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Research Article

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Habitat fragmentation and occurrence of intestinal parasites among the Praomysdelectorum sub-populations in Taita and Kyulu hills, Kenya

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Abstract

Rodents, like other wild animals, are subject to a wide variety of parasitic infestation. Although wild animals are usually infected with several species of parasites, they seldom suffer massive deaths or epizootic. This is due to the normal dispersal and territorialism of most species. Despite the fact that most wild animals tolerate their parasite burdens fairly well, the animals will succumb when crowded and suffering from malnutrition. This study investigated the occurrence and the variety of intestinal parasites among the different sub-populations of *Praomys delectorum* in Taita and Kyulu Hills. Microscopic studies were conducted on the digesta of the animals. Threedifferent species of intestinal parasites were identified i.e. *Hymenolepis* sp, *Trichostronglus* sp and *Trichuris* sp. All the animal groups were found to have the ova and the adult *Hymenolepis* sp and only the Kyulu group had *Trichuris* species ova. The percentage infection varied between 25% and 63.16% across all the sub-populations. The Kyulu sub-population with the leastanthropogenic disturbance or a more stable ecosystem had the highest prevalence of parasites (63.16%). Of the Taita Hills sub-populations, Ngangao, with the least anthropogenic disturbance and lowest population of Praomysdelectorum, had the lowest prevalence of intestinal parasites at 25%. Density of rodent population, habitat type and degree of anthropogenic disturbance are factors that determine the occurrence and prevalence of intestinal parasites in the animal species under study.
Keywords: Rodents, Intestinal parasites, Anthropogenic disturbance, Sub-populations, Praomys delectorum

1. Introduction

Small mammals are integral components of the ecosystem and vectors of human diseases. They can also turn out to be pests especially when humans encroach into their natural habitat; yet there is an enormous deficiency of information on rodents inhabiting Kenyan forests. None of the surveys concerned with montane environment in East Africa has concentrated upon small mammals' microhabitat requirements or investigated the impact of habitat modification by humans upon small mammals (Cameron et al., 1996). Small mammals, especially rodents, are opportunistic feeders capable of changing their feeding habits depending on availability of food. This is an evolutionary adaptation to regulate their density during post-disturbances and to restrict competition with others (Bekele and Leirs 1997). Due to their sensitivity to change in the environment such as ground cover and food resource base, rodents are potentially useful indicators to changes in the local environmental conditions such as habitat modifications caused by man. Many species of rodents in Africa's forests are important consumers of seeds, seedling and insects (Lwanga 1994). The potential impact of rodents on the survivorship of seed and seedling population of trees is very great and is thought to play a major role on forest dynamics and regeneration (Kasenene 1980; Kasenene 1984; Lwanga 1994). If the conservation of our planet's biodiversity was to be effectively conserved in general and in particular tropical rain forests, then a far greater effort and commitment must be made toward establishing many large wilderness areas that are given protection. The greater density of rodents due to logging can persist for decades and perhaps longer. The rodents in turn are likely to have a major negative impact on seed and seedling survival which will contribute to suppression of forest regeneration. Mastomys, one of the commonest and most widely spread rodents in Africa is known to flourish on land that has been recently burnt or cultivated (Mugatha 2002). Mastomys is a common agricultural pest, an important vector of diseases such as plague and lassa-fever. Extensive surveys have shown that it is commonly found in association with human populations. Praomysjacksoni was found in highest densities in presently grazed areas and in certain microhabitats of Mount Elgon, (Cameron et al., 1996). Studies on ecosystem management practices and human plague problem in Tanzania associated forest degradation with the wild rodent habitat degradation. This has resulted in creating the centripetal movement of the wild rodents to human settlements and their surroundings.

