NANGARHAR UNIVERSITY
INTERNATIONAL JOURNAL OF BIOSCIENCES
REVIEW ARTICLE
e-ISSN: 2957-9988
NUIJB
Special Issue, 2024

Received: 23 Dec 2023 Accepted After Revision: 22 Jan 2024 Published Online: 10 Feb 2024

The Possible Effect of Hot Climate on Future of Cow Babesiosis and Theileriosis in Afghanistan

Bayer Darmel Mohammad[*1], Bawari Hanifullah[1], Stanikzai Peer Mohammad[1], and Kanker Mohammad Aziz[1]

[1]Department of Clinic, Faculty of Veterinary, Nangarhar University, Nangarhar, Afghanistan
*Corresponding author email: bayer500@yahoo.com

ABSTRACT

The worldwide the Tick-borne diseases (TBDs) are a great challenge from health and economic importance. Babesia protozoan parasites of the genus Babesia, order Piroplasmida, phylum Apicomplexa) and theileriosis are transmitted by different species of ticks. The first incident of theileria related parasite (T. annulata) infection was reported in 1979 from Afghanistan. By looking to the effect of climate on the living biology of ticks 25-35 C is favorable degree for the tick's activities. The climate change is a hot topic of the day and in this article we shortly reviewed the possible effects of hot climate on ticks' biology as vector for Babesia and thielaria parasites. In the end we can conclude that if the temperature is getting increase more than 40 degrees the ticks biological activities will be effected casing reduction in related disease and related disease may emerge in other provinces where the climate condition (temperature, humidity etc.) is not suitable at the present time. Hence, it is crucial to share the strategies for disease control and mitigation, particularly those transmitted by ticks, with healthcare professionals and communities in other provinces. Collaboration with doctors and experts, such as those currently working in Nangarhar province, through educational programs can facilitate knowledge sharing and preparedness efforts in other regions.

Keywords: Babesiosis, Climate change Jalalabad, cows, Theileriosis, Ticks

INTRODUCTION

Numerous diseases, including bacteria, viruses, rickettsia, and protozoa, are spread by ticks and can cause serious infections in both humans and animals. Tick-borne diseases are very important from a health and economic perspective for livestock in many parts of the world (Wikel, 2018). Theileriosis and Babesia protozoan parasites (of the genus Babesia, order Piroplasmida, phylum Apicomplexa) are spread by ticks of the species Hyalloma anatolicum, H. marginalatum, and H. excavum, and by Boophilus spp (Ixodid) respectively (Soulsby, 1982). Afghanistan reported the first confirmed case of tropical theileriosis (infection with T. annulata) in 1979 (Bulman et al, 1979).

Evidence has started to mount that suggests climate change is changing the distribution and transmission of parasitic diseases and the vectors that carry them (Kovats, 2001) The city of Jalalabad center of Nangarhar has an annual temperature of 21.35ºC (70.43ºF), which is 5.65% higher than the average for Afghanistan due to its subtropical steppe climate (W&C, 2023).

According to the information provided, changes in climatic patterns may have an impact on the geographic range of diseases carried by arthropod vectors, such as tick species. As a result, the review study aims to examine the relationship between tick biology and the future of theileriosis and babesiosis where both are transmitted indirectly through arthropod vectors.

EFFECTS OF HOT CLIMATE ON TICK BIOLOGY

Ticks spend a large portion of their existence feeding on their host or hosts, and the temperature and humidity of the surrounding air are what make them more likely to survive. The environment is influenced by the vegetation and climate, which also controls tick abundance and distribution. According to Estrada-Peña et al. (2012), rising temperatures due to climate change may limit their life span but enhance their rate of reproduction.

Climate change-related changes in tick abundance could have an effect on host communities and accelerate the spread of etiologic agents linked to tick-borne diseases. In certain places, reduced tick survival

and the capacity to transmit pathogens may result from predicted high temperatures and extreme weather events such as flooding, heat waves, and cold snaps (Nicholas et al., 2021).

The periods of preoviposition, oviposition, egg hatching (incubation), and moulting were all extended at 15 c, according to an ecological study that examined the association between temperature and tick egg hatch ratio (Yano, 1987).

Tick-seeking behaviors, metabolic rates, and energy reserves are all impacted by temperature fluctuations and other stressful events (Andrew et al., 2017).

