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Research Reports

A Study on The Ectoparasites and Hemoparasites Infections in Rodents from The Kilwa District, Tanzania

Studi Tentang Infeksi Ektoparasit dan Hemoparasit pada Rodensia di Distrik Kilwa, Tanzania

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ABSTRACT

Background: Ectoparasites play a significant role in facilitating the transmission of disease pathogens and parasites that affect animals and humans. **Purpose:** This study aims to assess the prevalence of ectoparasites and hemoparasites in rodents from the Kilwa district, Tanzania. **Method:** A cross-sectional study was conducted to trap 138 rodents using Sherman and wire cage traps. Ectoparasites were removed from rodents by using fine brushes and identified based on morphological features using a Stereo microscope with the assistance of dichotomous taxonomic keys. Blood samples were collected from supraorbital veins in captured rodents, and thick and thin smears were made, stained and examined using a Compound Microscope for screening hemoparasite. **Results:** The overall prevalence of ectoparasites in rodents was 57.87 % with a high infestation of rodents by *Echinolaelaps (Laelaps) echidninus* (44.20%) than *Laelaps nuttalli* (10.87%), *Xenopsylla cheopis* (12.32%), and *Rhipicephalus appendiculatus* (2.90%). Most ectoparasites were found in *M. natalensis* 76.40% followed by *R. rattus* 25.81%, and *G. leucogaster* 36.36%. Adult rodents recorded 63.41% of ectoparasites prevalence higher than juveniles 13.33% ($p < 0.05$). The overall prevalence of hemoparasites in rodents was 18.12%. The identified hemoparasites were *Anaplasma sp.* (13.04%), *Babesia sp.* (3.62%), and *Trypanosoma sp.* (1.45%) observed only in adult rodents. **Conclusion:** The study recommends engaging and encouraging the community to use integrated pest management practices for rodents and ectoparasite control and prevention to safeguard both human and animal health.

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ABSTRAK

Latar Belakang: Ektoparasit berperan penting dalam memfasilitasi penularan patogen penyakit dan parasit yang menyerang hewan dan manusia. **Tujuan:** Penelitian ini bertujuan untuk menilai prevalensi ektoparasit dan hemoparasit pada hewan pengerat dari distrik Kilwa, Tanzania. **Metode:** Penelitian cross-sectional dilakukan untuk menjebak 138 hewan pengerat menggunakan perangkap Sherman dan perangkap kawat. Ektoparasit dikeluarkan dari hewan pengerat menggunakan sikat halus dan diidentifikasi berdasarkan ciri morfologi menggunakan mikroskop stereo dengan bantuan kunci taksonomi dikotomis. Sampel darah dikumpulkan dari vena supraorbital pada hewan pengerat yang ditangkap, dan apusan tebal dan tipis dibuat, diwarnai, dan diperiksa menggunakan mikroskop majemuk untuk skrining hemoparasit. **Hasil:** Prevalensi ektoparasit pada rodensia secara keseluruhan adalah 57,87% dengan tingkat infestasi rodensia tertinggi oleh *Echinolaelaps (Laelaps) echidninus* (44,20%) dibandingkan dengan *Laelaps nuttalli* (10,87%), *Xenopsylla cheopis* (12,32%), dan *Rhipicephalus appendiculatus* (2,90%). Ektoparasit terbanyak ditemukan pada *M. natalensis* 76,40% diikuti oleh *R. rattus* 25,81%, dan *G. leucogaster* 36,36%. Tikus dewasa mencatat prevalensi ektoparasit sebesar 63,41%, lebih tinggi daripada tikus muda yang hanya 13,33% ($p < 0,05$). Prevalensi hemoparasit secara keseluruhan pada tikus adalah 18,12%. Hemoparasit yang teridentifikasi adalah *Anaplasma sp.* (13,04%), *Babesia sp.* (3,62%), dan *Trypanosoma sp.* (1,45%) yang hanya ditemukan pada tikus dewasa. **Kesimpulan:** This study revealed a high prevalence of ectoparasites (57.87%) and a moderate prevalence of hemoparasites (18.12%) among rodents in Kilwa district, Tanzania, with *Mastomys natalensis* being the most infested species.

