

## Preliminary Study on Ixodid Ticks Population of the Akagera National Park in Rwanda

<sup>1</sup>Nahayo Adrien, <sup>2</sup>Byukusenge Maurice, <sup>3</sup>Linden Annick and <sup>4</sup>Nshimiyimana Juvénal

<sup>1</sup>Animal Production Department, Higher Institute of Agriculture and Animal Husbandry (ISAE-Busogo), Rwanda

<sup>2</sup>Faculty of Veterinary Medicine, Umutara Polytechnic University, Rwanda

<sup>3</sup>Parasitic and Infectious Diseases Department, University of Liège, Belgium

<sup>4</sup>Byumba Polytechnic Institute (French), Rwanda

**Abstract:** In Rwanda and subtropical African region in general, tick-borne diseases are regarded as one of the main threats of animal and human health. In this study we assessed the ixodids population in Akagera national park which can harbored by wild animals. In August and September, 2011 and 2012, ticks were collected on vegetation in three sites located in Akagera national park by flagging method. Within a total of 204 ticks collected, three species including *Rhipicephalus appendiculatus*, *Hyalomma truncatum* and *Amblyomma variegatum* were identified. The *Rhipicephalus appendiculatus* was predominant with 90.3% followed by *Amblyomma variegatum* and *Hyalomma truncatum* with 5.1 and 4.5% of specimen sampled respectively. The results reported herein prove at the first time that the wild animal of Akagera national park are exposed to the tick and to the tick-borne diseases transmitted by these ones. Moreover, in this case, the wild animals of this park can act as reservoirs of those diseases for livestock and/or human in this region.

**Keywords:** *Amblyomma variegatum*, *Hyalomma truncatum*, *Rhipicephalus appendiculatus* Rwanda

### INTRODUCTION

Within the framework of the Rwanda's Economic Development and Poverty Reduction Strategy (EDPRS), the tourism sector expanded rapidly during the two last decades. The basin of Akagera river, encompassing the biggest wildlife reserve in Rwanda, the «Akagera national park», is a pastoral and touristic legacy of the regional countries; namely Rwanda, Tanzania and Uganda. One of the pillars of tourism in Rwanda is its landscape and animal diversity. The Akagera national park is also known for being the one of the best parks in Africa and the biggest protected wetland area in central and eastern Africa. Its diverse ecosystem is mainly composed of savanna (grassland with scattered acacias, small hills and swampy valleys). This diversity of the ecosystem makes for the animal diversity; the park provides shelter for several mammal species including 17 ungulate with 12 different species of antelopes, 18 carnivorous and 5 primate species (Dorst, 1998; RDB, 2011). Additionally, more than 525 of 702 migratory bird species known to reside or stay occasionally in Rwanda are found in this park (Vandeweghe, 2011). Thus, in 2010 the Rwanda Development Board (RDB) and the African parks network agreed to set a strategic plan for the joint management of Akagera national park in order to make it one of the best national parks in the world (RDB,

2011). However, apart from this fauna rich in diverse mammals, this region is also known to be home of endemic various tick species and tsetse fly (Bazarusanga *et al.*, 2007) with alarming consequences on health and management of the animals in the park. There are more than 800 species of Ixodidae or hard ticks with about 10% involved in the transmission of several animal and sometimes human diseases in the world (Tissot Dupont, 1998). Due to their wide geographical distribution, their species diversity, the variability of their behavior and the specificity of their relationships with their hosts, these ticks are able to transmit several bacterial, viral and parasitic diseases. The pathogens transmitted by ticks comprise the viruses, bacteria and a few helminthes (Amiel *et al.*, 2004). In addition to the transmission of pathogens, the ticks inflict various harms to their hosts, particularly blood loss, toxin-related effects "tick paralysis", inflammatory reactions or irritations caused by tick bites (Wall and Shearer, 2001). The tick bites can also serve as entrance way for bacterial infections and these effects bring about significant morbid states, even become fatal (Nshimiyimana and Mutandwa, 2010). In Rwanda, the most reported tick-borne diseases are east coast fever (theileriosis), anaplasmosis, babesiosis and cowdriosis (Bazarusanga, 1999; Nshimiyimana and Mutandwa, 2010). Although, the ticks of genus *Rhipicephalus* have been reported sub-Saharan African

