

## TICKS OF THE PROVINCE OF SALAMANCA (CENTRAL/NW SPAIN).

### Prevalence and parasitization intensity in dogs and domestic Ungulates

A. ENCINAS GRANDES\*

**SUMMARY.** By sporadic examination of 492 wild animals and regular weekly checks of dogs (179), cattle (288) and sheep and goats (141), 13 Ixodides were identified in the province of Salamanca. Some of these were only detected on the northern (*I. ricinus*) or southern (*H. lusitanicum* and *B. annulatus*) slopes of the mountains to the south of the province. Except for occasional introductions, *H. lusitanicum* and *B. annulatus* are not found on the Castilian plateau. In wild animals, 12 species were found of which only 4 are monotropic for some of these animals. In dogs, the most important species were *R. turanicus* and *R. sanguineus*. The latter shows only one generation per year and its nymphs are held to be the most important vector for the cases of boutonneuse fever registered in the provincial setting. In cattle, *R. bursa* is the most important tick, in terms of its prevalence in June/July (adults) and from November to January (immature forms). It also displays a much higher parasitization intensity than that of any of the other 7 species found on cattle. These remaining tick species (*D. marginatus*, *H. marginatum*, *H. lusitanicum*, *I. ricinus*, *R. turanicus*, *Hae. punctata* and *B. annulatus*) are abundant when *R. bursa* is absent; that is, in spring and at the end of summer, which thus are periods of richness in Ixodides but of low parasitism intensity. The ticks found on sheep and goats are the same as those detected on cattle, but in some of them prevalence and intensity vary as result of the kind of pasture frequented by the ovine and caprine hosts.

### Tiques de la province de Salamanque (Espagne). Prévalence et intensité parasitaire chez les Chiens et les Ruminants domestiques

**RÉSUMÉ.** L'inspection occasionnelle de 492 animaux sauvages et l'examen régulier, à une semaine d'intervalle, de chiens (174), de vaches (288), de chèvres et de moutons (141) ont permis l'identification de 13 Ixodidae dans la province. Quelques-unes de ces espèces ont été trouvées sur les pentes nord (*I. ricinus*) ou sud (*H. lusitanicum*, *B. annulatus*) des montagnes situées dans la partie sud de la province. Sauf des introductions occasionnelles, *H. lusitanicum* et *B. annulatus* ne se trouvent pas sur le plateau castillan.

Chez les animaux sauvages, on a trouvé 12 espèces dont seulement 4 sont monotropes de ces animaux. Chez les chiens, les tiques les plus importantes sont *R. turanicus* et *R. sanguineus*. Cette dernière espèce présente une seule génération par année et ses nymphes sont considérées comme le vecteur le plus important des cas de fièvre boutonneuse enregistrés dans la province. Chez les vaches, *R. bursa* est la tique la plus importante, due à sa prévalence en juin/juillet (adultes) et novembre/janvier (larves et nymphes) et à l'intensité parasitaire qui est toujours plus élevée que celle des 7 autres espèces (*D. marginatus*, *H. marginatum*, *H. lusitanicum*, *I. rici-*

\* Dto. de Parasitología, Facultad de Farmacia (Apartado 449), 37080 Salamanca, España.

Accepté le 29 mai 1985.

*nus*, *R. turanicus*, *Hae. punctata* et *B. annulatus*) trouvées chez ces animaux. Celles-là sont abondantes quand la première est absente; c'est-à-dire au printemps et vers la fin de l'été, qui sont donc des époques riches en tiques mais d'intensité parasitaire faible. Les tiques trouvées chez les chèvres et les moutons sont aussi les mêmes que celles des vaches, la prévalence et l'intensité des infestations de certaines d'entre elles variant seulement selon les différentes sortes de pâturages fréquentés par ces animaux.

---

In the catalogue of Iberian Zooparasites (Cordero *et al.*, 1980), 13 species of Ixodides are cited for the Province of Salamanca. Besides certain errors in some of the species mentioned, no reference is made in the literature cited to seasonal prevalence nor to the parasitism intensity of the species found. These two aspects, with few exceptions, are relatively undocumented in this country even with respect to the ticks of domestic animals, in spite of their undoubtable interest for the understanding of the epizootiology epidemiology of bovine and ovine pyroplasmiasis and Mediterranean Spotted Fever, all of great socioeconomic importance.

The aim of the present work is to clarify these two aspects of the biology of the ticks found in the Province of Salamanca, mainly those affecting domestic animals owing to their economic and/or vectorial relevance in the diseases mentioned above. In this sense, it was necessary to establish which ticks are present in the province; previous data by other authors are inconclusive in that they are based on the examination of only small numbers of ticks taken from an even more reduced number of host species.

## Materials and methods

Ticks were sporadically taken from feral hosts and regularly from domestic animals. For such purposes, over 1983-1984 weekly collections were made from dogs, cattle and sheep and goats from livestock rearing farms in which the animals were preferentially on a free range regimen, spending only a few hours, at most, in stables for feeding or milking purposes, etc. No continually stabled animals were considered nor any dogs previously treated with insecticides or which lived indoors or which were prevented from living a completely free open air life. On each farm, the percentage of animals infested and the number of ticks per animal were recorded.

In the case of large animals, the detection procedure consisted of a macroscopic examination of their hides. In small animals (e.g. mice) the same protocol was performed with the aid of a binocular lens; the sediments of the 70 % alcohol used for washing the animals were also examined.

