Ticks and Tick-Born Diseases in Senegal: An Ecological Niche Modelling approach to estimate the spatial distribution of hard-ticks of medical and veterinary importance

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Background

Ticks and Tick Born Diseases (TBDs) cause serious risks to the economy of countries and public health due to their negative impact on animal and human health [**1**]. An aim of this study is to estimate the diversity and spatial distribution of hard-ticks of medical and veterinary importance in Senegal.

Methods

Tick data collected from sheep and goat during a nationwide surveillance conducted between 2017 and 2022 were used to assess ecological diversity and structure of ticks. The Maximum Entropy approach and Ecological Niche Factor Analysis (ENFA) were used to develop a predictive spatial model for tick distribution using bio-climatic variables, livestock densities and altitude [**2,3**].

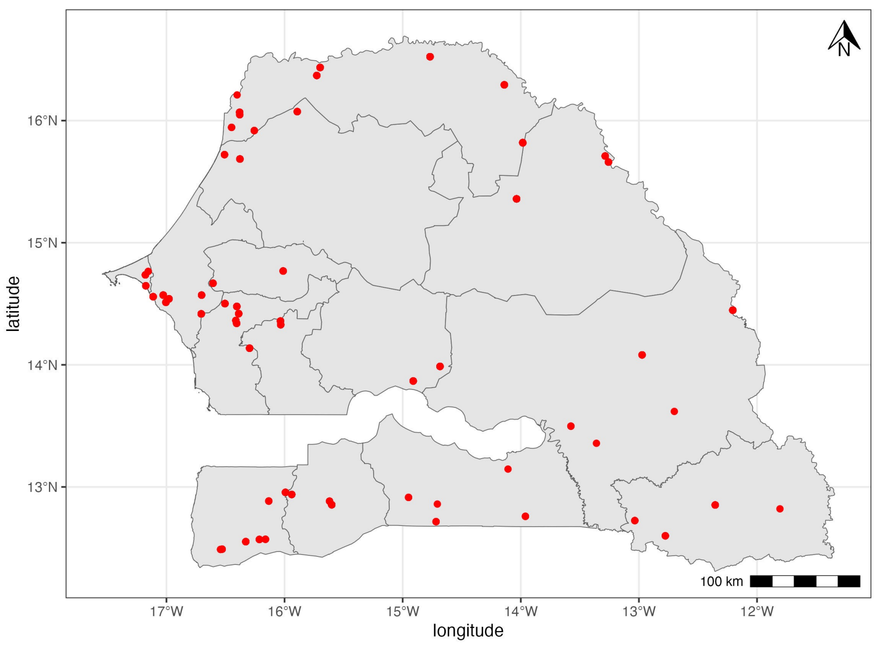

Figure 1. Maps sampling sites in 14 region of Senegal between 2017 and 2022

Results

A total of 6,575 ticks belonging to 4 genera (*Amblyomma, Hyalomma, Rhipicephalus, Boophilus*) and 14 species were collected from the small ruminants.

Table 1: Ecological indices of composition and structure of adult's tick population at different agroecological zone of Senegal.

Agroecological zones	N	S	H	1-D
Groundnut Basin	1904	14	1,29	0,58
Casamance	431	6	0,79	0,46
Ferlo	707	7	1,35	0,71
Niayes	103	2	0,05	0,02
Eastern Senegal	130	5	0,98	0,55
Senegal River Valley	1728	8	1,31	0,69

Abbreviation: N Abundance, S Specific richness, H Shonnon index and 1-D Simpson's index