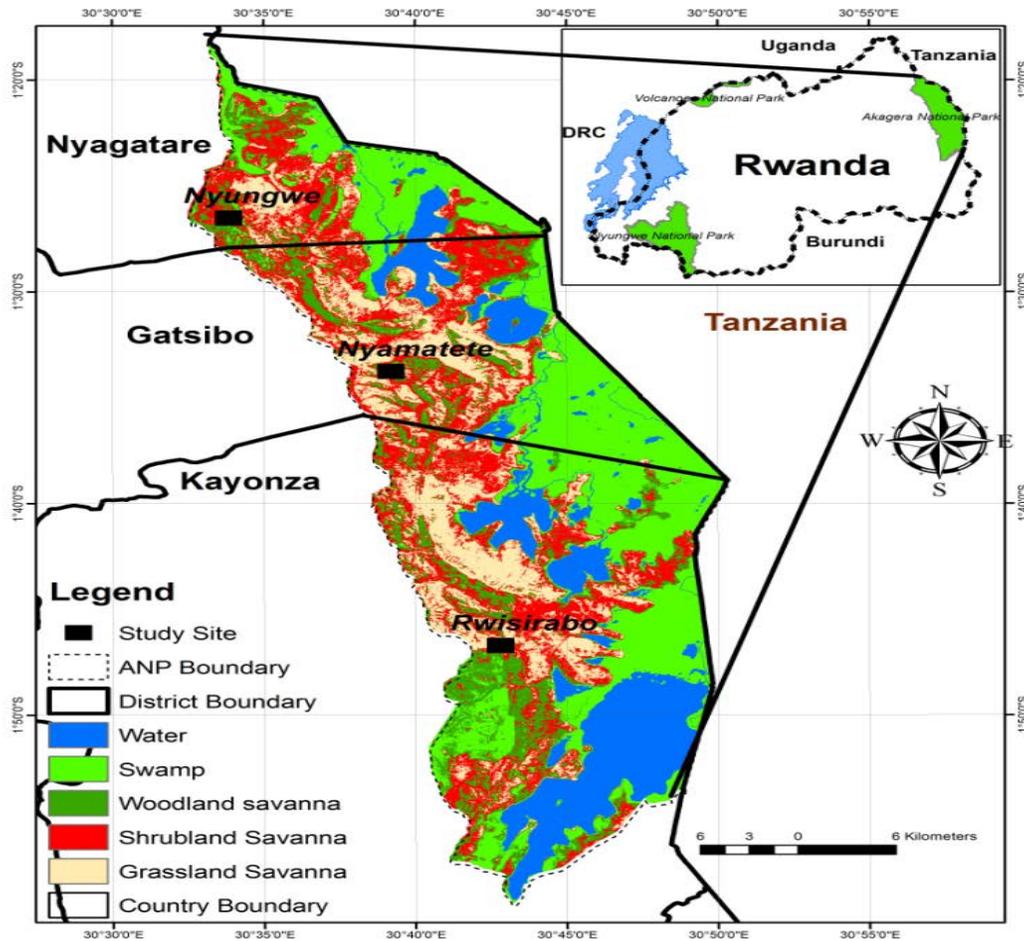


Fig. 1: Location of three sites of ticks sampling

countries including Rwanda (FAO, 1982; Bazarusanga *et al.*, 2007; Nshimiyimana and Mutandwa, 2010), unfortunately, there is a lack of scientific data on the ticks harbored by wild animals and prevalence of tick-borne diseases in those animals in Rwanda. The aim of this study was to make an inventory of the ixodid tick species which parasite the wild animal in the Akagera national park.

## MATERIALS AND METHODS

**Study area:** The region of Akagera is one of the last sanctuaries of inter-lakeside savannas in Africa. It is located on the border between Rwanda, Tanzania and Uganda with geographic coordinates 1.37°S and 30.47°E. The Akagera national park is located in the lowest zone of Rwanda with the altitude between 1000 and 1550 m, the annual mean temperatures range between 21 and 24°C with daily high extremes reaching sometimes 32.2°C. Even though in throughout Rwanda there are two rainy season, the great from March to June and from October to December for the small, the rainy period in the park and surrounding is the shortest

(from November to May). The annual rainfall is also the lowest of the country (between 800 and 950 mm) with monthly variations ranging from 13 to 137 mm. The hydrography of the region is the densest of the country since 1/3 of the park surface is dominated by swampy valleys drained by a network of several rivers and small lakes.