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Kata kunci: Ektoparasit; Hemoparasit; Prevalensi; Rodensia

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INTRODUCTION

Rodents are small mammals from the order Rodentia characterized by the presence of diastema, continuous gnawing, and constant growth of their long incisor teeth (Gomes Rodrigues, *et al.,* 2017). Rodents represent the most diverse group of mammals in the world Vaughan *et al.* (2013), accounting for approximately 42% of worldwide mammalian richness (Dehghani, *et al.,* 2012; Happold and Lock, 2013). Rodent abundance along with species diversity is quite affected by the modification of natural habitats influenced by anthropogenic disturbance, and climatic change (Mayamba, *et al.,* 2020).

Rodents play an economically significant role as they are used as a source of food for humans and as prey to many predators including some species of snakes, birds, and carnivorous mammals (Garshong, *et al.,* 2013). Ecologically, rodents fulfill a crucial role in ecosystems, exerting a dynamic influence on vegetation regeneration (Garshong, *et al.,* 2013). Beyond their ecological impact, rodents serve as hosts for parasites and reservoirs of zoonotic pathogens (Dahmana, *et al.,* 2020). Rodents are recognized as hosts for the maintenance, growth, and development of various life stages in ectoparasites (Obiegala, *et al.,* 2021). Ectoparasites thrive on the external surfaces of their hosts drawing nutrients from their host tissues resulting in dermatitis (Alemu and Kemal, 2015). Most ectoparasites act as vectors for the transmission of zoonotic pathogens to humans and animals (Bakre, *et al.,* 2020). Arthropod ectoparasites form a diverse and highly adaptable group of invertebrates and its infestation to the host is influenced by factors such as host characteristics, parasite traits, and environmental factors that affect host exposure and susceptibility to parasitic infestation (Vetaas, 2021; Shilereyo, *et al.,* 2022). Additionally, land use patterns play a role in the distribution of rodents and their associated ectoparasites (Massawe, *et al.,* 2007).

Blood parasites (hemoparasite) inhabit and destroy the red blood cells leading to anemia, anorexia, jaundice, reduced weight gain, loss of production, high morbidity, and even mortality (Opara, *et al.,* 2016). Parasitic diseases have a significant impact on human and animal health worldwide, more pronounced in developing countries including Tanzania (Ellis, *et al.,* 2003). Hemoparasite infection in rodents is influenced by factors such as the abundance of arthropod vectors, climatic conditions, the season of capture, and ecological features (Matei, *et al.,* 2018; Abdullah, *et al.,* 2019).

MATERIAL and METHOD

Description of the Study Site

This study was conducted in Kilwa district southern zone of Mainland Tanzania. Kilwa is one of the six administrative districts in the Lindi region of Tanzania (Figure 1). Geographically, Kilwa is located at latitudes 9°02'22.0" S and 39°02'40.4" E. It shares borders with the Rufiji district in the coast region to the north, the Indian Ocean to the east, the Lindi district, the Nachingwea district, and Ruangwa district to the south, and the Liwale district to the west. According to the National Bureau of Statistics Tanzania 2022, the total area of Kilwa district is 14,999 square kilometers, with a total population of people of 297,676. Kilwa district experiences a tropical climate, characterized by a warm and humid rainy season extending from November to May, featuring intense rains in February and March. The mean annual rainfall ranges from 800 to 1400 mm. Coastal areas have slightly higher temperatures, with a mean annual temperature ranging from 22-30°C and humidity levels between 98-100%. The land cover and vegetation in Kilwa District are characterized by sparse population density and natural vegetation, including Miombo woodlands, scattered trees, scrubs, and dense vegetation (Lokina, *et al.,* 2020).

