Journal of Global Biosciences
ISSN 2320-1355
Volume 9, Number 6, 2020, pp. 7496-7509
Website: www.mutagens.co.in
URL: www.mutagens.co.in/jgb/vol.09/06/090604.pdf

Research Paper

SPATIO-TEMPORAL DISTRIBUTION OF TICKS (Ixodidae) IN THE CATTLE PENS OF THE REGION OF TONKPI, WESTERN COTE D'IVOIRE

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Abstract

A study has been carried out in the Tonkpi region on ticks at the level of cattle paddocks with the general objective of determining the spatial and temporal distribution of ticks in the region.. The enumeration survey method allowed 2,511 of 19,724 cattle slaughtered to be examined and 11,257 ticks collected in the region's cattle paddocks on two years (2017 and 2018). 3 genera have been identified, including 4 tick species with low frequencies (28.93%). in the dry season and high (71.07%) in the rainy season. These are *Rhipicephalus (Boophilus) microplus, Amblyomma variegatum Rhipicephalus (Boophilus) annulatus* and *Hyalomma truncatum* of which *Rhipicephalus (Boophilus) microplus* is the dominant species. For seasonal dynamics, there are peaks of infestation in April for *Rhipicephalus (Boophilus) microplus*, in June for *Amblyomma variegatum* and in August for *Rhipicephalus (Boophilus) annulatus* and *Hyalomma truncatum.* Comparisons between tick species from one season to the next were found to be significant at the significance level of 5% (p> 0.05).
Key words: ticks, dynamics, season, paddocks, cattle, Tonkpi.

INTRODUCTION

In West Africa, tick-borne diseases have been very often obscured in favor of large viral or bacterial epizootics (Gueye et al., 1989). Thanks to the different crises known by Côte d'Ivoire, cross-border transhumance has moved and extended to the western area. The practice of moving animals from one country to another, in search of pasture and potential market, is not without consequences.

Pathogens that ticks are likely to transmit to humans and livestock (babesiosis, theileriosis, ehrlichiosis, anaplasmosis) perpetuate economic losses related to reduced production, mortality and expense related to treatment costs.

With the non-existence of quarantine zones in the neighboring countries, arriving animals can contract diseases in this country and spread them back to their own country. This phenomenon of transboundary diseases has also been applied to ticks'borne diseases (Adakal et al., 2013). Studies on the main cattle ticks were conducted in Côte d'Ivoire by Azokou et al., 2016), Toure et al (2012), Madder et al (2011) and Aeschlimann (1967). However, an in-depth study is more than necessary to improve knowledge of the dynamics and genetic diversity of populations of different tick species (Djakaridja et al., 2014; Toure et al., 2012). In fact, slaughterhouses in departmental capitals have been selected because their cattle paddocks still have animals all year round. It is from these cattle parks that secondary slaughterhouses in the region are supplied with cattle. As a result, the main cattle parks in the departmental capitals are representative of the Tonkpi region (INS, 2014). It is in this context that a study was initiated at the slaughterhouse cattle parks of the Tonkpi region over two years (2017-2018) receiving beef cattle from neighboring countries (Mali, Burkina and Guinea) to supply the cattle market. The main objective of this study is to determine the spatial and temporal distribution of ticks in the Tonkpi region. To achieve this goal, the specific objectives are:

- identify cattle tick species in cattle paddocks;
- determine spatio-temporal distributions.

MATERIAL AND METHODS

1- Study area

The study area is the Tonkpi region with a population of 992,564 inhabitants, mostly rural, agricultural and has five departments (Biankouma, Danané, Man, Sipilou and Zouan-Hounien) (Figure 1) .The Tonkpi region where the series of low plateaus is linked in places with very rugged areas with contours varying between average slopes and altitudes sometimes exceeding 1,000 m (INS, 2016). The equatorial regime climate is characterized by two dry seasons (a long dry season from November to March and a short dry season from July to late August) and two rainy seasons (a large rainy season from March to June and a short rainy season from September to October) Ferralitic soils with medium chemical fertility are dominant and generally have low vegetation cover,

there are also soils developed on basic rocks, hydromorphic soils in the shallows and mineral soils in mountainous regions (INS, 2014).