Besides the ticks collected with these procedures, a further 457 specimens belonging to the Department of Parasitology of the Centro de Edafología y Biología Aplicada. C.S.I.C. (Salamanca, Spain) taken from different hosts inhabiting the province were also examined.

The ticks *R. sanguineus*, *R. turanicus* and *R. pusillus* were differentiated in

TABLE I. — Wild Animal Ticks. L, larvae ; N, nymphs ; ♂ ♀, adults.  
Nº, number of specimens captured.

Species	Stage	Nº	Host	Month	Observations
<i>xodes anisuga</i>	N	5	Fox, 2/25 ; Boar 1/12	V, X	
	♂ ♀	9	Fox, 7/25	II, III, V, X, XI	
<i>xodes montalis</i>	L, N	17	Magpie ( <i>Pica pica</i> ) 3/6 (32) Field fare ( <i>Turdus philomelos</i> ) 1/3 Black bird ( <i>T. merula</i> ) 1/2 Field fare ( <i>T. viscivorus</i> ) 1/3 ; (man)	III, IV	The female on a person was not anchored
	♀			III	
<i>xodes exagonus</i>	N	25	Hedgehog 4/8 ; Ferret 1/1 Fox 3/25	I, III, IV, VI VII, X, XII	
	♂ ♀	16	Hedgehog 4/8 ; Fox 3/25 ; Ferret 1/1 ; Dog 1/179	II, III, IV, V, VI VII, VIII, IX	
<i>xodes cinus</i>	♂ ♀	7	Boar 2/12 ; Fox 3/25	I, X, XII	Confined to mountainous zones of the province
<i>Ixodes marginatus</i>	L, N	14	<i>Apodemus sylvaticus</i> 6/12 (60) <i>Arvicola sapidus</i> 1/1	VII, VIII	
	♂ ♀	58	Boar 6/12	I, VI, X, XI, XII	
<i>Ixodes uncinata</i>	L, N	4	Magpie ( <i>Pica pica</i> ) 1/12 (32) Hare 1/60	VIII, XI	
<i>Ixodes argintatus</i>	L, N	900	Partridge ( <i>Alectoris rufa</i> ) 3/3 (140) ; Field fare ( <i>T. phi- lomelos</i> ) 1/3 ; Magpie ( <i>Pica pica</i> ) 8/12 (32) ; Little owl ( <i>Athene noctua</i> ) 1/1 ; Stone curlew ( <i>Burhinus oedicne- mus</i> ) 1/1 <i>Buteo buteo</i> 1/1	VII, VIII, IX, X	The field fare and one of the partridges were found dead in the country, prob- ably due to the number of L and N anchored to their heads.
	♂ ♀	12	Hare 3/60 ; Boar 1/12 ; Fox 1/25	VI, IX, X	
<i>Ixodes sitanicum</i>	♂ ♀	25	Boar 2/12	VI, IX	
<i>Ixodes anguineus</i>	♂ ♀	74	Fox 4/25 ; rabbit 1/12 (140) Hare 2/60 ; Hedgehog 3/8	V, VI, VII, VIII X	Only males were seen on hares
<i>Ixodes varanicus</i>	♂ ♀	26	<i>Apodemus sylvaticus</i> 1/28 (60) ; Fox 4/25 ; rabbit 1/12 (140) ; Boar 1/12 ; cat 1/1 ; Hare 2/60 ; Hedgehog 3/8	IV, V, X, XI	Only males were seen on hares and on <i>A. sylvaticus</i>
<i>Ixodes isillus</i>	♂ ♀	120	Fox 4/25 ; Dog 2/179 ; Boar 1/12 ; cat 1/1 ; rabbit 12/12 (140)	II, IV, V	
<i>Ixodes ursa</i>	L, N	456	Hare 57/57 (60)	X, XI, XII	

the adult stage according to the characters described by Batelly *et al.* (1977), Feldman-Muhsam (1952), Gilot *et al.* (1977), Morel and Vassiliades (1962) and Saratsiotis and Batelli (1975). The juvenile phases were either reared until the adult stage or were classified according to the criteria given by some of the previous authors and by Filippova (1981).

## Results

The *Ixodoidea* found by us in the provincial setting were two *Argasidae* (*Argas reflexus* and *Ornithodoros erraticus*) and 13 Ixodidae; the former were collected from dove coots and pig-pens, respectively, and the latter from a total of 1,097 animals examined.

*Ticks from wild animals.* — Ticks were found in 16 species of wild animals of which very unequal numbers were examined, the total number being 492. Animals of another six species were consistently seen to be free of parasites, either because of the small sample size (1-6 specimens) or because those animals do not act as hosts, at least not in the season when they were captured. Such is the case of turtle-doves (*Streptopelia turtur*) in that of the 180 examples examined over August and September, none were found to harbour parasites.

*Table I* shows the hosts of the different developmental stages. The names are followed by a fraction in which the numerator refers to the number of animals parasitized; the first figure of the denominator refers to the number of animals examined during the season in which the developmental stage in question was found and the second, in brackets, indicates the number of animals of the same species examined during other periods of the year. Where the denominator only features a single number, this refers to the total number of animals examined over the year.