Rodents harbour many intestinal parasites; some of which also infect other animals including man. Some of these parasites include *Trichurismuri, Hymenolepis* sp (Tapeworm), *Trichostrongylus* sp and *Nippostronglus* sp, *Angiostronglus cantonensis, Strongyloides* sp and *Trichnella* sp (Schmidt and Roberts 2000). Trichurismuris is a nematode parasite that is related to the human whipworm *Trichuristrichiura.* Some 60 – 70 species of *Trichuris* have been described from a wide variety of mammals. The parasite is normally found in the large intestines and rectum of various mammals. *Trichurismuris* occur often in rats and mice (Cheng 1986). According to the American Liver Society, the genus *Hymenolepis* contains in excess of 400 species virtually all of which are found in higher vertebrates. Two species of *Hymenolepis* are of particular interest. *Hymenolepis nana* which is a parasite of humans and rodents in particular, mice and *Hymenolepis diminutaa* parasite of rodents but has also been reported in humans on rare occasions. *Hymenolepis nana* can complete its life-cycle in the absence of an intermediate host. It presents a modification of the typical cyclophyllidean life-cycle pattern in that the parasite requires only one host in which to complete its development. The beetle *Tribolium confusium* and *Tene briomolitos* are their common intermediate hosts (William and Landfair 2004). Hookworm belongs to the order *Strongylida* which is a very large order that contains important pathogens of man and domesticated animals. The order contains the super family *Trichostrongyloidea* that comprises intestinal nematodes, which are parasites to many domesticated animals and wild rodents. Trichostrongylussp has been found in the small intestines of ruminants, rodents, pigs, horses, birds and humans. *Trichostrongy lusaxei,* is found in a wide variety of mammals. The eggs resemble those of hookworms but are usually larger (Schmidt and Roberts 2000; Cheng 1986). *Nippostronglus brasiliensis* is a nematode parasite found in the gastrointestinal tract of rats with similar life cycle and morphology to the human hookworm. Transmission does not require an intermediate host. Infection of rats is generally accomplished by skin penetration by the infective filariform larvae (Cheng 1986). *Angiostronglus cantonensis* is a nematode parasite that was initially thought to be a parasite of rodents. However it was later found in the humans in many countries. *Strongyloides* are among the smallest nematode parasites of humans. *S. ratti* is parasite in rodents. Domestic trichinosis involves *Trichinella spirallis* in the strict sense. It is epidemiologically most important to humans because of the close relationship among rats, pigs and people. Infected pork is the most common source of infection. Pigs become infected by eating trichinous meat in garbage or by eating rats (Schmidt and Roberts, 2000). In the life-cycle of *Trichinella spiralis* the animal serves as both the definitive and the intermediate host with larvae and adults occurring in different organs (Cheng 1986).

2. Materials and methods

2.1. Study area

Taita Hills and the Kyulu Ranges are among the rain forests of the montane habitat in South East Kenya (Fig 1). The Taita Hills, like other montane rain forests, have been subjected to heavy human activities leading to fragmentations into different forest patches. These hills rise abruptly from the Tsavo Plains to a series of ranges. Dry bush-land runs up into the lower slopes of the hills, grading into moist forest, farmlands or plantations. The forests of Taita Hills are experiencing different levels of habitat alterations with the indigenous trees being selectively harvested or cleared to give way to plantations and other forms of land use. The Taita Hills are divided into three distinct isolates: Mount Sagala, Mbololo and Dawida Massif. The main bodies of the hills known as Dawida Massif is made up of eight forest patches, among them are: Ngangao, Chawia, Yale and Macha forest patches (Oguge et al., 2004).

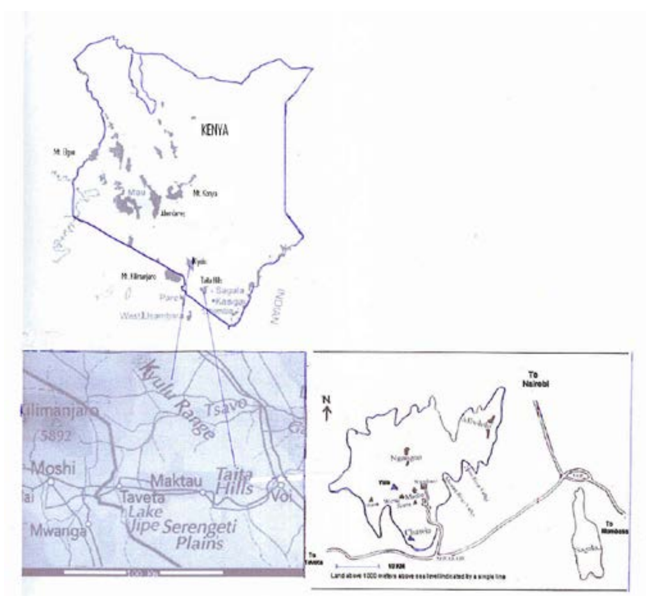

Fig 1. Map of Kenya showing the position of Kyulu and Taita Hills.

Ngangao is one of the two larger patches with the least anthropogenic disturbance but with the lowest P. delectorum population density of an average of 20 animals per hectare (Oguge, Pers. comm). Yale and Macha are smaller forest patches with an average density of about 30 animals per hectare and Chawia with an average density of 50 animals per hectare (Oguge, Pers. comm). The Kyulu Ranges are recent volcanoes of perhaps over 1000 years old (Bally, 1939). The high ranges of velvety green cones rising to an altitude of 2170 m creates a verdant mountainous contrast to the surrounding arid African Savanna (Beentje, 1990). The ranges run 64 Km in length and 16 km in width and are geographically equidistance from Mt. Kilimanjaro to the (South-east) Taita Hills (East) and highlands of Machakos (North-west) (Ogugeet al., 2004). The forest vegetation here is presumed to be pioneer (Beentje 1990); standing at 1450-1750m above sea level. The southern portion is composed of mist forests (Beentje, 1990) while the northeast has a much drier vegetation type. The Kyulu Forest population assumed to be from an area that is ecologically stable was compared with sub-populations from Taita Hills. The forest patches of the Taita Hills are found between 030 20'S and 300 15 `E. These forests patches are: Yale (2100 m: 030`380280'E), Chawia (1600 m; 03028`S, 38020`E) and Ngangao (2150 m; 03022`S,38020`E) (Oguge et al., 2004). The animals from Kyulu Forest were collected in the mist forest at 2047.1`S 37052.14`E at an altitude of 1700 m (Oguge et al., 2004).