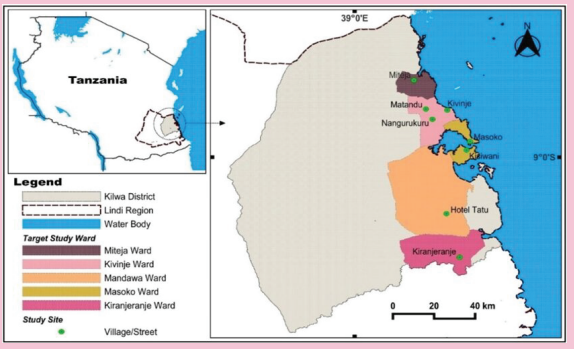

Figure 1. Map of Tanzania showing the study area. Map created in Quantum Geographic Information System (QGIS)

Study Design and Sampling Strategies

This study utilized a cross-sectional design. Purposive sampling was used to select five wards, namely Masoko, Kivinje, Miteja, Kiranjeranje and Mandawa based on the availability of rodents. Masoko, Kisiwani, Kivinje, Nangurukuru, Matandu, Hoteli tatu, Kiranjeranje, and Miteja villages were purposively selected depending on the availability of rodents. Random sampling was then conducted across various households, peridomestic areas, agricultural fields, and fallow lands.

Trapping Procedure for Rodents

Rodents were trapped inside houses, peridomestic areas, fallow land, and agriculture fields using Sherman traps (H.B. Sherman Traps Inc., Tallahassee, FL, USA) and wire cage traps (Mulungu, *et al.,* 2008). A total of 100 traps were baited with peanut butter mixed with maize flour and set at each site for three consecutive nights before shifting to another site. Traps were arranged in a line of 5 to 10 m apart as described by Mulungu, *et al.,* (2008). For indoor, ten houses for each site were selected where 2 to 3 traps were placed per house depending on the size of the house Traps were inspected daily in the early morning at 07.00. Trapped individuals were humanely anesthetized using cotton wool soaked in diethyl ether and placed in a bottle with a lid (Gebrezgiher, *et al.,* 2023). The weight, age, sex, and external body measurements including body length, tail length, and hindfoot length were recorded for each captured animal. Captured animals were identified following Happold and Lock (2013).

Collection of Ectoparasites

Each anesthetized rodent was combed with fine brushes to remove ectoparasites from the fur, ears, tail, groin, genitalia, and anus. The ectoparasites from each trapped rodent were collected in a dish separately counted and preserved in a labelled micro vial containing 70% ethanol (Morick, *et al.,* 2009). Samples were taken to the Parasitology Laboratory at Sokoine University of Agriculture for further identification processes.

Identification of Ectoparasites

Each ectoparasite was identified based on its morphology features using a Stereo microscope (OPTA-TECH) under a magnification power of 10x, with the assistance of dichotomous taxonomic keys (Mathison and Pritt, 2014). Fleas were cleared in a 10% potassium hydroxide (KOH) solution for a day as an initial cleaning process. Subsequently, they were immersed in distilled water for 20 minutes and subjected to serial dehydration in an increasing grade of ethanol (70%, 80%, 95%, and absolute) for 30 minutes in each concentration. Following dehydration, the specimens were cleared with xylene for one hour. Dibutyl phthalate polystyrene-xylene (DPX) was used to mount the flea specimen on a microscope slide and a coverslip was applied before microscopic examination (Mathison and Pritt, 2014; Campbell, *et al.,* 2018).

Collection and Preparation of Blood Smear

Immediately following the administration of anesthesia to the captured rodents blood samples were collected aseptically from supraorbital veins using capillary tubes (Katakweba, 2018). Thick and thin blood smears were prepared by placing a small drop of blood on one end of the glass slide, the spreader slide was allowed to touch the blood at an angle of 45°, and then spread gently but firmly along the surface of the horizontal slide so that the blood was dragged behind the spreader to form the film with a feathered edge. The prepared thin film was then air dried, fixed in methanol for 3 min, and stained in freshly prepared 10% Giemsa stain at pH 7.1 for about 30 min. Afterward, the stained film was rinsed in buffered water and allowed to dry (Thanee, *et al.,* 2009; Katakweba, 2018).

Laboratory Examination of Hemoparasite

Prepared blood smears were subjected to a compound microscope (OPTA-TECH) for observation with each smear examined at ×100 magnification using oil immersion to identify the presence of blood parasites and identification of hemoparasites was based on parasite morphology (Thanee, *et al.,* 2009).

