



## Research Article

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# Prevalence of Rodents and Their Ectoparasitic Fleas in Erstwhile Plague Endemic Nilgiri Hills and Downhill Areas of Tamil Nadu State

## Abstract

A study has been carried out in the Nilgiri hills and downhill areas of erstwhile plague-endemic localities to determine the prevalence, density of rodents and rat fleas, their significance in plague surveillance and control activities undertaken in this region. Four species of rodents, viz., *Rattus rattus*, *Bandicota bengaliensis*, *Bandicota indica* and *Mus musculus* and one species of insectivore *Suncus murianus* were trapped in the study. Flea species recorded were given in the order of abundance *Xenopsylla cheopis*, *Styvalius ahale*, *Nosophylla nilgiriensis* and *Xenopsylla astia*. The absolute and specific flea index of *X. cheopis* the study computed for hilly and downhill villages were 0.39 and 0.20 respectively. When the prevalence of rodents and fleas was compared between the hilly and downhill areas of the study area, the trap-positive index, prevalence of rodents and fleas, absolute flea index and specific flea indices of *X. cheopis* were significantly higher in hilly areas than in downhill areas. The implication of the findings of the study on the plague surveillance and control activities undertaken in the erstwhile plague-endemic Nilgiris district of Tamil Nadu state was discussed.

**Keywords:** Nilgiri hills, Erstwhile plague endemic, Hilly and downhill area rodents, Ectoparasitic fleas, Prevalence.

## Introduction

In India, the endemic foci for plague exists in many states of the country and from time to time outbreaks occur due to interplay of various factors responsible for the transmission of this disease. The anti-plague activities are being carried out by the concerned state health authorities in the erstwhile endemic areas, and the National Centre for Disease Control (NCDC) is coordinating the above activities by carrying out laboratory surveillance and routine reporting. The Nilgiri hills area situated in the Nilgiris district of Tamil Nadu state was endemic for plague and has had reported cases and deaths in the past.<sup>1</sup> The regular plague surveillance activities are being carried out by the state department of public health and preventive medicine and coordinated by the NCDC branch, Coonoor (TN). A study on the prevalence of rodents and rat fleas has been undertaken in the Nilgiri hills and downhill areas of Tamil Nadu during the year 2005 and the results are presented.

## Materials and Methods

### Study Area

The Nilgiris hills are situated in the northwestern part of Tamil Nadu state bordering Kerala and Karnataka states of the peninsular India (Latitude of 11°10' N and Longitude of 76° and 5'). A total of 17 villages situated in the talukas of Coonoor, Manjoor and Kotagiri of Nilgiris district, the hilly areas located in the altitude ranges from 1400 to 2000 meters above mean sea level (MSL), were selected. Similarly in the downhill area

of 9 villages from Mettupalayam taluka of Coimbatore district in the altitude range of 200 to 400 meters above MSL were also selected for the study. The average daily temperature of the higher altitude of Nilgiris ranges between 5°C or below during November to March and a maximum of 28°C during May/June. The study area is abundant in water resources with numerous rivers and canals. The higher altitude areas of Nilgiris district have temperate or equitable climate with abundant vegetation. A large number of tea, coffee gardens and vegetable fields are present in these areas. In the Nilgiris, the peculiar configuration of land, prevailing climatic conditions, abundance of a variety of wild rodents and fleas attribute to its endemicity for plague.

**Rodent and Flea Surveillance**

The rodents were trapped by using wonder traps from the domestic environment of the study area and transported to the plague laboratory and identified. Rodent Ectoparasitic survey was carried out by collection of rat fleas infested on the rodents by combing method and identified. The absolute and specific flea indices were calculated as per the standard methods.<sup>2,3</sup> Statistical tests were carried out by using

Chi-square test to find the variation in trap positivity, rodent and flea prevalence between hilly and plain areas surveyed.