*Dog Ticks.* — *R. sanguineus* and/or *R. turanicus* were found, either alone or in mixed infestations (13 %, 31 %, 12.5 % of the dogs over the months IV, V and VI), in 100 % of the dogs (134) examined from April to October.

Adults of *R. turanicus* appeared during the first fortnight of April and disappeared towards the end of June. They did not give rise to very heavy infestations, the maximum value recorded being 23 ticks on a single dog. In the above mentioned period, they were also seen to infest other animals (*Tables III and IV*).

The adults of *R. sanguineus* also began their activity in April, though slightly later, in the second fortnight. In June/July their prevalence and intensity were maximal. During this period, and even in May, infestations involving as many as 375 ticks/animal were not uncommon. These massive infestations are not included in *Table II*. Towards the end of July they began to disappear and from August onwards were hardly ever found. At this time, the nymphs made their appearance, populations reaching a very pronounced maximum in September. In October the numbers of nymphs and certain adults, which begin to reappear in this month (not in 1984) are very low. Between November and March, no ticks were found on the 45 dogs examined.

TABLE II. — Seasonality, prevalence and mean intensity of infestations of *Rhipicephalus turanicus* and *R. sanguineus* in dogs. A, adults; N, nymphs.

	IV	V	VI	VII	VIII	IX	X	XI-III	TOTAL
Dogs	15	16	32	22	16	17	16	45	179
Ticks	88	286	1,155	635	173	625	12	—	2,974
<i>Rhipicephalus turanicus</i>									
specimens	63	85	10	—	—	—	—	—	158
prevalence	100 %	62.5 %	18.7 %						
mean infestation intensity	4.2	8.5	1.6						
<i>Rhipicephalus sanguineus</i>									
specimens	25	201	1,145	635	173	625	12	—	2,816
prevalence (A)	13.3 %	68.7 %	90.6 %	100 %	56.2 %	35.2 %	18.7 %		
prevalence (N)	20 %	—	15.6 %	22.7 %	43.7 %	94.1 %	12.5 %		
mean intensity (A)	10	18.3	35.1	25.8	6.5	1.6	1.6		
mean intensity (N)	1.6	—	28.4	13.2	16.2	38.4	3.5		

In 1984, a number of nymphs, together with the adults, was observed as early as April and with the exception of May continued to show their presence, though only on a few dogs and at low parasitization intensity (2-6 per animal, exceptionally more than 100) during the season of activity of the adults. In 1983, the first nymphs were seen in July. A few larvae were found in September on only two dogs.

Besides the ticks referred to above, *R. pusillus*, *I. hexagonus*, *R. bursa*, *H. marginatum* and *I. ricinus* were also found, though only on a single occasion out of total 179 dogs examined. The latter three species were represented by only one specimen.

*Cattle Ticks.* — The individuals of *R. bursa* alone account for 78.8 % of the ticks found on cattle. The adult form of the species is found in maximum numbers in June-July, together with another maximum of immature forms in November-January. On a single farm, parasitization intensity varies considerably from one animal to another. Cattle grazing in small fields, unoccupied for most of the year, do not usually have more than 4-6 adult ticks or larvae/nymphs, according to the season of the year. Those animals grazing on pasture land subjected to an intensive and continuous regimen show from 50 to 100, though vast numbers were sometimes found, specially when the forms present were immature. Such cases, hitherto unobserved in dairy cattle, in contrast to the case of animals in worse living conditions, were excluded from *table III*.

Other species of cattle ticks abound when *R. bursa* is not present; that is, during months III-V and IX-X, which are thus rich in species but low in parasitization intensity: mean intensity was less than 4 ticks per animal.

The data relating to *I. ricinus* and *H. lusitanicum* shown in *Table III* refer

TABLE III. — Cattle ticks. Specimens collected, prevalence and monthly intensity of infestations (respectively, upper, middle and lower figures of each of the rows in front of each species). L, larva ; N, nymph ; A, adult.

	III	IV	V	VI	VII	VIII	IX	X	XI	XII-II	TOTAL
Cattle	24	24	54	28	19	19	34	20	34	32	288
Ticks	31	88	126	469	472	58	53	58	98	425	1,878
<i>Rhipicephalus bursa</i>	1 (N) 4.16 % 1	9 (A) 12.5 % 3	23 (A) 27.7 % 1.53	428 (A) 92.8 % 16.46	470 (A) 100 % 24.7	47 (A) 73.6 % 3.35	21 (A) 38.2 % 1.61	11 (N) 55 % 1	84 (L, N) 88 % 2.8	387 (L, N) 53 % 22.8	1 481
<i>Dermacentor marginatus</i>	30 (A) 75 % 1.6	16 (A) 12.5 % 5.33	1 (A) 1.85 % 1	3 (A) 7.14 % 1.5	— — —	— — —	8 (A) 11.7 % 2	19 (A) 30 % 3.16	13 (A) 17.6 % 2.16	35 (A) 18.7 % 5.8	125
<i>Hyalomma marginatum</i>	— —	52 (A) 70.8 % 3.05	82 (A) 57.4 % 2.64	35 (A) 50 % 2.5	2 (A) 10.5 % 1	11 (A) 26.3 % 2.2	14 (A) 5.8 % 7	7 (A) 15 % 2.33	— — —	— — —	203
<i>Hyalomma lusitanicum</i>	— —	5 (A) 8.33 % 2.5	11 (A) 5.5 % 3.66	1 (A) 3.57 % 1	— — —	— — —	6 (A) 5.88 % 3	14 (A) 20 % 3.5	— — —	3 (A) 6.25 % 1.5	40
<i>Ixodes ricinus</i>	— —	— —	— —	— —	— —	— —	1 (A) 2.94 % 1	3 (A) 10 % 1.5	— — —	— — —	4
<i>Haemaphysalis punctata</i>	— —	— —	1 (A) 1.85 % 1	— — —	— — —	— — —	3 (A) 5.88 % 1.5	3 (A) 10 % 1.5	1 (A) 2.9 % 1	— — —	8
<i>Rhipicephalus turanicus</i>	— —	6 (A) 12.5 % 2	8 (A) 5.5 % 2.66	2 (A) 7.14 % 1	— — —	— — —	— — —	— — —	— — —	— — —	16
<i>Boophilus annulatus</i>	— —	— —	— —	— —	— —	— —	— —	1 (A) 5 % 1	— — —	— — —	1