**Ticks collection and identification:** The ticks have been collected from three sites in the Akagera national park. The three sites are Rwisirabo located in sector Mwiri, Nyamatete located in sector Rwimbogo and Nyungwe located in sector Karangazi. These sectors are in turn located in three different districts; Kayonza, Gatsibo and Nyagatare (Fig. 1). The choice of the sites was motivated by the fact that each of them is known to be frequented by wild herbivores. Ticks were collected using the "flagging" method. A white flannel of 1 m<sup>2</sup> was dragged over the vegetation on a surface of 3 ha. After each 10 m, ticks were removed from the flannel, counted and stored in eppendorf tubes before they could be sent to the laboratory of parasitology of High Institute of Agriculture and Animal Husbandry (ISAE-

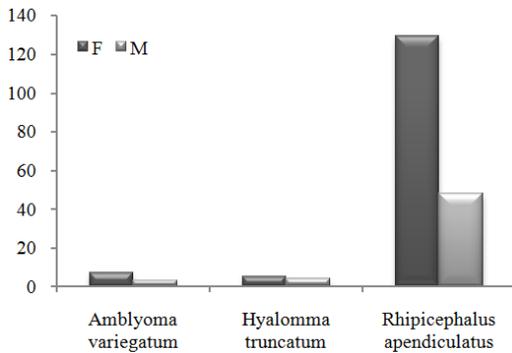


Fig. 2: Identification of collected ticks (species and sex)

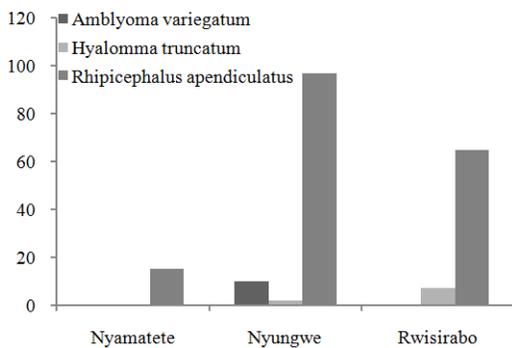


Fig. 3: Distribution of ticks sampled by species and sites

Busogo) for identification. Collection was performed twice a day (morning from 7:30 to 10:30 and evening from 4:00 to 6:00) during a period of two months, August and September 2011 and 2012. Morphologically, gender, species, sex and stage of development of each tick were identified using identification keys (Morel, 1981; Madder, 2000; Walker *et al.*, 2003). Subsequently, ticks were preserved in labeled tube containing absolute ethanol.

## RESULTS

In total, 204 including 196 adults, 4 nymphs and 4 larvae ticks were collected. Among the 196 adults, 141 were female while 55 were male. After identification three species were identified. *Rhipicephalus appendiculatus* appeared to be the most dominant species with 177 ticks (90.3%) followed by *Amblyomma variegatum* with 10 ticks (5.1%) and *Hyalomma truncatum* with 9 ticks (4.5%). Among the 141 identified female ticks 129 were *Rhipicephalus appendiculatus*, 7 were *Amblyomma variegatum* and 5 *Hyalomma truncatum*. Among 55 males, 48 were *Rhipicephalus appendiculatus*, 4 *Hyalomma truncatum* and 3 *Amblyomma variegatum* (Fig. 2). As for the origin, the Nyungwe site in Karangazi sector seems to be the most infested. In fact, more than a half of the ticks (54%) were collected in that sector and all the

three species were founded there and then followed by Rwisirabo site in Mwiri sector with 78 ticks (38.2%) and lastly is Nyamatete site in Rwimbogo sector with 7.8% of the collected ticks (Fig. 3).

## DISCUSSION

The results from this study show clearly that wild animals of the Akagera national park are exposed to tick infestations and probably to tick-borne infections. During the 1900-1994 war, large predators like leopards and lions were eliminated from this park and after the war, around 2000 ha which in the past were used as a hunting area has been converted for silvo-pastoral activities. On one hand, due to this disappearance of big predators, the population of herbivores increased dramatically in the park; on the other hand, in this newly created silvo-pastoral area, more than half of the total national cattle population is reared. So far, studies conducted on ticks in Rwanda have targeted domestic animals and particularly cattle (FAO, 1982; Bazarusanga *et al.*, 2007; Nshimiyimana and Mutandwa, 2010). Thus, it is common to see domestic animals and/or wild herbivores crossing the park boundaries in search of water and fresh grass. Because of this issue, an electrical fence is being built around the park. However, this fence will maybe limit the transmigration of large animals but it is inefficient in limiting the migration of small mammals and birds which are known to disseminate ticks, particularly the immature stages ones (Githeko *et al.*, 2000). In addition, in the governmental endeavor for land consolidation, the intensification of cereal crops in the region provide a suitable shelter to those small mammals and birds which widely disseminate ticks (Bjoersdorff *et al.*, 2001; Githeko and Ndegwa, 2001). Therefore, our hypothesis was that this region occur the suitable conditions for the development and dissemination of ticks both in wild and domestic environments. Thus, three tick species were collected and identified, among which *Rhipicephalus appendiculatus* was predominant. Due to their good ecologic adaptability, Rhipicephalidae are known to be the most widespread ticks in the world and *Rhipicephalus appendiculatus* is founded the whole year between 1000 and 2500 m of altitude (Berggren, 1978; Morel, 1981). In central and southern subtropical Africa the activity of the various stages of *Rhipicephalus appendiculatus* are seasonal, with more adults in mid and late summer. Moreover, in sufficient rainfall tropical regions, three generations in year can occur (OIE, 2009). The predominance of the *Rhipicephalus appendiculatus* species observed in our study tallies with the results obtained in previous studies of ticks in Rwanda (FAO, 1982; Bazarusanga *et al.*, 2007; Nshimiyimana and Mutandwa, 2010). The presence of *Amblyomma variegatum* has also been