Data Analysis

The collected data were entered into Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 4.2.2 was used for analysis. Descriptive statistics were performed to calculate the prevalences and frequencies of the variables.

$$\text{Prevalence (N)} = N1/N2 * 100/1$$

Where N = Percentage prevalence, N1 = Number of hosts infected, N2 = Total number of hosts examined for the ectoparasite/blood parasite. Associations between variables such as rodent species, sex, age, village, and habitats were determined by both Pearson's chi-square test and Fisher's exact tests. The differences were considered significant at p-value < 0.05.

RESULTS

Rodent Abundance

A total of 138 rodents were caught and identified, comprising *M. natalensis* 64.49% (n=89), *R. rattus* 22.46% (n=31), *G. leucogaster* 7.97% (n=11), *A. wilsoni* 2.90% (n=4), *G. dolichurus* 1.45% (n=2), and *A. chrysophilus* 0.73% (n=1) (Table 3). Most rodents were found in agricultural fields accounting for 36.23% (n=50) of all captured rodents. *Rattus rattus* was found inside houses and godowns contributing to 22.46% (n=31) of all captured mammals. *Mastomys natalensis* was found mostly in the agricultural field at 31.88% (n=44) while *G. leucogaster* was captured in the peridomestic area at 7.86% (n=11) of all captures.

Adult rodents captured were higher, 89.13% (n=123), than juvenile rodents,10.87% (n=15). The prevalence of male rodents was 57.97% (n=80), while females were 42.03% (n=58). In comparison to other villages, the highest percentage of rodents was caught in Matandu village, 22.46% (n = 31), while the lowest percentages were at Kisiwani village 5.80%; (n = 8) and Miteja village, 2.90% (n = 4).

Ectoparasites Infestation in Rodents

Rodents were infested with one or more groups of ectoparasites. Rodents identified with ectoparasites were *M. natalensis, R. rattus, and G. leucogaster,* resulting in an overall prevalence of 57.97% (n=80) of ectoparasites. Out of 138 examined rodents, 36.23% (n=50) had mites, 11.59% (n=16) had fleas, 2.90% (n=4) had ticks, 5.80% (n=8) had both mites and fleas and 2.90% (n=4) had both mites and ticks while 42.03% (n=58) did not present any ectoparasites. A total of 383 ectoparasites were collected from rodents where 93.99% (n=360) were mites from two species *L. echidninus* 80.16% (n=307) and *L. nuttalli* 13.58% (n=52) then 5.22 % (n=20) were fleas (*X. cheopis*), and tick (*R. appendiculatus*) 1.04% (n=4). On the other hand, 28.99% (n=40) of rodents had an infestation of 1 to 4 ectoparasites, 24.64 % (n=34) with 5 to 9 ectoparasites and 4.35% (n=6) with 10 or more infestation of ectoparasites.

In this study, *M. natalensis* contributed a higher prevalence of ectoparasites of 76.40% compared to other species while *A. wilsoni, G. dolichurus,* and *A. chrysophilus* had no ectoparasite (Table 1). Male rodents were 80 exhibiting a higher infestation rate of 58.75 % (n=47) compared to females 58, which had an infestation rate of 56.90% (n=33). Adult rodents were 123 with a higher prevalence of ectoparasite 63.42% (n=78) than 15 juvenile rodents with a prevalence of 13.33 % (n=2) ectoparasite. Rodents caught outdoors were 107 exhibiting a higher prevalence of ectoparasites 67.29% (n=72) than 31 rodents captured indoors with a prevalence of 25.81% (n=31). The prevalence of ectoparasites in rodents differed significantly among rodent species, habitats and villages (p< 0.01).

However, no significant differences ($p > 0.05$) were found in ectoparasite prevalence between different sexes and ages in rodents.