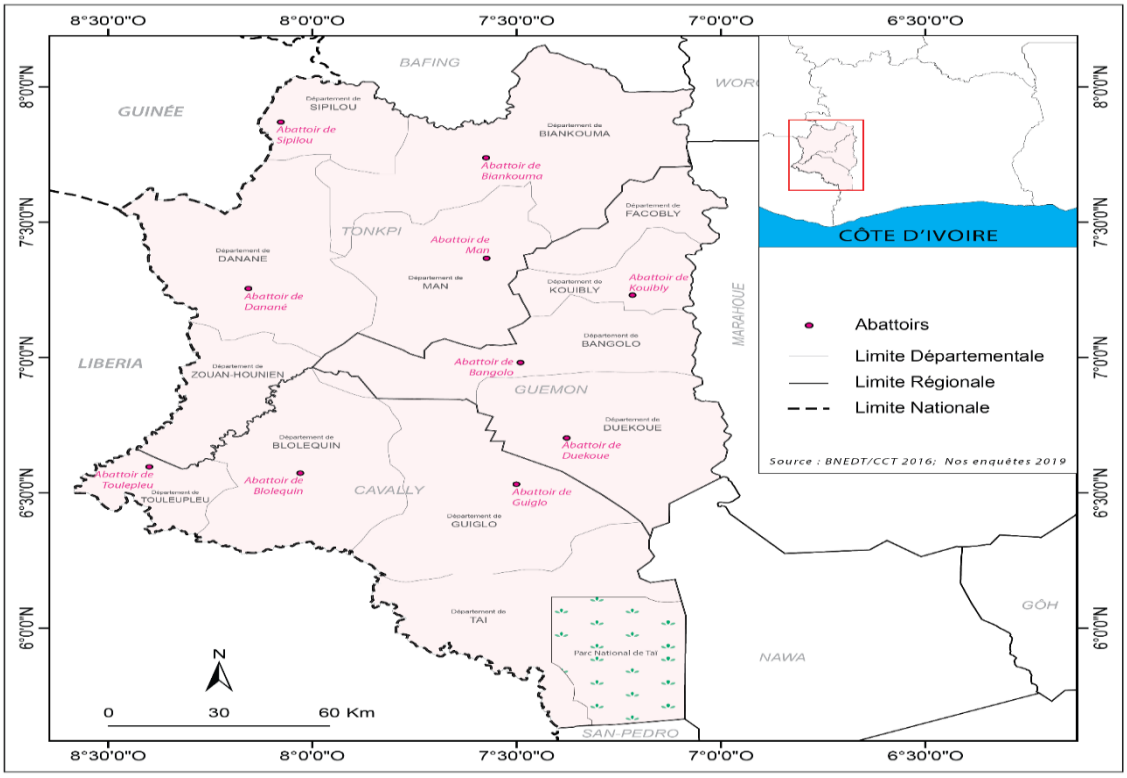

Figure 1: Map of the Tonkpi region showing study sites

2- Sampling

During the period from 2 of January, 2017 to 31 of December, 2018, ticks were taken from beef cattle in 3 cattle paddocks (Man, Danané and Biankouma). For sampling, only the main slaughterhouses cattle paddocks in the departmental capitals were selected because they still have animals all year round. This criterion of choice is important in the context of the study to determine the spatio-temporal distribution of tick species. It is from these cattle paddocks that the secondary slaughterhouses in the region are supplied with beef cattle. 2,511 cattle out of 19,724 were slaughtered and ticks were removed for 15 minutes per cattle intended for the slaughterhouse. To determine the

size of the representative sample, the formula of Katholi et al. (1995), for statistics in epidemiology was applied:

$$n = p(1-p)\frac{Z\alpha^2}{i^2}$$

n = sample size;

Zα = risk value α is 1.96;

α = risk;

p = percentage of the qualitative variable studied in the population;

i = desired precision, that is to say half the confidence interval.

3- Sampling methods and identification of ticks

Ticks are taken from the animal using fine forceps placed closest to the skin. Avoid crushing them during sampling. The collected ticks are immediately introduced into a tube containing alcohol at 70 ° C for preservation and on which the identification elements of the sampling site and the animal are marked. A total of 11 257 ticks were collected from 2 511 beef cattle.

In the laboratory, a binocular loupe and identification keys (Okello-Onen et al., 1999; Walker et al., 2003) were used to identify tick species at the 100 X magnification optical microscope according to specific criteria (Walker et al., 2003), in particular, the scales shiny back (*Amblyomma*), perforation of the back (*Hyalomma*), adanal plates (*Rhipicephalus*), dentition with number of rows, presence and absence of silk or caudal appendage (*Rhipicephalus Boophilus*).