exclusively to the mountainous area to the south of the province (*fig. I, A, d*). On the only occasion they were seen outside this region, both species were found either on animals originating from that area or from the Province of Cáceres (*H. lusitanicum*), also to the south, or on wild boars and foxes (both species) which roam from the mountainous zone to the plain to the north of the mountains.

Regarding localization on the bovine host, *D. marginatum* and the juveniles of *R. bursa* attach themselves, respectively, to the head (base of the horns) and between the hairs of the back, flanks and neck. The remaining species are to be found on the udders and perineal regions and occasionally on the animals' extremities (head and tail).

*Sheep and Goat Ticks.* — (*Table IV*). The same species were found on these

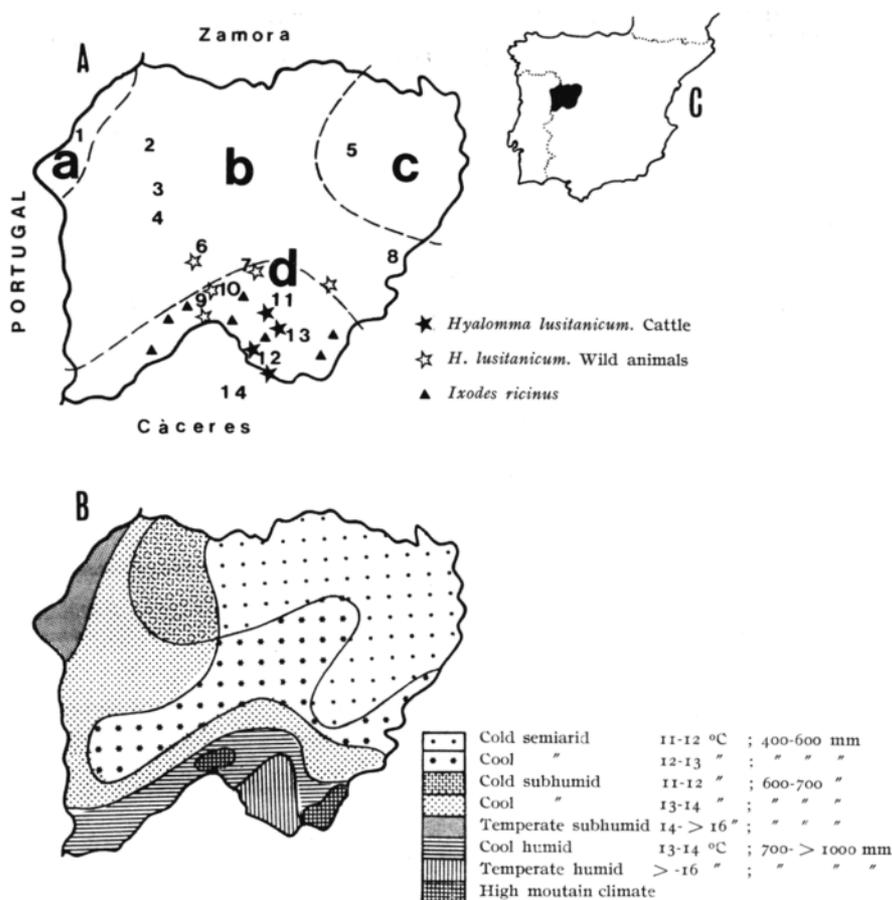


FIG. 1. — Province of Salamanca. Distribution of *H. lusitanicum* and *I. ricinus*. A, Ecological-physiognomic formations : a, b, c, *Durilignosa* (oceanic-dry, continental-dry and continental-semiarid, respectively). d, *Aestilignosa*. B, Provincial climatic areas. Mean annual temperatures and rainfall. C, Situation of the province in the Iberian Peninsula. A, B, according to Oliver and Calabuig (1979) simplified.

hosts as on cattle, the only differences being in the prevalence and intensity of parasitization. *R. turanicus* and *I. ricinus* show greater prevalence on sheep and goats (27.07 % and 20.15 %) than on cattle (0.85 % and 0.21 %). *H. marginatum* was found in practically the same numbers on cattle (10.8 %) as on sheep and goats (10.27 %) and the same is true of *Hae. punctata* (0.85 % and 0.88 %). In contrast, *H. lusitanicum*, *D. marginatum* and *R. bursa* were more abundant on the cattle examined (2.12 %, 6.65 % and 78.8 %, respectively) than on the ovine and caprine hosts (0.39 %, 0.29 % and 41.3 %).

