. (71,63% and

28,37%) and in West Serbia in 1989. (64,64% and 34,63%). Females were also predominant in North-East Serbia (Milutinović et al., 1987).

As for the results concerning unfed, fed and gravid females, it should be pointed our that mass livestock infestations with these arthropods occur in the second half of spring, the beginning of summer and in mid-autumn. This was also reported by Tovornik (1976) for the area of Stara Ves. Our findings, concerning the seven-year study, showed that within the species *Ixodes ricinus, Dermacentor marginatus* and *Rhipicephalus bursa* 80-90% of the specimens were fed females, whereas the percentage of unfed forms and gravid females was small. Within the period 1978-1980. females, i. e. fed forms (80%) were predominant in the area of North-East Serbia (Milutinović et al., 1987).

It is noteworthy that the fecundity of *Ixodes ricinus* females depends on the amount of sucked blood (Gray, 1987).

Among the total number of specimens of *Dermacentor marginatus* collected in East South-East and West Serbia females were prevalent (25,40% and 8,86%, respectively). Thus, within the species females were predominant both in East and South-East Serbia (59,30%) and also in West Serbia (65,78%). A greater number of females was also reported by Milutinović et al. (1987). However, a more detailed study of *Dermacentor marginatus* females referning to their age, origins and biotope of survival was carried out by Honzakova et al. (1980).They concluded that in specimens older than half a year there was no influence of these factors on the duration of feeding and that with increasing age the ability for full engorgement did not diminish. Moreover the data obtained indicate the possibility that a higher percentage of females of equal age engorge from the forest biotope than from the meadow biotope. In our investigations con cerning the ratio of fed to unfed and gravid females, the most abundant were forms with a few gravid females. In addition Černy et al. (1982) reported that females of *Dermacentor marginatus* were able to survive the second winter if not engorged after the first winter, i. e. in a smaller part of the *Dermacentor marginatus* population in Central Europe a two-year life cycle regularly took place beside the one-year life cycle. Furhermore, because a tiny percentage of *Dermacentor marginatus* females are able to pass the third winter in an unfed state and after the end of this period can engorge successfully; it should be admitted that a three-year life cycle may be possible.

In contrast to the other detected species which were female dominant, *Haemaphysalis sulcata* showed male prevalence in both regions of Serbia. Among *Haemaphysalis sulcata* females, most were unfed, while gravid forms were not found at all.

Concerning *Haemaphysalis punctata* we should stress female prevalence in the total number of ticks detected and within its species (6,36% and 60,61%, rspectively) in East and South-East Serbia. In West Serbia females were also predominant with values of 10,78% and 71,57% respectively. A greater number of females in comparison to males was also reported by Miščević et al. (1990) in North-East Serbia.

As for the sex ratio in *Rhipicephalus bursa* females also predominated accounting for 9,42% of the total number of collected specimens and 55,48%

within the species in East Serbia, while males were more numerous in West Serbia accounting for 3,17% of the total number of collected ticks and 67,95% within the species.

The species *Dermacentor pictus* showed an equal abundance of each sex.

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IZUČAVANJE ODNOSA POLOVA KRPELJA (ACARINA, IXODIDAE) SRBIJE

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SADRŽAJ

U radu su izneti rezultati istraživanja odnosa mužjak-ženka kod deset determinisanih vrsta krpelja na području zapadne, istočne i jugoistočne Srbije.

Dokazana je značajnost razlike u distribuciji frekvencije mužjaka i ženki ustanovljenih vrsta krpelja, kako u ukupnom nalazu, tako i u okviru pojedinih vrsta krpelja.