One indicator was estimated:

Tick frequency == 100 x number of tick species / total number of ticks collected.

RESULTS

1- Distribution and comparison of tick species.

11,257 ticks were collected from 2,511 beef cattle in the cattle yards. The morphological study made it possible to identify 3 genera including 4 species of ticks with various frequencies (Figure 2). These are *Rhipicephalus (Boophilus) microplus* (55%), *Amblyomma variegatum* (38.42%), *Rhipicephalus (Boophilus) annulatus* (6.30%) and

Hyalomma truncatum (0.28%). It turns out that the tick Rhipicephalus (Boophilus) is present at all stasis on the same animal unlike the other species (Table I).

In terms of frequency comparison, *Rhipicephalus (Boophilus) microplus* appears to be the tick with the highest frequency both in the department of Man (24.27%) and Danané (21.52%) as in Biankouma (9, 21%). Frequency comparisons between tick species from one locality to another were made using the Chi-square test from Pearson. The difference is significant in all the species identified at the significance level of 5% (p> 0.05).

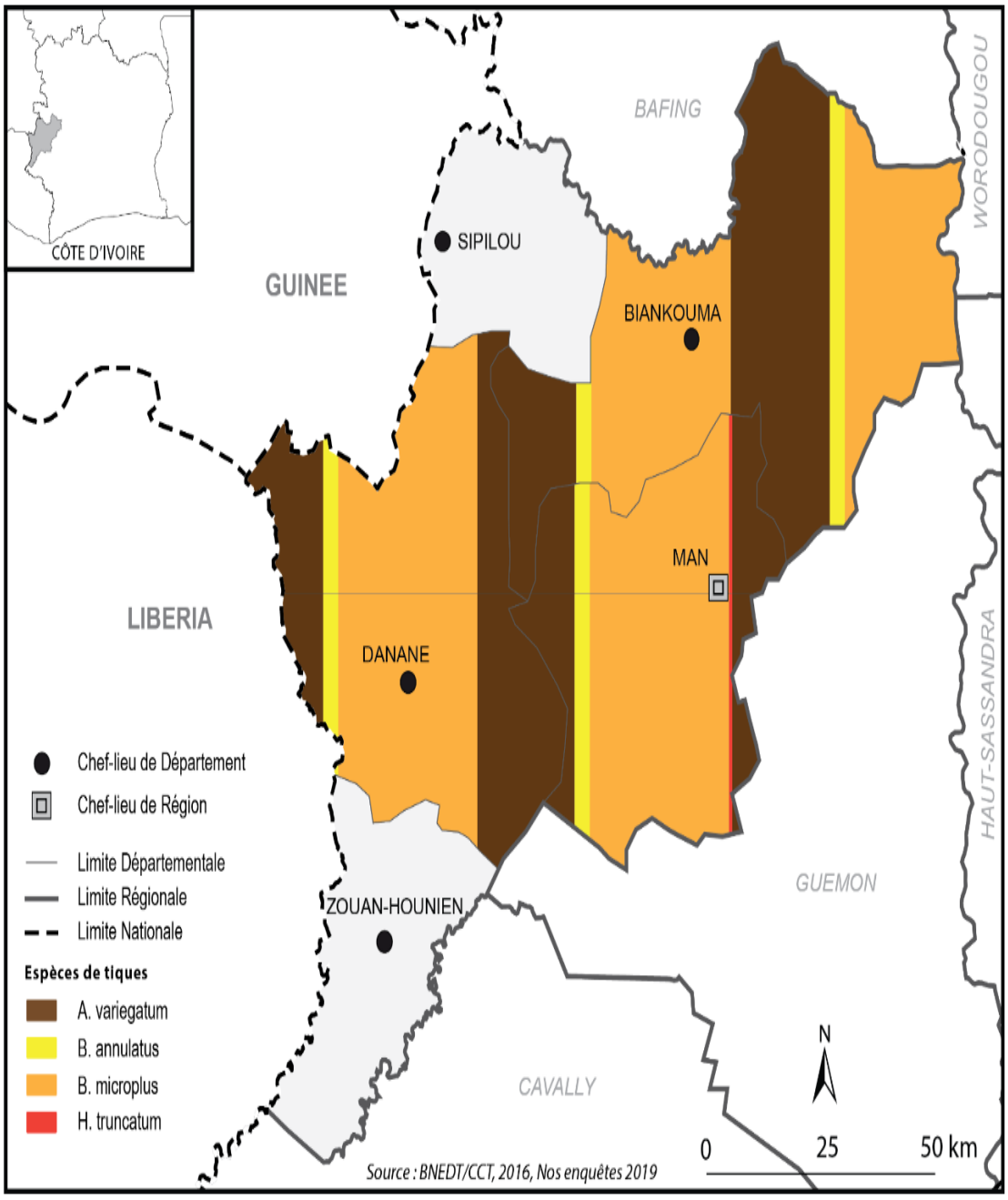

Figure 2 : Ticks frequency map of the region of Tonkpi (INS, 2016)

Table I : Tick distribution by species

Tick species	**Number of ticks**	**Percentage**	**Number of cattle**	**Frequencies by species and by locality in %**			
				Biankouma	**Danané**	**Man**	**Total**
Rhipicephalus (Boophilus) microplus			2511	9,21	21,52	24,27	55
Females	5269	46,81					
Males	585	5,20					
Larvae	0	0,00					
Nymphs	337	2,99					