Hemoparasites Prevalence in Rodents

A total of 138 blood smears from rodents were screened for hemoparasites, the identified hemoparasites from screened rodents were *Anaplasma sp.* 13.04% (n=18), *Babesia sp.* 2.90% (n=5), and *Trypanosoma sp.* 1.45% (n=2), with the overall prevalence of 18.12% (Table 2). Rodents caught indoors *(R. rattus)* had a higher prevalence of hemoparasites, 19.35% (6/31), more than other rodent species caught outdoor, 17.75% (19/107). Male rodents showed a higher prevalence of hemoparasites at 20.0% (16/80) compared to females at 15.52% (9/58) although this difference was not statistically significant $p>0.05$. Hemoparasites were only found in adult rodent species. The study observed no significant differences ($p> 0.05$) in hemoparasite prevalence between rodent species, sexes, ages, habitats and villages in rodents.

DISCUSSION

Rodents have been shown to serve as reservoir hosts for various disease parasites and pathogens. In our study, six different species of rodents including *M. natalensis, R. rattus, G. leucogaster, A. wilsoni, G. dolichurus,* and *A. chrysophilus* were captured. The *M. natalensis* was the most abundant rodent species accounting for 64.49% of captures and was found in peridomestic, fallow land and agricultural fields. The high relative abundance of *M. natalensis* is likely due to their generalist ability to adapt to different habitats with different food crops ranging from the crop field to surrounding home fields (Mwamengele, *et al.,* 2024). These findings align with previous reports that M. natalensis was the most abundant rodent pest species and the most common species captured in fallow land and rice farms (Mulungu, *et al.,* 2013).

The *R. rattus* rodent species were captured inside houses due to their behavior of thriving in close association with human homes providing shelter and abundant food sources. The finding of our study is in alignment with Katakweba (2018) and Sabuni, *et al.,* (2018), who reported that *R. rattus* lives commensally with humans and is widely dispersed throughout homes.

The 57.97% prevalence of ectoparasite in rodents for this study suggests that, of all captured animals at least half of the population is infected with ectoparasite that could play a role in the transmission of vector-borne pathogens including Bartonella species, Rickettsia species and other pathogens harbored by ectoparasites. The prevalence of this study is higher than the prevalence of ectoparasite of 56.4% reported by Deng, *et al.,* (2024) in the Ilemela district and Mawanda, *et al.,* (2020), who reported an overall prevalence of ectoparasite of 35.3% in Uganda. The prevalence of ectoparasites in this present study was also low in comparison with the study of Wale, *et al.,* (2023), who reported a prevalence of 73.4% in Ethiopia. These differences in prevalence could be attributed by host species, habitat type, methods used, environmental conditions, season of study, and anthropogenic influences like agriculture. Rodent species influence the abundance and prevalence of ectoparasites (Lareschi and Krasnov, 2010; Obiegala, *et al.,* 2021). A study observed *M. Natalensis, R. Rattus,* and *G. leucogaster* infested by ectoparasite. These species have also been reported in other studies in Tanzania as hosts of ectoparasites (Deng, *et al.,* 2024; Mhamphi, *et al.,* 2024). Field rodent species *M. natalensis* had a higher prevalence (76.40%) of ectoparasite than other species, which may be due to their general tendency to adopt a wide variety of environments. This correlates with Deng, *et al.,*(2024), who reported a 67.7% higher prevalence of ectoparasites in *M. natalensis* than in other species caught.

The prevalence of ectoparasites in male rodents was higher than in females but was not statistically significant. This means that both sexes of rodents may play an equal role in the transmission of vector-borne pathogens such as *Yersinia pestis, Trypanosoma sp., Bacillus sp.,* and *Leptospira sp.* through ectoparasites like fleas, mites, and ticks (Katakweba, *et al.,* 2012; Deng, *et al.,* 2024). This is inconsistent with the study of Matthee, *et al.,* (2010) and Shilereyo, *et al.,* (2022) which reported a significantly higher prevalence of ectoparasites in male small mammals due to their large bodies and moving larger distances for searching food than in females.