2.2. Collection and preservation of animals

The animals were collected from the study areas using standard small Sherman's mammal live traps (foldable aluminium trap of 5.5x 7x 18 cm) by line transect. Upon capture, the animals were weighed (using Pesola balance in grams) and the live weight recorded. Euthansia was performed on the animals and the head plus body (HB) length measured and reproductive status (RS) noted. The HB was taken as the distance between the tip of the snout and mid anus. The animals were then fixed in formal saline buffered with Borax salt for 72 hours. They were then washed in water and preserved in 70% ethanol before being transported to the laboratory at Kenyatta University.

2.3. Microscopic examination

Portions of the digesta from the stomach, small intestine, caecum and large intestine from each animal were put in small Bijour bottles. The contents were mixed with 10% formal saline at a ratio of 1:10 (digesta content to formal saline). The digesta was then concentrated by centrifugation at 5000 revolutions per minute for 3 minutes. The supernatant was discarded. Two drops of the sediment were transferred to a slide and stained with Lugol's iodine and observed under low (X100) and medium power (X 250) using an optical microscope for ova and larvae. Any parasites seen during the extraction of the digesta were recorded for presence.

3. Results

All the animal groups were found to have the ova and adult *Hymenolepis* sp. and *Trichurismurisov*a were only observed in the digesta of the Kyulu animals while *Trichostonglus* sp (Hookworm) larvae and eggs were identified in all the animals from the four forest patches. Two animals from Chawia had *Trichostrongylu* ssp (rodent hookworms) larvae as well as ova. Although not included in the table, an Ascaroide-like nematode was observed in the stomach of one animal in the Ngangao sample. Some animals had multiple infestations. In Kyulu one animal had both hookworm and *Hymenolepis* sp and four had *Trichuris* sp and *Hymenolepis* sp. One animal from Yale and two from Chawia had both hookworm and *Hymenolepis* sp ova. The animals with multiple infestations were considered for each type of parasite (Table 1).

4. Discussion

Animals from Kyulu were found to harbour all the three species of intestinal parasite i.e. Hymenolepis, Trichostronglussp and Trichuris sp. No Trichurismuris eggs were found in the

Taita Hills sub-population.Kyulu population with the highest prevalence of parasites (63.16%) is considered to be from a more stable ecosystem while Ngangao with the least anthropogenic disturbance had the lowest prevalence (25%) but with the lowest population density per hectare of Praomysdelectorum. Chawia and Yale sub-populations had 50% and 45% percentage infection respectively and are from the more disturbed habitats. Yale and Chawia with more anthropogenic disturbance had more animals with intestinal parasites compared to Ngangao. This could be attributed to interaction of the rodent with domestic animals and domestic waste. Virtually all the *Hymenolepis* sp are found in higher vertebrates.

Table 1. Occurrence of intestinal parasites andpercentage infection (prevalence) of *P. delectorum* in different forest patches.

Forest	*N*	*Hymenolepis* ova/adults	*Trichostronglus sp* (Hookworm)	Trichuris sp (ova)	Total No.of animals infected	% Infection (Prevalence)
Kyulu	19	5	1	6	12	63.16
Ngangao	16	1	3	-	4	25.00
Yale	18	4	4	-	8	45.83
Chawia	20	5	5	-	10	50.00

Two species of *Hymenolepis* sp, *H. nana* and *H. diminuta* are parasitic to both rodents and humans. The other parasites *Trichurismuris* and *Trichostronglus* sp are related to some intestinal parasites in man but are not known to be zoonotic. The Kyulu population surrounded by savannah grassland may have a wider range of movement. This could make them to interact with more wild animals some of which they have common intestinal parasite. The sub-populations of Taita Hills with more prevalence of intestinal parasites could be expected to be affected negatively in their population growth. However it is known that wild animals tolerate their parasite burdens fairly well although the animals eventually succumb when crowded and suffering from malnutrition. If the parasites were a contributory factor in the population variations, then we could expect Ngangao population to harbour more parasites than Chawia and Yale as it had the lowest population density per hectare. The findings from this study revealed that no Trichurismuris ova were found in the Taita Hills sub-populations. This could only suggest that either the Taita Hills sub-populations were not infected or are a resistant strain to Trichurismuris. Earlier research work on mice revealed that there is a strain of mice that, upon infection with the caecum nematode *Trichurismuris*, launch an immune response and in doing so expels the parasite before potency. There are other mouse strains which do not develop the protective response resulting in chronic infection and the presence of adult worms (Garside et al., 2000).

4. Conclusion

The prevalence of the parasites increased with increase in anthropogenic disturbance among the Taita Hills sub-populations. The Taita Hills sub-populations were either not infected by the Trichurismuris or are resistant to Trichurismuris as no ova were found in their digesta.

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Conflict of interest statement

We declare that we have no conflict of interest.

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