Amblyomma variegatum				6,43	15,03	16,96	38,42
Females	3546	31,50					
Males	779	6,92					
Rhipicephalus (Boophilus) annulatus				1,06	2,47	2,78	6,30
Females	635	5,64					
Males	75	0,66					
Hyalomma truncatum				0,00	0,00	0,28	0,28
Females	28	0,25					
Males	3	0,03					
Total	**11257**	**100**	**2511**	**16,70**	**39,02**	**44,28**	**100**

2-Spatio-temporal distribution of ticks

The comparison of tick infestations in 2017 and 2018 during the dry season and the rainy season seems similar.

In the dry season, 4 species of ticks were observed with a low infestation of less than 400 ticks per month from November to February. The peak tick infestation was observed in August of each year.

Regarding the rainy season, the same tick species were observed with high frequencies from March to September. The peak of tick infestation is different from species to species. It turns out that the periods of infestation are decreasing, especially in the sawtooth pattern for *Rhipicephalus (Boophilus) microplus* and stabilize in the form of a plateau for the other species. Thus, the peaks of infestation were recorded in April for *Rhipicephalus (Boophilus) microplus*, in June for *Amblyomma variegatum*, finally, in August for *Rhipicephalus (Boophilus) annulatus* and *Hyalomma truncatum* (Figures 3 and 4). It must be recognized that from March to September, the tick infestation was high. However, *Hyalomma truncatum* was the minority species recorded compared to the other species (*Amblyomma variegatum, Rhipicephalus (Boophilus) microplus* and *Rhipicephalus (Boophilus) annulatus)*.