Adult rodents recorded 63.41% of ectoparasites' prevalence, higher than juveniles 13.33% ($p< 0.05$). The greater susceptibility of adults to infestation may be attributed to their large body size and behavioral patterns, such as scavenging large home distances for the search of different foods and reproduction purposes (Matthee, *et al.,* 2010; Shilereyo, *et al.,* 2022). Additionally, early infestation of juvenile rodents triggers the production of reactive oxygen species (ROS) through mitochondrial dysfunction creating a hostile environment and enhancing parasite elimination, while adult rodents depend on granulocyte activity to kill parasites, a mechanism that is effective in both juvenile and adult rodents (Lun, *et al.,* 2024)

The most common ectoparasite species in all of the villages that were studied were *E. echidninus* 80.16%. This could be attributed to the fact that *E. echidninus* can survive in different weather conditions which provides a better association with rodents. The study results align with Baak-Baak, *et al.,* (2016), who reported a high prevalence of *E. echidninus* at 79.4% (27/34) in rodents in Mexico and Thanee, *et al.,* (2009), who reported a prevalence of 62% of *E. echidninus* in Thailand. Also, Deng, *et al.,* (2024) reported a higher prevalence of *E. echidninus* (39.6%) in rodents in Mwanza.

The study showed a low prevalence of fleas which may be due to their legs being well-developed and fitted for jumping thus reducing the probability of their collection. The presence of an efficient and durable resilin elastomeric protein located in the hind leg of fleas enhances jump ability, enabling rapid movement between hosts and effective escape from predators (Sutton and Burrows, 2011).This is in agreement with Dada

(2016), who also reported a low prevalence of fleas, 7.4%, which was attributed to the flying ability of fleas to escape from their host. Our results show that Nangurukuru village was the highest-infested village with ectoparasites compared to other villages. This could possibly be due to the agricultural activity and vegetation structure of the area that create an ideal environment for ectoparasites to thrive on the host. According to Hamidi, *et al.,* (2015), agricultural landscapes contribute to higher parasite burdens and prevalence in rodent populations. Fallow land and agricultural fields influence abundant rodent populations and increase their vulnerability to ectoparasite infestation (Deng, *et al.,* 2024).

Rodents caught outdoors (peridomestic, fallow land and agriculture field) had a higher prevalence of ectoparasites than rodents caught indoors. This could be attributed by the fact that outdoor environments have a large home range and host a more diverse range of rodent species that leads to greater contact among individual rodents, facilitating the sharing of ectoparasites in comparison to indoor rodents that may experience more controlled climates that are less conducive to ectoparasite proliferation (Shilereyo, *et al.,* 2022; Gebrezgiher, *et al.,* 2023). These findings are in agreement with the study of Deng, *et al.,* (2024), who found a higher prevalence of ectoparasites in rodents captured outdoors than indoors.

The overall prevalence of hemoparasites harbored by captured rodents was 18.12% with *Anaplasma sp.* at 13.04% (n=18), *Babesia sp.* at 3.62% (n=5), and *Trypanosoma sp.* 1.45 (n=2). The previous study by Katakweba (2018) found a 22.9% prevalence of hemoparasites in Morogoro. Another study conducted on small mammals in the Ilemela district reported a 35.5% prevalence of hemoparasites in small mammals (Deng, *et al.,* 2024). A study done in Nigeria on domestic rats reported a 16% prevalence of hemoparasites (Dada, 2016). According to Islam, *et al.,* (2020), the prevalence of blood parasites was 13% in rodents and shrews of Bangladesh. The variation in the prevalence of hemoparasites in rodents between different places could be affected by different geographical conditions, distribution of vectors, and host defense.

The prevalence of hemoparasites in male rodents was 20.0%, while in females it was 15.52% but was not statistically significant. This means that all species have an equal chance of exposure to hemoparasite infection. These findings are in agreement with Wanyonyi, *et al.,*(2013), who reported no sex bias in the prevalence of hemoparasites in rodents. The adult rodents had a higher prevalence of hemoparasites, 20.3% (25/121), than juvenile rodents who had no hemoparasites but was not statistically significant. This means that rodents of all ages have an equal chance of being infected by hemoparasites. This is inconsistent with the study of Wanyonyi, *et al.,* (2013), who reported higher parasitism of hemoparasites in adult Mastomys species than in juvenile Mastomys species in Kenya. Islam, *et al.,* (2020), reported that older small mammals get more exposure to infection than juvenile small mammals.