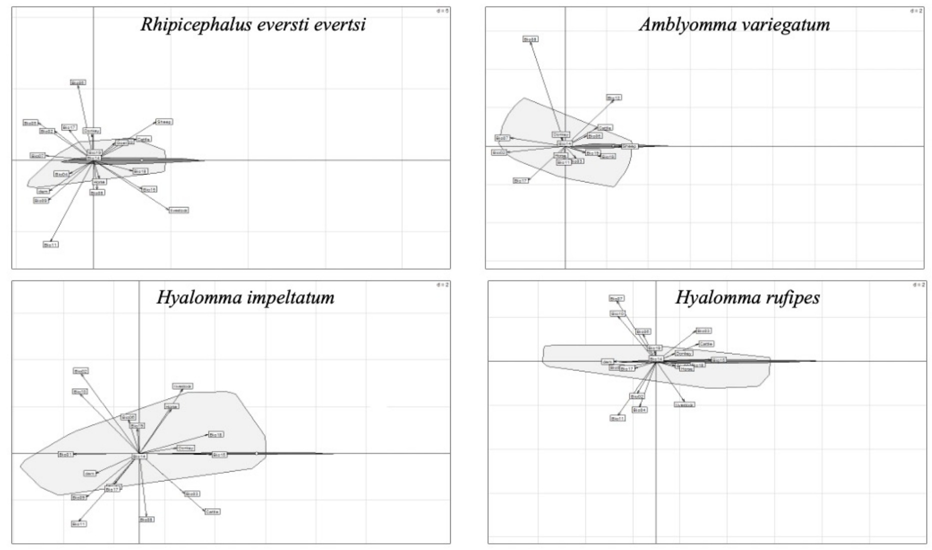

Figure 2. Ecological niche factor analysis (ENFA) of Ticks distribution in Senegal. *Rhipicephalus evertsi evertsi, Amblyomma variegatum, Hyalomma impletatum* and *Hyalomma rufipes*. Variables leading to ecological niche are represented into the light grey polygon and the dark grey polygon shows environmental conditions where Ticks were observed (representation of the realized niche), and the small white circle corresponds to the barycentre of its distribution

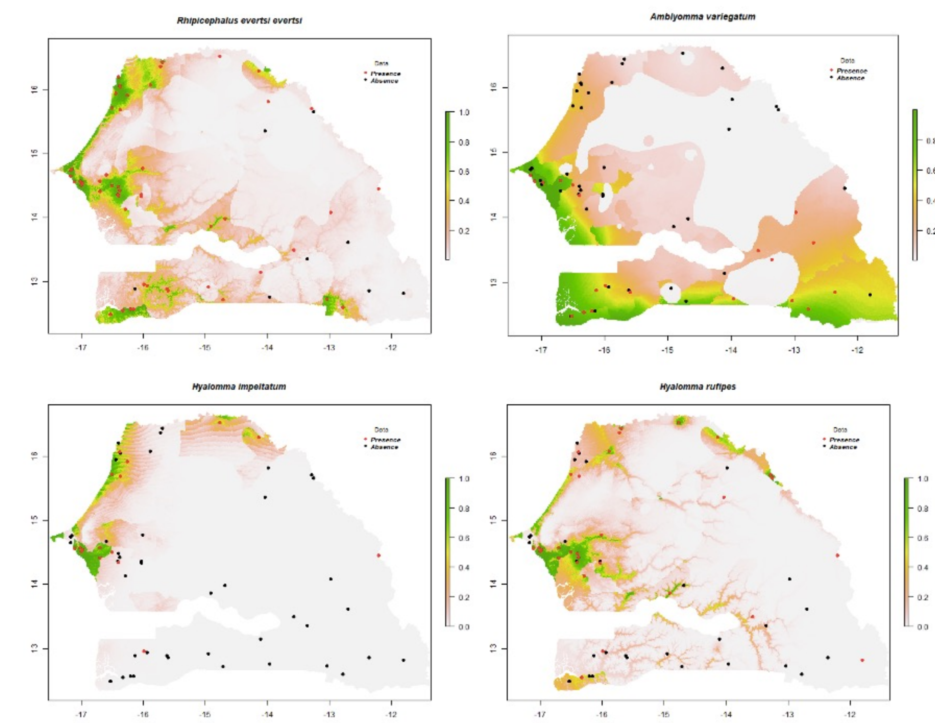

Figure 3. MaxEnt predicted suitable areas. *Rhipicephalus evertsi evertsi, Amblyomma variegatum, Hyalomma impletatum* and *Hyalomma rufipes*. Green areas indicate areas that are likely to have suitable habitats for this vector species, while lighter areas indicate areas that are less suitable for the vector

Table 2: Accuracy of the Niche Models: Area Under the Curve (AUC) for the MaxEnt

Accuracy	Train	Test	Species
AUC	0.89	0.71	*Am. variegatum*
AUC	0.97	0.74	*Hy. rufipes*
AUC	0.95	0.68	*Rh. evertsi evertsi*
AUC	0.98	0.86	*Hy. impeltatum*

Conclusion

We present tick species diversity and distribution, and ecological niche models for different tick species, namely *Rhipicephalus eversti evertsi*, *Hyalomma rufipes*, *Amblyomma variegatum and Hyalomma impeltatum*, potential vectors of Crimean-Congo Haemorrhagic Fever virus and others TBDs in Senegal. This information will be helpful in developing risk maps for disease outbreaks.

References

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