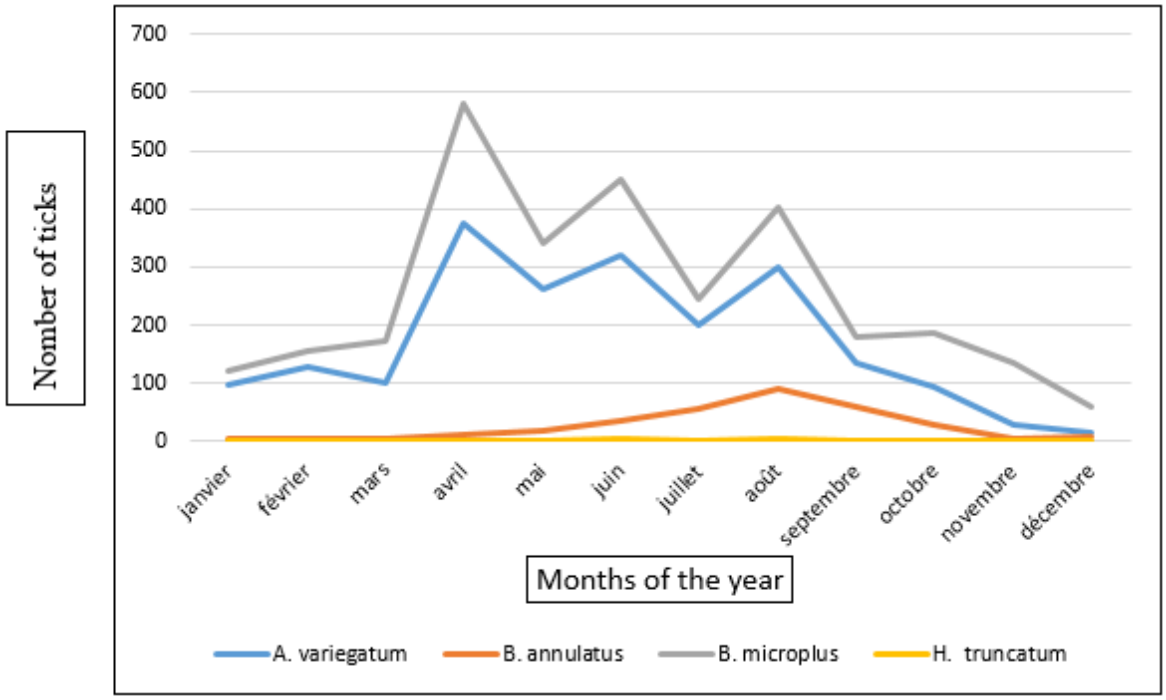

Figure 3 : Temporal distribution of ticks in the Tonkpi region in 2017

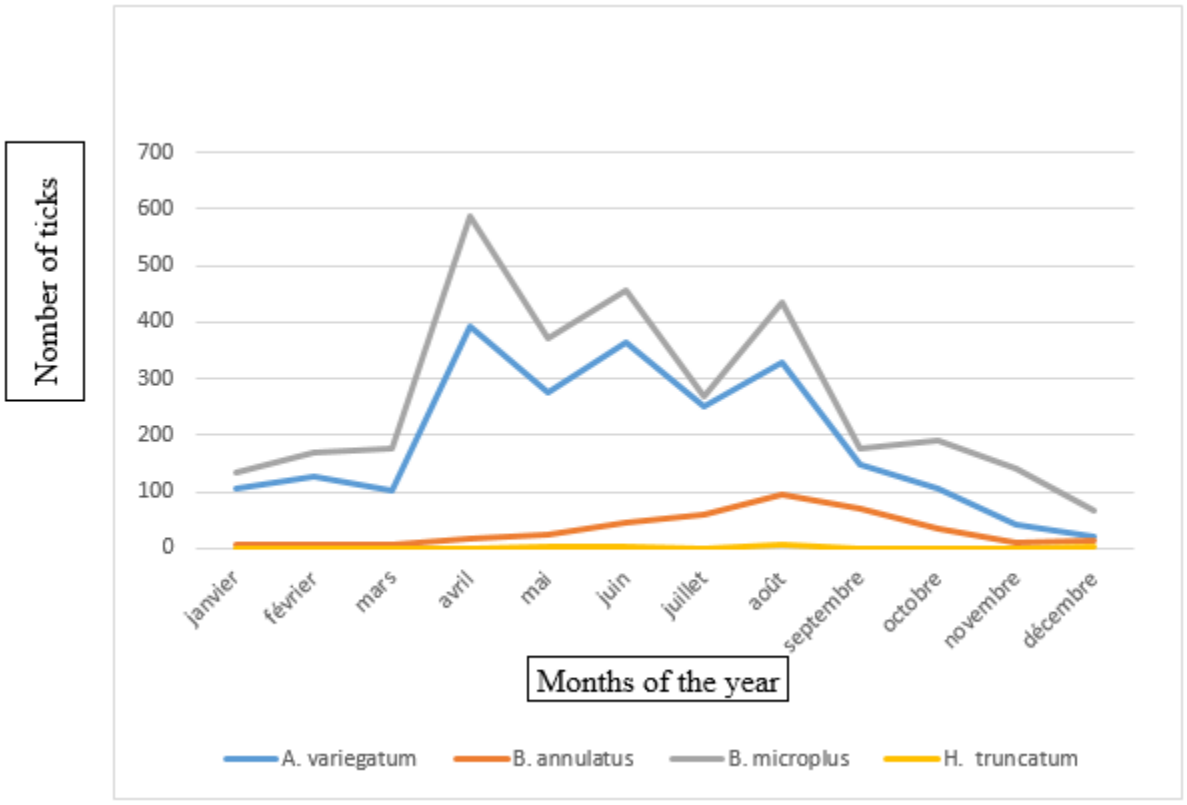

Figure 4 : Temporal distribution of ticks in the Tonkpi region in 2018

3- Seasonal Dynamics of Ticks

The seasonal dynamics of ticks in 2017 and 2018 for the dry and rainy season seem similar. The frequency of tick infestations is found to be low in the dry season and high in the rainy season. The species identified in 2017 and 2018 are respectively *Rhipicephalus (Boophilus) microplus* (55.77% and 54.28%), *Amblyomma variegatum* (37.98% and 38.83%), *Rhipicephalus (Boophilus) annulatus* (5.99% and 6.60%) and *Hyalomma truncatum* (0.26% and 0.29%). Indeed, seasonal variation in the Tonkpi region shows that tick infestations reached the first peak at the start of the rainy season in April and a second peak in August (Figures 5 and 6). In total, more than 71% of the ticks were collected during the rainy season (Tables II and III). Comparisons of infestation frequencies between different species of ticks in 2017 and 2018 were made from season to season using the Pearson's Chi-2 test. The difference was significant at the significance level of 5% (p> 0.05).

Table II: Seasonal dynamics of ticks in the Tonkpi region in 2017

Months of year	Number of cattle examined	*A. variegatum*		*B. annulatus*		*B. microplus*		*H. truncatum*	
		Nomber of ticks	Frequency (%)	Nomber of ticks	Frequency (%)	Nomber of ticks	Frequency (%)	Nomber of ticks	Frequency (%)
Rainy season									
March	83	101	1,86	4	0,07	171	3,15	0	0
April	153	376	6,93	12	0,22	581	10,71	1	0,02
May	155	261	4,81	20	0,37	342	6,30	1	0,02
June	152	321	5,92	37	0,68	452	8,33	3	0,06
July	150	201	3,70	56	1,03	245	4,52	0	0,00