TABLE IV. — Sheep and goat ticks. Specimens captured, prevalence and parasitization intensity (respectively, upper, middle and lower figures of each of the rows in front of each species).

	IV	V	VI	VII	IX-X	TOTAL
Sheep and goat	18	43	39	22	19	141
Ticks	246	199	306	150	111	1,012
<i>Rhipicephalus bursa</i>	—	17 10.3 % 4.2	212 43.5 % 12.5	141 68 % 9.6	44 44 % 14.6	418
<i>Rhipicephalus turanicus</i>	92 61 % 8.36	138 73 % 4.5	42 35.5 % 3	2 4.5 % 2	—	274
<i>Ixodes ricinus</i> *	151 86 % 11	—	—	—	53 89 % 3.1	204
<i>Hyalomma marginatum</i>	2 11 % 1	40 18 % 5.6	51 30 % 3.6	7 4.5 % 7	4 15 % 2	104
<i>Haemaphysalis punctata</i>	—	—	—	—	10.5 % 4.5	—
<i>Hyalomma lusitanicum</i>	— 3	3 2.3 % 1	1 2.5 % 1	—	—	4
<i>Dermacentor marginatus</i>	—	1 5.5 % 1	1 2.3 % 1	—	1 5.3 % 1	3

\* Values refer only to the mountainous zones to the south of the province.

## Discussion

Of the Ixodides cited for this province by other authors, *H. detritum*, *H. impresum* and *D. reticulatus* were not found. Bearing in mind that the first two are African or inhabit medium/hot Mediterranean regions (Morel, 1981) and that the third species does not develop in zones of Mediterranean climate or above altitudes of 1,000 m.a.s.l. (Gilot, 1975) — the height at which the mountains of the province of Salamanca begin to rise above the plain —, their presence in the province is very doubtful in as much as that the climate, though Mediterranean, is for the most part cold/cool and dry (Oliver and Calabuig, 1979). We attribute to the same causes the absence of other species which, as in the previous case, belong to two different climatic zones; the Central European zone and the warm Mediterranean zone. Among these absent

species are *I. trianguliceps* and *I. acuminatus*, cited by Gilot *et al.* (1976) in small mammals from the North of Spain and the rabbit ticks *I. ventalloi* and *Hae. hispanica*. Regarding these latter, and particularly in the case of *I. ventalloi*, there is little doubt as to their absence in this area according to the number of rabbits examined (140) during the seasons in which, as pointed out by Rodríguez *et al.* (1981), all the developmental stages of these parasites may be found in Ciudad Real. Only *I. trianguliceps* and *I. acuminatus* may be excluded from the flat areas of the province where the small mammals examined up to the present were found.

Regarding the species encountered, and starting with their distribution (*Table V* and *fig. I*), that of *I. ricinus* is to be expected in view of its high R.H., tree covering, etc., requirements (Gilot and Pautou, 1982; Nosek, 1978). According to our findings, we believe that the distribution of *H. lusitanicum*, common in Extremadura, and further north, the southern slopes of the mountains to the south of the province of Salamanca (though not on the northern faces, and much less so on the plains of the province), reaches its northernmost limit on these southern slopes of the mountains — with mean annual temperatures of 16° C — in the Western part of the peninsula. It is likely that the environmental requirements of this species of ticks for egg shedding (> 16° C) and larval moulting (Ouhelli and Pandey, 1984) hinder its expansion over the plains of the province; indeed the same could be said for the whole of the Castilian plateau, and accordingly the data referring to certain high and cold provinces (Burgos, Segovia) should be revised.

The remaining ticks were collected from diverse localizations, in areas of *Durili-gnosa/Aestilignosa* of greater or lesser oceanic/continental influence, though no preferential distribution could be observed for them other than the determinant presence of their hosts. Since hosts are very rare in the region typified by Oliver and Calabuig (*loc. cit.*) as a continental semiarid zone (*fig. I,A,c*) — mainly employed for cereal cultivation — it was not possible to check whether there are differences between the species present in this region and those found in other areas of the province, as has been reported for mosquitos (Encinas, 1982). In any case, with the exception of this semiarid zone it is possible to analyze the more or less favorable conditions available for the ticks of this province — and hence the diseases transmitted by them — by comparing their prevalence with data from other areas for the different groups of animals.

In feral species, we have noted that *I. hexagonus* and *I. canisuga*, taken from foxes, show a lower prevalence in Salamanca than in England (Harris and Thompson, 1978) and N.E. France (Aubert, 1975) where they are the only species, or at least the dominant one, for those animals. Of the 25 foxes examined by us, 14 of 17 captured in autumn/winter were infested with these species, whereas the 8 foxes examined in May and June were infested with *Rhipicephalus*. Although the parasitization of foxes by these latter seems to be common in the Mediterranean basin (Gilot and Pautou, 1981, 1982; Gil Collado, 1948; Sánchez Acedo and Vericat, 1973) it remains to be discovered whether the substitution observed by us (*Ixodes* by *Rhipicephalus*) is due to a decrease in the activity of the former in response to the harsh summer months of the region, or whether it is due to the fact that over the

TABLE V. — Capture sites with respect to the provincial climatic setting. The names of the capture sites are given only with respect to species exhibiting a restricted distribution or when they were only captured on limited occasions.