Anaplasma species was the most prevalent hemoparasite in captured rodents than other hemoparasite species. The higher prevalence of Anaplasma species could be attributed by the ecology of areas that favor Ixodes tick such as *Rhipicephalus appendiculatus* responsible for the transmission of Anaplasma species. The study is consistent with Thanee, *et al.,* (2009) who reported that the Anaplasma species was the most frequently observed hemoparasite (42.29%) in rodents captured in Thailand. The prevalence of Trypanosoma species in *R. rattus* in this study was relatively low 1.45% and this is inconsistent with the study of Katakweba, *et al.,* (2012), who reported a 45.2% prevalence of Trypanosoma species in *R. rattus.* Another study by Mulungu, *et al.,* (2013), also reported the prevalence of 17.6% of Trypanosoma species in *R. rattus*. This difference in prevalence could be attributed by environmental conditions and the distribution of vectors in the study area. *Rattus rattus* was the only rodent species captured indoors and had a higher prevalence of hemoparasites than other rodent species captured outdoors; this could be due to their behavior of living in closer proximity to humans and domestic animals, which increases the potential for zoonotic transmission of hemoparasites diseases including Babesiosis, Anaplasmosis and Hepatozoonosis to domestic animals (Katakweba, 2018; Issae, *et al.,* 2023). Additionally, rodents are known to transmit zoonotic diseases including leptospirosis, Bartonellosis, hantavirus, plague, and salmonellosis, which can be transmitted to humans through direct contact, contaminated food, or ectoparasite vectors (Dahmana et al., 2020; Issae et al., 2023). This is in line with the study of Katakweba et al. (2012) who reported higher infection by hemoparasites to rodents captured inside houses than outside houses.

Babesia species, Anaplasma species, and Trypanosoma species have been reported by many studies to be transmitted to livestock and wild animals by ticks such as *Rhipicephalus appendiculatus, Amblyomma variegatum,* and *Hyalomma marginatum* (Paoletta, *et al.,* 2018). Kamani, *et al.,* (2010) and Abdullah, *et al.,* (2019), reported the detection of Anaplasma species, Babesia species, Theileria species, and Trypanosoma species among cattle and sheep. Rar, *et al.,* (2016) and Król, *et al.,* (2022) reported the presence of Ixodes species of ticks in small mammals as a vector for the transmission of Borreliosis and Babesiosis in domestic and wild animals. A study by Kassian *et al.,* (2017) reported a prevalence of 9.3% of African Animal Trypanosomiasis (AAT) from cattle in Kilwa district. The presence of the Trypanosoma species opens a discussion for the rodent to be involved in transmitting African Trypanosomiasis to humans and animals. Katakweba (2018) reported that the spreading of Trypanosoma species from rodents to humans is inevitable, and people may suffer from sleeping sickness and die as a consequence of these diseases transmitted by tsetse flies from rodents.

CONCLUSION

Our study establishes baseline data on the prevalence of ectoparasites and hemoparasites from rodents in the Kilwa district. Species such as *M. natalensis, R. rattus,* and *G. leuco-*

gaster harbor hemoparasites of public health concern, including Anaplasma, Babesia, and Trypanosoma species with ectoparasites like *E. echidninus, L. nuttalli, X. cheopis,* and *R. appendiculatus* acting as the vector that facilitates transmission of pathogens and parasites to animals and humans. We recommend integrated pest management to protect human and animal health. Further research using advanced diagnostic tools, such as PCR, is suggested to enhance the sensitivity and specificity of hemoparasite detection.

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CONFLICT of INTEREST

The authors declare that they have no conflict of interest regarding the research, authorship, and publication of this article.

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ETHICAL APPROVAL

This study was conducted following ethical standards and received approval by the Ethics Committee of the Department of Research and Publication at Sokoine University of Agriculture, Morogoro, Tanzania with the reference number DPRTC/R/186/26.

AUTHORS' CONTRIBUTIONS

PNW was involved in the conception, data collection, analysis and interpretation, and drafting of the manuscript. MJM and CS provided supervision for both field and laboratory activities, and they played a key role in critically reviewing, editing, and revising the manuscript. All authors have reviewed and approved the final version of the manuscript.

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