September	68	135	3,49	58	1,07	178	3,28	0	0,00
October	51	95	1,75	27	0,50	186	3,43	1	0,02
Total	**812**	**1490**	**27,46**	**214**	**3,94**	**2155**	39,72	**6**	0,11
Representativeness in %.		**27,46**		**3,94**		**39,72**		**0,11**	
Dry season									
January	48	98	1,81	3	0,08	120	2,21	1	0,02
February	99	128	2,36	5	0,13	156	2,88	0	0,00
November	103	301	5,55	92	2,38	401	7,39	6	0,11
December	79	30	0,55	3	0,08	134	2,47	0	0,00
August	75	14	0,26	8	0,21	60	1,11	1	0,02
Total	**404**	**571**	10,52	**111**	2,05	**871**	16,05	**8**	0,15
Representativeness in %.		**10,52**		**2,05**		**16,05**		**0,15**	

Table III : Seasonal dynamics of ticks in the Tonkpi region in 2018

Months of year	Number of cattle examined	*A. variegatum*		*B. annulatus*		*B. microplus*		*H. truncatum*	
		Nomber of ticks	Frequency (%)	Nomber of ticks	Frequency (%)	Nomber of ticks	Frequency (%)	Nomber of ticks	Frequency (%)
Rainy season									
March	90	101	1,73	8	0,14	176	3,02	0	0
April	181	392	6,72	16	0,27	586	10,05	1	0,02
May	166	277	4,75	25	0,43	370	6,35	2	0,03
June	157	365	6,26	45	0,77	456	7,82	4	0,07
July	150	252	4,32	59	1,01	269	4,61	0	0,00
September	73	148	2,54	69	1,18	176	3,02	0	0,00
October	56	104	1,78	34	0,58	189	3,24	1	0,02
Total	**873**	**1639**	28,11	**256**	4,39	**2222**	38,11	**8**	0,14
Representativeness in %.		**28,11**		**4,39**		**38,11**		**0,14**	
Dry season									
January	54	105	1,80	5	0,09	134	2,30	1	0,02
February	105	128	2,20	8	0,14	168	2,88	0	0,00
November	110	329	5,64	95	1,63	434	7,44	6	0,10
December	52	42	0,72	9	0,15	141	2,42	0	0,00
August	73	21	0,36	12	0,21	66	1,13	2	0,03
Total	**394**	**625**	**10,72**	**129**	**2,21**	**943**	16,17	**9**	0,15
Representativeness in %.		**10,72**		**2,21**		**16,17**		**0,15**	

