Distribution and risk factors of Ixodidae tick species in vegetation in the Basque Country

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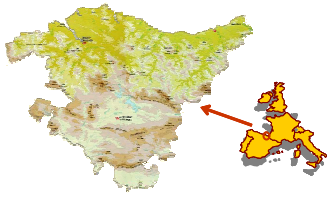
INTRODUCTION

- Ticks are an emerging worldwide human and animal health hazard as vectors of pathogens including *Borreliaspp., Anaplasma* spp., *Rickettsia* spp., *Francisella* spp., *Babesia* spp., *Theileria* spp. and Louping-ill-like viruses, diagnosed in the Basque Country in Spain.
- Tick stages include eggs, larvae, nymphs and adults and their development and survivability depends on biotic and abiotic factors, mainly climate, vegetation type and host density and it is commonly seasonal and varies between years. Typical tick life cycle in North and Central Europe is completed in 3 years.
- Information on tick population dynamics is essential for tick and tick-borne disease (TBD) control and this study describes monthly tick distributions and risk factors in region from two similar studies carried out in 1992-93 (study 1) and 2003-04 (study 2).

Fig. 1: Location of the Basque Country



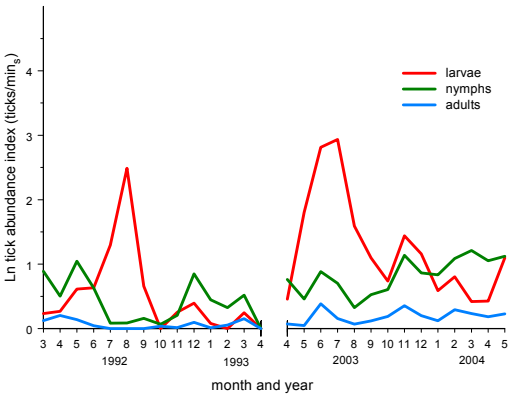
7234 km2, altitude: 0-1500 m, mild and wet Atlantic climate, 40% forest-cover, 400,000 livestock and abundant wildlife

MATERIAL & METHODS

- 47 sampling areas scattered over 7 of 8 natural regions in the Basque Country (Fig. 1) defined according to terrain altitude, rainfall, T° and dominant vegetation.
- 7 common areas sampled in both studies (1992-93 & 2003-04) for comparison purposes.
- Vegetation ticks collected by blanket dragging (Fig. 2) and adults morphologically speciated.
- Other data collected: altitude, orientation, human access, predominant vegetation, ambient T°, ground wetness and district's livestock density and rainfall.
- Random effects Poisson regression was used to investigate tick recovery rates.

Fig. 2: Sampling ticks from vegetation by blanket dragging

RESULTS



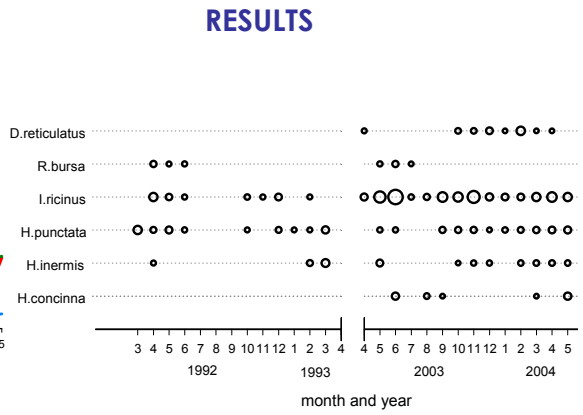


Fig. 3 (left) and Fig. 4 (right): Seasonal relative abudance of tick stages and adult species, respectively

Table 1: Estimates of a Poisson model investigating risk factors associated with tick recovery rates

Variable	Rate ratios	95%CI	P-value
Fixed effects			
Rainfall (mm); temp. (°C)*			
0-48; 0.5-14	1.00	-	-
0-48; 15-19	1.66	1.11, 2.49	0.01
0-48; 20-24	2.15	1.44, 3.20	0.014
0-48; 25-36	2.11	1.48, 3.02	0.0002
53-1927; 0.5-14	1.22	0.90, 1.66	0.2
53-1927; 15-19	1.59	1.16, 2.19	0.005
53-1927; 20-24	2.18	1.50, 3.16	<0.0001
53-1927; 25-36	2.96	1.98, 4.42	<0.0001
Ground moisture state			
Dry	1	-	-
Damp	0.89	0.74, 1.07	0.2
Wet	0.38	0.20, 0.65	0.0009
Altitude (m)			
660-900	1	-	-
450-650	1.53	1.11, 2.12	0.004
Forest			
Absent	1	-	-
Present	1.43	1.13, 1.81	0.004
Human presence			
Null and Low	1	-	-
Moderate and high	0.58	0.42, 0.79	0.0007
Random effects: variance estimate and standard errors			
Sampling area	0.06	0.03	0.039
Residual	0.71	0.08	<0.0001

- 150,000 ticks of 11 species of the genera *Ixodes*, *Haemaphysalis*, *Dermacentor* and *Rhipicephalus,* including *H. concinna* not previously reported in Spain, were collected in both studies.
- Mean recoveries were 0-10 ticks/minute-sampling in 32 zones, 20-50 ticks/min$_s$ in 12 zones and 140-220 ticks/min$_s$ in 3 zones.
- In 1992-93 *H. punctata* was the predominant tick with spring-summer and autumn-early winter peaks of activity (Fig. 3 & 4).
- In 2003-04 ticks were more abundant and *I. ricinus* was the most common and was active throughout the winter (Fig. 3 & 4).
- Higher tick abundance coincided with increased livestock census in the 1990s and milder winter temperatures in 2003-04.
- Evidence of synchrony in activity patterns of adults and nymphs most of the time and for nymphs and larvae during most of 2003 and 1993 (Fig. 3).
- Tick collection rates were associated with the interaction between ambient T° at sampling and rainfall 7 days prior to sampling and were higher at medium rather than higher altitude, in forest than in open grasslands and lower in recreational areas frequented by people and with wet vegetation at sampling (Table 1).

SUMMARY & CONCLUSIONS

- Ticks are widespread in the Basque Country and are active throughout the year suggesting that winter diapause may be reduced or absent and ticks may complete the life cycle in less than 3 yrs.
- There was synchronicity between tick stages and this allows ticks to co-feed in the same host and facilitates pathogen transmission between ticks. This form of transmission determines the ocalise foci of Tick-borne Encephalitis (TBE) in Europe. It would be useful to investigate if TBE-like Louping-ill endemicity in the Basque Country is related to larval and nymphs dynamics.
- High ambient temperatures are detrimental for I. *ricinus* survival however, this study suggests it may be resistant to 25-36°C so long as there is sufficient relative humidity and this findings are important for tick control.

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