In an experiment, the effect of temperature on Boophilus annulatus's biology during oviposition was examined in a lab setting. The findings show that while temperatures of 15°C (about 1800 eggs/female) and 40°C (approximately 300 eggs/female) did not result in hatching, high temperatures of 12°C and 45°C caused the death of the female without ovipositing. At 25–35°C, the average number of eggs laid by a female was at its maximum (2700 eggs/female), and it fell at 20°C, 15°C, and 40°C. Davey (1988)

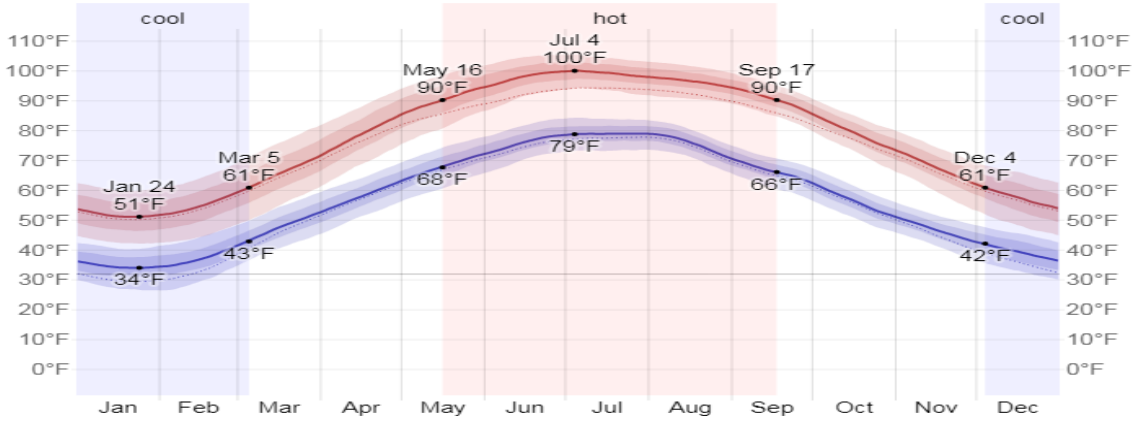
The connection between environmental change and the spread of tick-borne infections, underlining the need to consider natural and epidemiological variables included (Dark, 2009).

In a concentrate on ticks where three species amblyomma, americanum, dermacentor variabilis, and Ixodes scapularis under gone in hotter and less sticky circumstances to assess their endurance, physiology, and questing conduct. Ticks in hotter and less muggy circumstances had more limited endurance times contrasted with those in cooler and more damp circumstances. climatic pressure experienced under hot and dry circumstances increments tick death rates. Ticks of each of the three species reliably kicked the bucket subsequent to losing around 51% of their absolute body water content. Also, the review features species-explicit contrasts in water misfortune and parchedness resilience among the three tick species. (Caleb et al, 2023)

The animal's thermos-neutral zone can be affected by the climate, which can directly cause stress and its effects. It may also have an indirect effect by encouraging pathogens and vectors to survive in the environment, resulting in an increase in the severity and frequency of diseases. Early warning, detection, and treatment of major diseases can all benefit from the use of climate data that are spatially matched to disease data (Royford, 20).

As per weather conditions flash the warm season in Jalalabad endures from May 16 to September 17, for 4.0 months with a typical day to day high temperature above 90°F. The most sweltering month of the year for Jalalabad is counted July, where a typical high temperature is 99°F and the low is 79°F. The cool season endures from December 4 to Walk 5 for 3.0 months, where a typical day to day high temperature under 61°F. The coldest month of the year in Jalalabad is January, with a typical low of 35°F and high of 52°F (Weatherspark, 2023).

Climate in Jalalabad



(Weatherspark, 2023)

TICKS BORN DISEASE (TBHS)

The PCR results showed location T. annulata in H. anatolicum in salivary organs as per acquired results, T. annulata had a high recurrence in dairy steers and presence of H. anatoloicum affirmed, as the vectors for T. annulata in the Herat region, Afghanistan (Amiri, 2021).