Species	Site, N°	Climatic areas <sup>++</sup>
<i>Ixodes canisuga</i>	9	Cold and cool semiarid Cool subhumid
<i>Ixodes hexagonus</i>	12	Cold and cool semiarid Cold and cool subhumid
<i>Ixodes frontalis</i>	Saucelle (1) <sup>+</sup> ; Guadramiro (2); Fuenteliante (3); Sotoserrano (12)	Cool and temperate subhumid Temperature humid
<i>Ixodes ricinus</i>	8	Cool and temperate humid
<i>Dermacentor marginatus</i>	14	Cold and cool semiarid Cold and cool subhumid Cool and temperate humid
<i>Haemaphysalis punctata</i>	9	Cold semiarid Cold and cool subhumid Cool and temperate humid
<i>Hyalomma lusitanicum</i>	Horcajo* (13); Sotoserrano* (12); Valero* (11); El Maillo** (9); El Cabaco** (10); Tamames** (7); Campocerrado** (6)	(* Temperate humid (Mediterranean complex of river Alagón). (**) Cool humid and cool subhumid band parallel to the previous one.
<i>Hyalomma marginatum</i>	26	Probably throughout the province
<i>Rhipicephalus sanguineus</i>	35	Throughout the province
<i>Rhipicephalus turanicus</i>	21	Throughout the province
<i>Rhipicephalus pusillus</i>	7	Cold semiarid Cold and cool subhumid Temperate humid
<i>Rhipicephalus bursa</i>	18	Probably throughout the province
<i>Boophilus annulatus</i>	Revilla (8); (Las Hurdes, Cáceres) (14)	(8) Cool semiarid
<i>Ornithodoros erraticus</i>	El Pito (4)	Cool subhumid
<i>Argas reflexus</i>	Salamanca (5)	Cold semiarid

\*, continuous presence on cattle

\*\*, sporadic finding on wild animals

<sup>+</sup>, situation in Fig. 1, A.

<sup>++</sup>, see Fig. 1, B.

summer months the foxes do not inhabit lairs, which are the typical habitats of the *Ixodes* mentioned.

In the data presented in *Table 1* of interest are the parasitization intensity in birds by *H. marginatum*, already described by Hoogstraal (1956); the high prevalence of *R. bursa* in hares, described as a generalized phenomenon by Hoogstraal and Aeschlimann (1982) and the seasonality of *I. frontalis*, which according to the dates of our captures and those reported by other authors (Lamontellerie, 1965) seems to show its greatest activity in March.

Regarding dog ticks, in this province *R. turanicus* shows seasonality and specificity with respect to its host in agreement with the data reported by other authors referring to other areas (Feldman-Muhsam, 1956; Gilot and Paotou, 1981; Morel and Vassiliades, 1962). The same, however, is not true of *R. sanguineus*, a synanthropic species, though it is also subject to climatic influences of the region which are apparent in the number of generations per year. According to Koch (1982), in Oklahoma/Arkansas (USA) there are three maxima (IV,V,IX) in adult populations and a further two (VII and IX) in the larval and nymph population; that is two generations per year. Other authors, several appearing in the work of Hoogstraal (1956), conclude, though no definitive evidence is put forward, that this species has 2-3 generations per year. In Italy, Starkoff (1958), who found adults over almost the whole year, did not report the presence of nymphs in September. As may be seen from *Table II*, in Salamanca there is a maximum in adult populations in May-July and another in the nymph population in September; according to our own criteria this is suggestive of only one generation per year.

In Israel, Feldman-Muhsam (1982) reported that the principal hibernating forms are unfed adults. The same is true of this study area, though our finding of some unfed nymphs on stable floors towards the end of the winter suggests that the nymph form is able to survive through the cold season. These nymphs are most likely those which appear on dogs in April.

The parallel development in the size of the nymph populations in the provincial setting and the cases of boutonneuse fever reported in the same areas (I-VI, 1; VII, 3; VIII, 7; IX, 15; X, 1) (Bol Epidemiol. Semanal. Ministry of Health and Consumer Protection, 1984, nos 1647-1665), together with the greater tendency of the nymphs of *R. sanguineus* to attach themselves to human beings (Gilot and Marjolet, 1982) prompts us to suspect that this form is the principal vector of the disease.

On considering the ticks of domestic ungulates, we refer principally to those of cattle, which as pointed out above are the same as those of sheep and goats. We believe that the differences in the prevalence in both groups of animals, of certain species could be due to the grazing areas frequented by the ovine host — many of them stubble or fallow fields — which are unsuitable for the development of ticks. The presence in these areas of a large part of the flocks sampled could be the reason why *Table IV* is not representative of all the provincial flocks.

Cattle ticks are almost the same as those observed by Garcia and Hueli (1984) in Andalusion (S. Spain) cattle, though with certain important differences which tend to highlight the climatic affinities of the ticks.