reported in semi-arid regions in Rwanda (Bazarusanga *et al.*, 2007), in Uganda (Matthysse and Colbo, 1987) and in Zimbabwe (Norval, 1994). In 2007, Bazarusanga and coworkers have considered that climatic preferences of *Amblyomma variegatum* and *Rhipicephalus appendiculatus* are similar, although *Amblyomma variegatum* can be sometimes absent in high humid environment (Norval, 1994). *Hyalomma truncatum* observed in this study had never been reported in previous studies (Bazarusanga *et al.*, 2007; Nshimiyimana and Mutandwa, 2010), although its presence had been reported in almost all the Sub-Saharan Africa (Norval, 1994; Gueye *et al.*, 1989; Regassa *et al.*, 2001). The introduction of this species often considered as invasive is probably associated with the massive entry of cattle from Uganda and Tanzania after the 1990-1994 war and/or the dissemination by migratory birds, which is not a rare phenomenon. The spatio-temporal dynamics of different tick species depends not only on the availability of suitable hosts but also on bio-climatic factors (Gilot and Perez-Eid, 1998; Githeko and Ndegwa, 2001; Estrada-Pena, 2003) and during their free-living periods, the survival of ticks depends on temperature and soil humidity (Wall and Shearer, 2001; Bazarusanga *et al.*, 2007; Nshimiyimana and Mutandwa, 2010). Our sampling period (August-September) corresponds to the end of dry season in Rwanda. This season characterized by the low rainfall and high temperature relatively, seems to be unfavorable of the development of ticks, especially the immature ones as they do not resist well to dryness in comparison to adults. This could be the reason of the relatively reduced number of collected ticks, mainly the nymphs or larval stages. While there is a perceptible difference between the sampled sites (for example, 7 times between Nyungwe and Nyamatete) the interpretation of this difference must be done with caution because of the smaller size of sample and short period of sampling. Furthermore, although the characteristics of field (biotope) were similar for all three sites, there are other bioclimatic parameters such as soil temperature, humidity and altitude as well as host species sheltered in ground that may lead to this difference. Unfortunately, these parameters have not been technically verified and that makes the results reported above limited at descriptive level. The sex-ratio was not analyzed in all the three species identified since the sample size was relatively small ( $n = 10$  and  $9$ ) for *A. variegatum* and *H. truncatum* respectively. However, for *Rhipicephalus appendiculatus*, the sex-ratio (male/female) was 1/2.7. This ratio although different from 2/1 observed by Bazarusanga and collaborators in 2007 can be justified in two ways. First, the needs of blood meals are higher for female than in male ticks. Secondly, the ticks mating takes place generally on the host and it is only when the female is taking her blood meal that she spreads the pheromones

that attract the males (Taylor *et al.*, 2007). Due to the small number of ticks collected and relatively short period of sampling, we were unable to perform the deep statistical analysis of our results. Additionally, because of the sampling period (relatively short) and unfavorable of tick development (dry season) but also the biotopes and altitudes similar for the three sites, these results do not provide more information about the spatio-temporal dynamics of these tick species.

## CONCLUSION

Even this study remains at a preliminary level, to our best knowledge, is the first of its kind carried out in this park. Interestingly, our results demonstrate not only a real risk of infestation of wild animals by ticks, but also provide the evidence of the presence of three tick species (*R. appendiculatus*, *H. truncatum* and *A. variegatum*) in the Akagera national park. These facts justify the interest for further research in the future to assess:

- The role of ixodid ticks in epidemiology of different tick-borne diseases in the wild animals in this park, but also
- The interface between those wild animals, livestock and human in tick-borne diseases transmission in Region