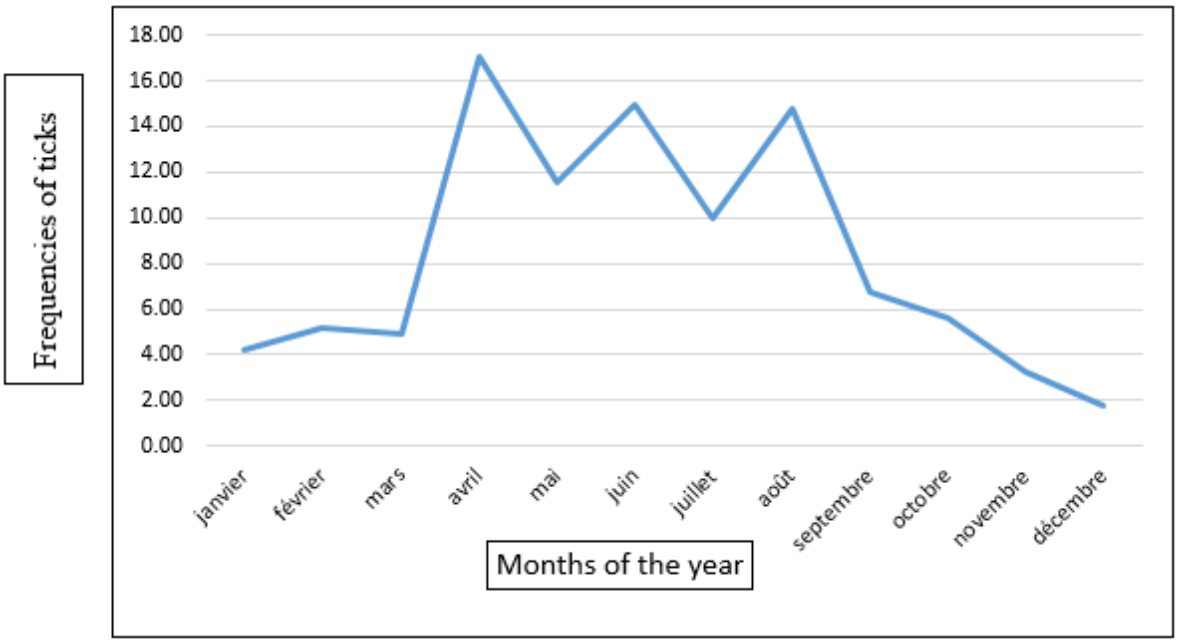

Figure 5 : Seasonal dynamics of ticks in the Tonkpi region in 2017

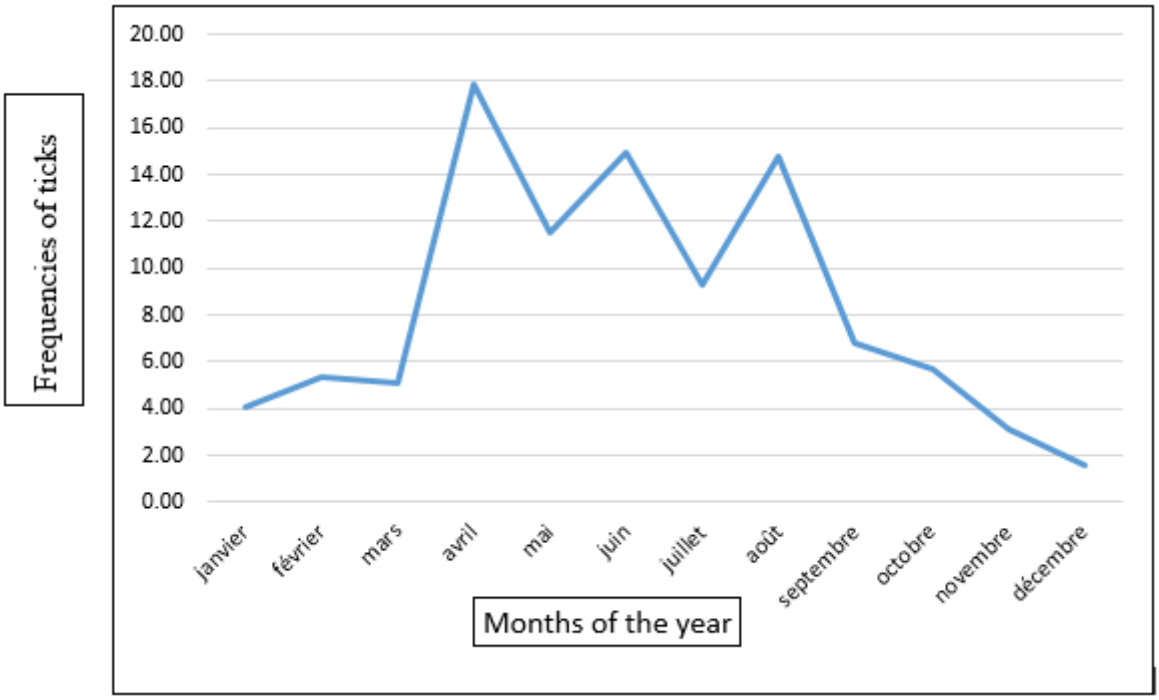

Figure 6 : Seasonal dynamics of ticks in the Tonkpi region in 2018

DISCUSSION

The studies on ticks were carried out in Côte d'Ivoire by several researchers (Diaha-Kouamé et al., 2017; Djakaridja et al., 2014; Touré et al., 2012; Achi et al., 2012; Aeschlimann, 1967). Tick infestations are a major constraint to ruminant farming in Côte d'Ivoire (Azokou et al., 2016). However, the Mountain District, which has 3

administrative regions and borders on 2 countries such as Guinea and Liberia, is not documented.

In the present study, cattle in cattle paddocks are infested with 3 genera of ticks, of which 4 species have been identified. These are *Rhipicephalus (Boophilus) microplus* (55% of ticks), the dominant tick and present at all stasis in cattle compared to *Amblyomma variegatum* (38.42% of ticks), *Rhipicephalus (Boophilus) annulatus* (6, 30% of ticks) and *Hyalomma truncatum* (0.28% of ticks).This could be explained by the fact that cattle benefited from acaricide treatments (1 treatment every 15 days) during the dry season. This observation was made by Touré et al. (2012) who reported that regular acaricide treatments in herds significantly reduce ticks. Another explanation would be that the traditional type of breeding system adopted in the various farms promotes the transmission and infestation of ticks between cattle (Achi et al., 2012). Movements of cattle as a result of the search for fodder or grazing places are to be considered insofar as they facilitate the spread of ticks between cattle on the same pastures (Komoin-Oka et al., 2004). According to Jorgensen et al. (1994), breeding methods are among the most influencing factors for tick infestations.

