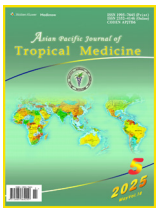

Perspective

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Tick studies in Malaysia: Growth, stagnation, and future prospects

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Tick studies in Malaysia have experienced a dynamic evolution characterized by periods of growth, stagnation, and the potential for revival. Beginning during the colonial era in the early 1900s, tick studies were primarily conducted by European scientists and curators, establishing the foundation for tick taxonomy in the region. Pioneering works by George Henry Falknier Nuttall and Cecil Warburton introduced several new tick species, including *Haemaphysalis (H.) calva*, *H. mjoebergi*, *H. vidua* and *H. wellingtoni*[1]. However, some records from this period are now considered doubtful, for instance *Amblyomma (A.) breviscutatum*, *A. clypeolatum* and *A. integrum*. The 1929 description of *Ornithodoros batuensis* by Stanley Hirst[2] marked the first documentation of a soft tick species in Malaysia, setting the stage for subsequent research endeavours.

The Golden Age of tick studies (early 1950s-late 1980s) in Malaysia saw a surge in tick research activities, largely spearheaded by American and British researchers such as Glen Milton Kohls, Harry Hoogstraal, J. Ralph Audy, and Robert Traub. Notable contributions included the description of new tick species (*e.g.*, *H. atheruri*, *H. borneata*, *H. traubi* and *Ixodes malayensis*) and extensive studies on tick-borne diseases (TBD), particularly tick-borne viruses such as Langat virus, Lanjan virus, and Keterah virus. In 1957, Kohls[3] constructed the first checklist and dichotomous keys for ticks that were endemic in Malaya (now Peninsular Malaysia) and Borneo (including Malaysian Borneo and Kalimantan), which remain the only keys specific to the Malaysian tick fauna. Additionally, Audy and colleagues[4] expanded the list of tick species found in Peninsular Malaysia. Local researchers also made significant contributions during this period, signifying a shift towards indigenous expertise in tick studies.

Despite these early advancements, the field experienced a decline in the early 1990s to the early 2010s, attributed to limited funding and shifting research priorities, such as a focus on mosquito studies. However, local scientists persisted in collecting ticks during scientific expeditions, providing valuable insights into tick diversity and distribution patterns. Nevertheless, there was a noticeable decline in studies focused on tick taxonomy, particularly concerning soft ticks[5]. Despite this decline, reports of human tick bite studies have remained prevalent, shedding light on the interactions between ticks and humans. Works by Indudharan and colleagues[6], as well as Mariana and colleagues[7], have contributed valuable insights into the epidemiology and implications of tick bites on human health in Malaysia.

During the mid-2010s, the rise of TBD studies and tick molecular analyses signalled a potential renaissance in tick research in Malaysia. Investigations have shifted towards bacterial and protozoal pathogens, particularly in vulnerable communities such as the Aboriginal (Orang Asli) populations[8]. Veterinary-important pathogens have also received attention, alongside advancements in tick molecular analyses and phylogenetic studies[9]. Dmitry Apanaskevich, currently serving as an assistant curator of the U.S. National Tick Collection, has made significant contributions to the field of tick taxonomy, particularly in the revision of Malaysian *Dermacentor*, *Haemaphysalis* and *Ixodes* species. His work has led to the reinstatement of *H. dentipalpis*, a species originally described in Malaysia. Additionally, Dr. Apanaskevich has described numerous novel species, including *Dermacentor (D.) falsosteini*, *D. limbooliati*, *D. tamokensis* and *Ixodes abramovi*. Despite these advancements, knowledge of the overall hard and soft tick taxonomy remains limited, emphasizing the need for further research in this area.

One of the many challenges of tick research in Malaysia is the

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significant shortage of researchers and professionals dedicated to studying ticks and tick-borne diseases (TBDs), due to a lack of training opportunities, research projects, and public awareness[10]. This issue is exacerbated by the modest perception of veterinary diseases and veterinarians in the country, along with a general lack of knowledge about TBDs among humans. Securing funding for tick research is a common difficulty, as research in medical and veterinary entomology, particularly on ticks and TBDs, is often not recognized as a priority, despite its significant impact on human and animal health and the socioeconomic aspects of livestock farming. To address these challenges, it is crucial to develop a digital platform for securely and efficiently sharing robust data on ticks, tick-borne pathogens (TBPs), and TBDs. Integration with other geospatial data, such as land use and climate, will allow for risk modelling and prediction of TBDs in the region. Additionally, conducting more studies on vector competence to understand the transmission dynamics of TBPs and the factors influencing them, both in the laboratory and the field, is essential. Investing in capacity-building and training programs for researchers and practitioners will enhance their skills and knowledge in tick ecology, pathogen transmission, and disease management.

The Tick Cell Biobank Asia Outpost, established in 2018 in Malaysia, addresses a critical gap in tick-borne disease research by providing local tick cell lines for *in vitro* studies. Essential for understanding tick biology, disease transmission, and vaccine development, the Outpost supports researchers across Asia by establishing and characterizing regional tick cell lines, and offering resources and training. This initiative advances tick-borne disease research and highlights the growing importance of tick studies in Malaysia.

Looking ahead, interdisciplinary collaborations, increased funding support, and a renewed focus on tick taxonomy, DNA barcoding, ecology, and disease transmission dynamics are critical for propelling tick studies in Malaysia forward. By leveraging emerging technologies and building upon the foundations laid by earlier researchers, Malaysia has the opportunity to re-establish itself as a hub for tick research and contribute valuable insights to the global scientific community. Furthermore, tertiary education in Malaysia, especially in medical-related courses, has incorporated medical and veterinary acarology into the course syllabi, some institutions even taught lectures in forensic acarology. Thus, contributing to the advancement of acarological research in Malaysia in the near future.

Conflict of interest statement

The authors declare that there are no competing interests.

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Authors' contributions

A.R.K. wrote the manuscript, V.L.L., J.H., D.T. and H.C.C. contributed to the final version of the manuscript.

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