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## REFERENCES

- Amiel, C., G. Abadia and D. Choudat, 2004. L'ehrlichiose granulocytaire humaine en Europe: Revue Générale. Méd. Mal. Infect., 34: 111-122.
- Bazarusanga, T., 1999. Molecular characterisation of *T. parva* parasites in the field of Rwanda. M.Sc. Thesis, Institute for Tropical Medicine, IMT Antwerp, Belgium.
- Bazarusanga, T., D. Geysen, J. Vercruyssen and M. Madder, 2007. An update on the ecological distribution of Ixodid ticks infesting cattle in Rwanda: countrywide cross-sectional survey in the wet and the dry season. Exp. Appl. Acarol., 43: 279-291.
- Berggren, S.A., 1978. Cattle ticks in Malawi. Vet. Parasitol., 4: 289-297.
- Bjoersdorff, A., S. Bergstrom, R.F. Massung, P.D. Haemig and B. Olsen, 2001. Ehrlichia-infected ticks on migrating birds. Emerg. Infect. Dis., 7(5): 877-879.

- Dorst, J., 1998. Protected Areas in Francophone Africa (French). ACCT, Paris.
- Estrada-Pena, A., 2003. Climate change decreases habitat suitability for some tick species (Acari: Ixodidea) in South Africa. *J. Vet. Res.*, 7: 79-93.
- FAO, 1982. Rwanda epizootiology and control of tick-borne diseases. Technical Report No. 1. AG: RW/77/006. Food and Agriculture Organisation, Rome.
- Gilot, B. and C. Perez-Eid, 1998. Bio-ecology of ticks inducing the most important diseases in France. *Med. (French) Mal. Infect.*, 28: 325-334.
- Githeko, A.K. and W. Ndegwa, 2001. Predicting malaria epidemics in the Kenyan highlands using climate data: A tool for decisionmakers. *Glob. Climate Change Hum. Health*, 2: 54-63.
- Githeko, A.K., S.W. Lindsay, U.E. Confalonieri and J.A. Patz, 2000. Change in climate and vector-borne diseases: A regional analysis (French). *Bull. World Health Organ.*, 78(9): 1136-1147.
- Gueye, A., M. Mbengue and A. Diouf, 1989. Haemoparasitic ticks and cattle in Senegal. *J. Anim. Husbandry Vet. Med. Trop. Countries (French)*, 42(4): 517-528.
- Madder, M., 2000. Key to the Families and Genera of the Common Ticks. Antwerp, Belgium, pp: 12-26.
- Matthysse, J.G. and M.H. Colbo, 1987. The Ixodid Ticks of Uganda. Entomological Society of America. College Park, Maryland.
- Morel, P., 1981. Tick-borne Diseases of Livestock in Africa In: Handbook of Tropical Veterinary Parasitology. Ministry of Cooperation and Development, French Republic (French), Donachie, pp: 471-717.
- Norval, R.A.I., 1994. Factors affecting the distributions of the ticks *Amblyomma hebraeum* and *A. variegatum* in Zimbabwe: Implications of reduced acaricide usage. *Exp. Appl. Acarol.*, 18: 383-407.
- Nshimiyimana, J. and E. Mutandwa, 2010. Seasonal dynamics and distribution of ticks in Rwanda: Implications for tick control strategy in Rwanda. *Int. J. Anim. Vet. Adv.*, 2(1): 21-25.
- OIE, 2009. *Rhipicephalus appendiculatus*, *Brown Ear Tick*. Last updated September 2009. Retrieved from: [www.cfsph.iastate.edu/Factsheets/.../rhipicephalus\\_appendiculatus.pdf](http://www.cfsph.iastate.edu/Factsheets/.../rhipicephalus_appendiculatus.pdf)
- RDB, 2011. Rwanda Tourist Map. RDB, Rwanda.
- Regassa, A., 2001. Ticks infestation on Borana cattle in the Borana province of Ethiopia. *J. Vet. Res.*, 68: 41-45.
- Taylor, M.A., R.L. Coop and R.L. Wall, 2007. *Veterinary Parasitology*. 3rd Edn., Blackwell Publishing Ltd., Oxford, UK, pp: 208-210.
- Tissot Dupont, H., 1998. Epidémiologie des maladies transmises par les tiques. *Méd. Mal. Infect.*, 28: 344-348.
- VandeWeghe, 2011. Bids in Rwanda, RDB, Rwanda.
- Walker, A.R., A. Bouatourr, J.L. Camicas, A. Estrada-Peña, I.G. Horak, A.A. Latif, R.G. Pegram and P.M. Preston, 2003. Ticks of domestic animals in Africa: A guide to identification of species. Bioscience, Reports, UK.
- Wall, R. and D. Shearer, 2001. *Veterinary Ectoparasites: Biology, Pathology and Control*. 2nd Edn., Blackwell Science Ltd., Oxford.