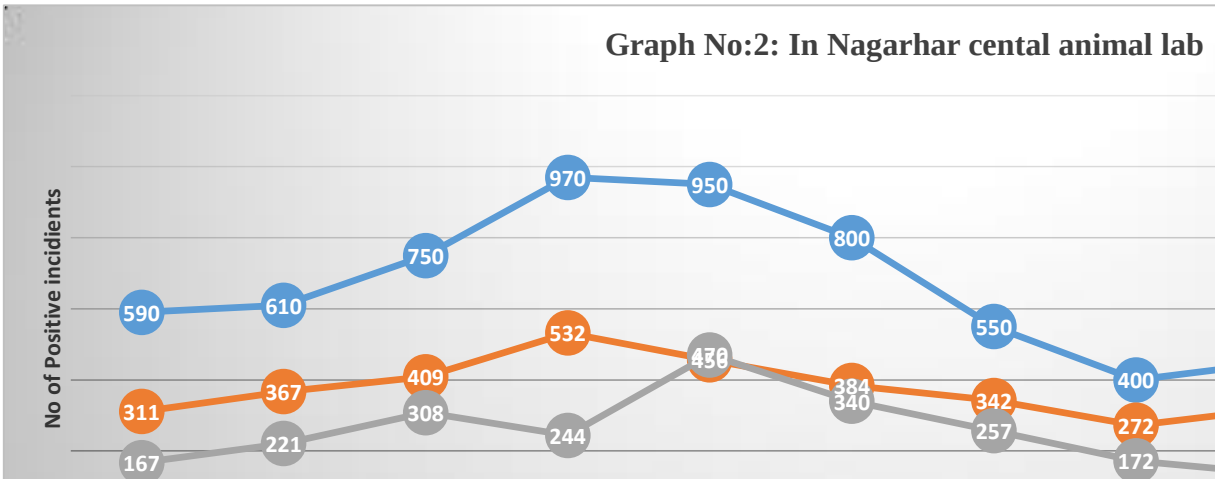
Theileria parasite in Herat region. The positive incidents in the 11 district ranged from 4% to 37%, and the annual outbreak frequently occurred in the late spring and early summer, resulting in financial losses (Tookhy, 2018).

The audit and examination show that ticks, and in this way TBDs, are delicate to environmental change which, created with a few different elements, co-characterizes their present and future grouping. Basic elements comprise of temperature and mugginess. The seasonal variation in the incidences of babesiosis and theileriosis demonstrates that the incidences are higher in the summer, followed by autumn, spring, and lower in the winter, which may be due to the favorable environment for the growth and development, survival, and tick-related issues in these seasons (Sayin et al., 2003).

Tick survival and reproduction can be significantly affected by the appropriate temperature and relative humidity. Notwithstanding, changes in certain variables like farming practices, timberland cover, and deferent plant species sythesis affects tick populaces and TBDs transmission. These impacts are immediate, through changes in neighborhood temperature and dampness, or backhanded, by changing the local area of accessible vertebrate blood has (like mice, raccoons, and deer), which go about as tick-borne microbe repositories. (HHS, 2022).

THEILARIOSIS AND BABESIOSIS INCIDENTS IN NANGARHAR CENTRAL LAB AS CASE.

To prove the presence and seasonal fluctuation of Theilarosis and babesiosis positive incidents in cows the data of three years was collected from central laboratory of Nangarhar province located in Jalalabad, Sheshambagh.



In the presented graph the incidents of theileriosis and babesiosis are greater in the month, June, July, August and September compare to other months and January has low incidents.

CONCLUSION

In the current situation Nangarhar province is experiencing the highest incidences of protozoan diseases for decades particularly babesiosis and theileriosis which are, transmitted by specific ticks. Notably as Sayin et al (2003) mentioned that the occurrences of these parasites have been observed to peak in summer, decline in winter, and rise again in spring. This pattern aligns with the average temperature in most districts of Nangarhar province where the warmest month of the year for Jalalabad is counted July, and average high temperature is 99°F and the low is 79°F. During the summer, creating favorable conditions for tick activity. Consequently, the highest incidences of these diseases are detected during the summer season.

With a possible increase in temperature, a decrease in relative humidity, and the disappearance of green ground cover, may has the impacts of climate change on these living organisms can be observed. For instance, as reported by Caleb et al. (2023), rising temperatures and reduced humidity pose challenges to tick activities, leading to a decrease in the transmission of associated diseases. There is possibility of reduction in ticks related biological activities according to Nicholas, et al, (2021) anticipated high temperatures and extreme weather events flooding (flooding, heat, cold,) may have different effects, on reduction tick survival and pathogen transmission ability in some locations. Additionally, the possibility of tick activities during both spring and autumn is also acknowledged.

Furthermore, while currently some provinces may not provide an ideal environment for the activities of these ticks due to factors such as temperature, elevation, and other climatic conditions as mentioned by Van et al. (2020) or Dave (1988) and Estrada-Peña et al. (2012). there is a future possibility of the spread of diseases like Babesiosis and theileriosis. Hence, it is crucial to share the strategies for disease control, treatment and mitigation, particularly those transmitted by ticks, with healthcare professionals and communities in other provinces. Collaboration with doctors and experts, such as those currently working in Nangarhar province, through educational programs can facilitate knowledge sharing and preparedness efforts in other regions. It is mentionable that the emergence of TBDs in other province may occur.