In addition, the movement of animals from neighboring countries and / or regions for the purpose of slaughter, without the latter being placed in quarantine, is directly introduced into the cattle pens (Merlin et al., 1987). Our observations are consistent with those of Tomassone et al. (2004) who found that *Boophilus spp* is the most abundant species (57.1%) in Guinea unlike Gueye et al. (1989) in Senegal and Kaboré et al. (1998) in Burkina Faso where *Amblyomma variegatum* is the most abundant (69%).

In the dry season, the frequency of tick infestations is low (28.93%) compared to the rainy season (71.07%). The peaks of infestation are in April for *Rhipicephalus (Boophilus) microplus,* in June for *Amblyomma variegatum*, finally, in August for

Rhipicephalus (Boophilus) annulatus and *Hyalomma truncatum*. This could be explained by the fact that the dynamics of certain ticks such as *Amblyomma variegatum* and *Rhipicephalus (Boophilus) microplus* are observed during the rainy season (Merlin et al., 1987).

Comparisons of infestation frequencies between different species of ticks in 2017 and 2018 were made from season to season using the Pearson Chi-2 test. The difference was significant at the significance level of 5% ($p > 0.05$).

CONCLUSION

The present study made it possible to examine 2,511 cattle out of 19,724 slaughtered and to collect 11,257 ticks in livestock parks in the region from 2017 to 2018. Three genera have been identified, including four species of ticks, in particular, *Amblyomma variegatum, Rhipicephalus (Boophilus) microplus Rhipicephalus (Boophilus) annulatus* and *Hyalomma truncatum*. It appears that the infestation frequencies are low (28.93%) in the dry season and high (71.07%) in the rainy season of which *Rhipicephalus (Boophilus) microplus* is the dominant species. The seasonal variation of ticks in the Tonkpi region is marked by the first peak at the start of the rainy season (April) and decreasing in a jagged pattern. However, the second peak appeared in August despite the acaricide treatments carried out by farmers.

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