According to the percentage representing the number of specimens of each species, with respect to the overall number of captures made, *D. marginatus* and *R. bursa* are more abundant in Salamanca (SA), than in Andalucía (AN) : 6.65 % SA-0.96 % AN and 78.8 % SA-41 % AN, respectively. This latter species also seems to be more abundant in this country than in surrounding areas ; though it is practically absent in France (Lamontellerie, 1965 ; Gilot and Marjolet, 1982), in Morocco it only represents, together with other species of *Rhipicephalus*, 3.9 % of the cattle ticks captured in July by Ouhelli and Pandey (1982). *H. lusitanicum* (2.12 % SA-33.4 % AN and *H. marginatum* (10.8 % SA-17 % AN) are less abundant, and *Hae. punctata* and *I. ricinus* are present in more or less the same proportions in both areas (0.42 % SA-0.18 % AN and 0.21 % SA-0.51 % AN, respectively). *R. turanicus* is not common to both areas (SA and AN) —at least it is not mentioned by authors working in southern Spain— and *B. annulatus*, though cited for the first time in Salamanca, does not seem to have established itself in this province because only one specimen was found, and that was on cattle from province of Cáceres.

Consequently, in Salamanca, *R. bursa* has optimal conditions which make it the most important tick of domestic ungulates ; in sheep it is also important as a vector for piroplasmiasis, according to the list of vector species given by Morel (1981), Purnell (1981) and Uilenberg (1981). Other ticks of the province act as vectors of these parasites in bovine hosts. Severe cases of piroplasmiasis are not an uncommon finding (Simón Vicente, 1964, 1965) and are probably related to the introduction of *B. annulatus* or *H. lusitanicum*, this latter being a vector for *Theileria annulata* whose presence may be constant on the southern slopes of the mountains of Salamanca overlooking the Alagón basin.

ACKNOWLEDGEMENTS. The author thank Dr. F. Simón Vicente for his generosity in providing the Ixodidae of the parasitic collection of the Centro de Edafología y Biología Aplicada (CSIC). Salamanca (España).

#### REFERENCES

- AUBERT M. F. A. : Contribution à l'étude du parasitisme du renard (*Vulpes vulpes* L.) par les Ixodidae (Acarina) dans le Nord-Est de la France. Interprétation de la dynamique saisonnière des parasites en relation avec la biologie de l'hôte. *Acarologia*, 1975, 17, 452-479.
- BATELLI C., GALLO C., RIILLI S., SOBRERO L. : Rhipicephalus del gruppo sanguineus dell'arcipelago Siciliano : *Rh. pusillus*, *Rh. sanguineus* e *Rh. turanicus*. *Riv. Parasitol.*, 1977, 38, 263-267.
- CORDERO DEL CAMPILLO M. y coll. : Índice Catálogo de Zooparasitos Ibéricos. Ministerio de Sanidad y Seguridad Social. *Servicio de Publicaciones*. Madrid, 1980, 579 p.
- ENCINAS GRANDES A. : Taxonomía y biología de los mosquitos del área salmantina. (Diptera, Culicidae). Consejo Superior de Investigaciones Científicas. Centro de Edafología y Biología Aplicada. *Ediciones Universidad de Salamanca*, Salamanca, 1982, 437 p.
- FELDMAN-MUHSAM B. : On the identity of *Rhipicephalus sanguineus* Lat. *Bull. Res. Council. Israel*, 1952, 2, 187-194.
- FELDMAN-MUHSAM B. : Host specificity of *Rhipicephalus sanguineus* (Latreille) and *R. secundus* Feldman-Muhsam in Israel. *Bull. Entomol. Res.*, 1956, 47, 43-45.
- FELDMAN-MUHSAM B. : Some observations on the hibernation of *Rhipicephalus sanguineus* in Jerusalem. In : *Review of Applied Entomology*, Series B, 1982, 70, 264.
- FILIPPOVA N. A. : On diagnosis of species of the genus *Rhipicephalus* Koch (Ixodoidea, Ixodidae) from the fauna of the USSR and adjoining territories by nymphal instar. *Parazitol. Sborn.*, 1981, 30, 47-68.