REFERENCES

Amiri, Samiurahman . M, Yaghfoori S, Razmi G. Molecular Detection of Theileria annulata among Dairy Cattle and Vector Ticks in the Herat Area, Afghanistan. Arch Razi Inst. 2021 Mar;76(1):79-85. doi: 10.22092/ari.2019.128212.1407. Epub 2021 Mar 1. PMID: 33818960; PMCID: PMC8410210

Bulman, G. M., Arzo, G. M., & Nassimi, M. N. (1979). An outbreak of tropical theileriosis in cattle in Afghanistan. Tropical Animal Health and Production, 11(1), 17-20. https://doi.org/10.1007/BF02237759

Davey, R. B. (1988). Effect of temperature on the ovipositional biology and egg viability of the cattle tick Boophilus annulatus (Acari: Ixodidae). Exp Appl Acarol, 5(1-2), 1-14. https://doi.org/10.1007/BF02053812

Gray, J. S., Dautel, H., Estrada-Peña, A., Kahl, O., & Lindgren, E. (2009). Effects of climate change on ticks and tick-borne diseases in Europe. Interdisciplinary Perspectives on Infectious Diseases, 2009, 593232. https://doi.org/10.1155/2009/593232

Kovats, R. S., Campbell-Lendrum, D. H., McMichael, A. J., Woodward, A., & Cox, J. S. H. (2001). Early effects of climate change: do they include changes in vector-borne disease? Philosophical Transactions of the Royal Society B: Biological Sciences, 356, 1057–1068. https://doi.org/10.1098/rstb.2001.0894

Magiri, R., Muzandu, K., Gitau, G., Choongo, K., & Iji, P. (Year). Impact of Climate Change on Animal Health, Emerging and Re-emerging Diseases in Africa.

Nielebeck, C., Kim, S. H., Pepe, A., Himes, L., Miller, Z., Zummo, S., ... & Monzón, J. D. (2023). Climatic stress decreases tick survival but increases rate of host-seeking behavior. Ecology and Evolution. https://doi.org/10.1002/ecs2.4369

Ogden, N. H., Beard, C. B., Ginsberg, H. S., & Tsao, J. I. (2021). Possible Effects of Climate Change on Ixodid Ticks and the Pathogens They Transmit: Predictions and Observations. Journal of Medical Entomology, 58(4), 1536–1545. https://doi.org/10.1093/jme/tjaa220

Rosendale, A. J., Dunlevy, M. E., Fieler, A. M., Farrow, D. W., Davies, B., Benoit, J. B., ... & Benoit, J. B. (2017). Dehydration and starvation yield energetic consequences that affect survival of the American dog tick. Journal of Insect Physiology, 101, 39-46. https://doi.org/10.1016/j.jinsphys.2017.06.012

Sayin, F., et al. (2003). Studies on the epidemiology of tropical theileriosis (Theileria annulata infection) in cattle in Central Anatolia, Turkey. Journal Title, 35(6), 521-539.

Soulsby, E. (1982). Helminths. Arthropods Protozoa of Domesticated Animals.

Tookhy, N.A., Fazly, M.J., Shakhes, S.A., Mohmand, N.A., Qattali, A.W., Pooyan, A., Matin, A., & Nasiry, Z. (2018). Prevalence Study of Bovine Theileriosis in Herat Province, Afghanistan.

U.S. Department of Health and Human Services. (Year). Changing Dynamics of Tick Ecology, Personal Protection, and Control Subcommittee Report to the Tick-Borne Disease Working Group Co-Chairs: Robert J. Miller and Kirby C. Stafford III. Retrieved from [URL]

Van Oort, B. E. H., Hovelsrud, G. K., Risvoll, C., Mohr, C. W., & Jore, S. (2020). A Mini-Review of Ixodes Ticks Climate Sensitive Infection Dispersion Risk in the Nordic Region. International Journal of Environmental Research and Public Health, 17(15), 5387. https://doi.org/10.3390/ijerph17155387

Wikel, S. K. (2018). Ticks and tick-borne infections: Complex ecology, agents, and host interactions. Veterinary Sciences, 5, 60. https://doi.org/10.3390/vetsci5020060

Yano, S., Shiraishi, S., & Uchida, T. A. (1987). Effects of temperature on development and growth in the tick, Haemaphysalis longicornis. Exp Appl Acarol, 3(1), 73-78. https://doi.org/10.1007/BF01200415