- GARCIA FERNANDEZ P., HUELI L. E. : Gairapatas (Acarina, Ixodidae) parásitas del ganado bovino en el Sur de España. Identificación, distribución geográfica y estacional. *Rev. Ibér. Parasitol.*, 1984, 44, 129-138.
- GIL COLLADO J. : Acaros Ixodoideos de España. *Rev. San. Hig. Públ.*, 1948, 22, 389-439.
- GILOT B. : Recherche des rickettsies hébergées par les tiques (Acariens; Ixodoidea) du Sud-Est de la France. Premier bilan. Contexte écologique de rencontre avec l'homme. *Bull. Soc. Path. Ex.*, 1975, 68, 529-538.
- GILOT B., JARRY D., PAUTOU G., MONCADA E. : Biotopes suburbains à *Rhipicephalus turanicus* (Pomerancev, Matikasvili, Lototzki, 1940) (Acarina, Ixodoidea) : étude préliminaire. *Ann. Parasitol. Hum. Comp.*, 1977, 52, 353-362.
- GILOT B., MARJOLET M. : Contribution à l'étude du parasitisme humain par les tiques (Ixodidae et Argasidae), plus particulièrement dans le sud-est de la France. *Med. Mal. Infect.*, 1982, 12, 340-351.
- GILOT B., PAUTOU G. : Répartition et intérêt épidémiologique de *Rhipicephalus turanicus* (Pomerantsev, Matikasvili, Lototzki, 1940) (Acarina, Ixodoidea). Ecologie de cette espèce dans le midi méditerranéen français. *Ann. Parasitol. Hum. Comp.*, 1981, 56, 547-558.
- GILOT B., PAUTOU G. : L'évolution des populations de tiques (Ixodidae et Argasidae) en relation avec l'artificialisation des milieux dans les Alpes françaises. Incidences épidémiologiques. *Acta Tropica*, 1982, 39, 337-354.
- GILOT B., PAUTOU G., GOSALBEZ J., MONCADA E. : Contribution à l'étude des Ixodidae (Acarina, Ixodoidea) des monts Cantabriques (Espagne). *Ann. Parasitol. Hum. Comp.*, 1976, 51, 241-254.
- HARRIS S., THOMPSON G. B. : Populations of the ticks *Ixodes (Pholeoixodes) hexagonus* and *Ixodes (Pholeoixodes) canisuga* infesting suburban foxes, *Vulpes vulpes*. *J. Zool. Lond.*, 1978, 186, 83-93.
- HOOGSTRAAL H. : African Ixodoidea. I. Ticks of the Sudan (with special reference to Equatoria province and with preliminary reviews of the genera *Boophilus*, *Margaropus* and *Hyalomma*). *U. S. Navy*, Washington D. C., 1956, 1101 p.
- HOOGSTRAAL H., AESCHLIMANN A. : Tick-Host Specificity. In : *Deuxième Symposium sur la spécificité parasitaire des parasites de vertébrés*. *Mem. Mus. Nat. Hist. Nat.*, Ser. A, Zool., 1982, 123.
- KOCH H. G. : Seasonal incidence and attachment sites of ticks (Acari : Ixodidae) on domestic dogs in southeastern Oklahoma and northwestern Arkansas USA. *J. Med. Entomol.*, 1982, 19, 293-298.
- LAMONTELLERIE M. : Les tiques (Acarina, Ixodoidea) du Sud-Ouest de la France. *Ann. Parasitol. Hum. Comp.*, 1965, 40, 87-100.
- MOREL P. C. : Maladies à tiques du bétail en Afrique. In : *Précis de Parasitologie Vétérinaire Tropicale*, 1981, 10, 473-717. République Française. Ministère de la Coopération et du Développement. Institut d'Élevage et de Médecine vétérinaire des Pays Tropicaux.
- MOREL P. C., VASSILADES G. : Les *Rhipicephalus* du groupe *sanguineus* : espèces africaines (Acariens : Ixodoidea). *Rev. Elev. Méd. Vet. Pays Trop.*, 1962, 15, 343-386.
- NOSEK J. : The effects of microclimate on *Ixodes ricinus*. In : *Weather and Parasitic Animal Diseases*. p. 105-116. (Editor T. E. Gibson). *World Meteorological Organization*, 1978, Technical note 159. WMO-Nº 497.
- OLIVER-MOSCARDO S., LUIS-CALABUIG E. : Factores termopluriométricos. In : *Estudio integrado y multidisciplinario de la dehesa salmantina. I. Estudio fisiográfico-descriptivo* (3º fascículo). pp. 101-155. *Centro de Edafología y Biología Aplicada de Salamanca y Centro Pirenaico de Biología Experimental*, Salamanca-Jaca.
- OUHELLI H., PANDEY V. S. : Prevalence of cattle ticks in Morocco. *Trop. Anim. Health Prod.*, 1982, 14, 151-154.
- OUHELLI H., PANDEY V. S. : Development of *Hyalomma lusitanicum* under laboratory conditions. *Vet. Parasitol.*, 1984, 15, 57-66.
- PUERNELL R. E. : Babesiosis in various Hosts. In : *Babesiosis* (M. Ristic, J. P. Kreier, Eds). *Academic Press*, 1981, New York, 25-63.
- RODRIGUEZ J. A., ZAPATERO L. M., SANCHEZ A. : Variación estacional de Ixodidae y Siphonaptera de lepóridos en la provincia de Ciudad Real. *Rev. Ibér. Parasitol.*, 1981, 41, 527-538.
- SANCHEZ C., VERICAT J. R. : Ectoparásitos de mamíferos y aves montaraces del alto Aragón. *Rev. Ibér. Parasitol.*, 1973, 33, 29-38.
- SARATSIOTIS A., BATELLI C. : *Rhipicephalus turanicus* Pomerantzev, Metkasshilli et Lototzki, 1940, en Italie. Comparaison morphologique avec *Rhipicephalus sanguineus* s. str. (Latreille, 1908) (Acariens, Ixodidae). *Riv. Parasitol.*, 1975, 36, 207-214.
- SIMON VIVENTE F. : Mapa parasitológico provincial. I. *Publ. del IOATO*, 1964, Salamanca.
- SIMON VICENTE F. : Los parásitos en el ganado de lidia (con especial referencia al de la provincia de Salamanca). *III Semana Internacional del Toro de Lidia*, Junta provincial de Fomento Pecuário, 1965, 131-154.
- STARKOF O. : Ixodoidea d'Italia. Studio Monografico. *Il Pensiero Scientifico*, Roma, 1958, 385 p.
- UILENBERG G. : Theilerial species of domestic livestock. In : *Advances in the control of Theileriosis* (Irvin, A. R., Cunningham, M. P., Young A. S., Eds). *Martinus Nijhoff Publisher*, The Hague, Netherlands, 1981, 4-37.