**Results and Discussion**

The particulars of rodents trapped and their species' prevalence in the study area, comprising of hilly area and downhill area are given in Table 1. A total of 2561 wonder traps were laid during the above study and the trap-positive rate was 8.87% and among the hilly areas the trap-positive rate of rodents (10.8) were significantly higher (P > 0.01) than that of downhill areas (5.28) surveyed (Fig. 1). Trap positivity is the parameter showing the relative density of rodents in the area studied. A total of 414 rodents were trapped in the study area comprising of *Rattus rattus* (327), *Bandicota bengaliensis* (77), *Bandicota indica* (3), *Mus musculus* (7), and the insectivore *Suncus murianes* (1). Among the various rodent species trapped *R. rattus* is more abundant followed by *B. bengaliensis* in both hilly and downhill areas. In hilly areas *B. indica* were not recorded whereas in downhills *M. musculus* and the insectivore *S. murianes* was not trapped (Fig. 2).

**Table 1. Particulars of Rodents Trapped and Its Species Prevalence in Hilly and Downhill Areas**

Terrain	No. of Villages Surveyed	No. of Traps Laid	No. of Positive for Trap	Trap Positivity Rate	Rodents Species Collected					
					Rr	Mm	Bb	Bi	Sm*	Total
Nilgiris district hilly area	19	1823	197	10.8	250	7	70	-	1	328
Coimbatore district downhill area	7	738	39	5.28	77	-	7	3	-	87
Total	26	2561	236	8.87	327	7	77	3	1	415

Rr-*Rattus rattus*, Bb-*Bandicota bengaliensis*, Bi-*Bandicota indica*, Mm-*Mus musculus* insectivore, Sm-*Suncus murianes* (insectivore).

When the study results were compared between the hilly areas and adjoining downhill areas, both trap-positive rate and the rodent density were significantly higher in the former than in the latter. Higher rodent population density in hilly areas may be attributed to the abundance of rodent food and other favorable climatic factors conducive for their population growth. Bacteriological and serological examination of the rodent specimens collected were conducted in the laboratory showing none of the specimens collected was positive for plague activity. From the rodents trapped in the study, a total of 161 ectoparasitic fleas

were collected, identified and given in the order of abundance, viz., *X. cheopis* (83), *S. ahale* (50), *N. nilgiriensis* (25) and *X. astia* (3). The absolute flea index and specific flea index of *X. cheopis* computed for the study area were 0.39 and 0.20 respectively. The absolute and specific flea indexes of *X. cheopis* were showing higher values in hilly areas than in downhill areas surveyed. However, the above parameters were below the critical levels for the transmission of human plague. Among the various flea species recorded in the study, *X. cheopis* is more prevalent followed by *S. ahale* and the particulars are given in Table 2.

Table 2. Particulars of Flea Species Recorded from Rodents and Their Indices in Hilly and Downhill Areas

Terrain	Total No. of Rodents Collected	Flea Species Collected				Total Fleas Collected	Total Flea Index	Specific Flea Index of Xc
		Xc	Xa	Sta	Nn			
Nilgiris districts hill area	328	75	1	49	25	150	0.46	0.22
Coimbatore district downhill area	87	8	2	1	-	11	0.13	0.09
Total	415	83	3	50	25	161	0.39	0.2

X. c-*Xenopsylla cheopis*, Xa-*Xenopsylla astia*, St.a-*Styvalius ahale*, Nn-*Nosophylla nilgiriensis*

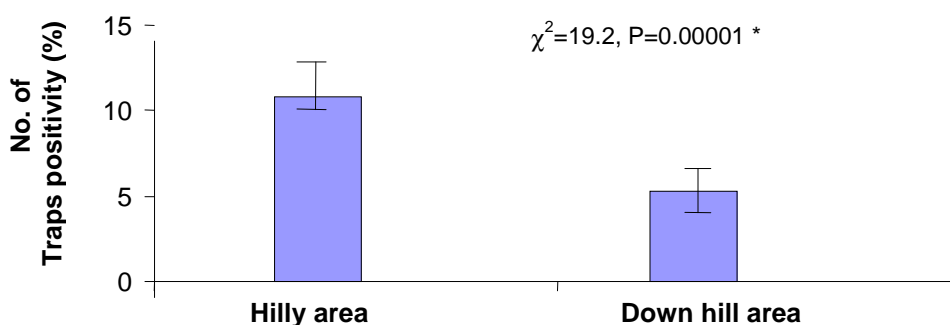


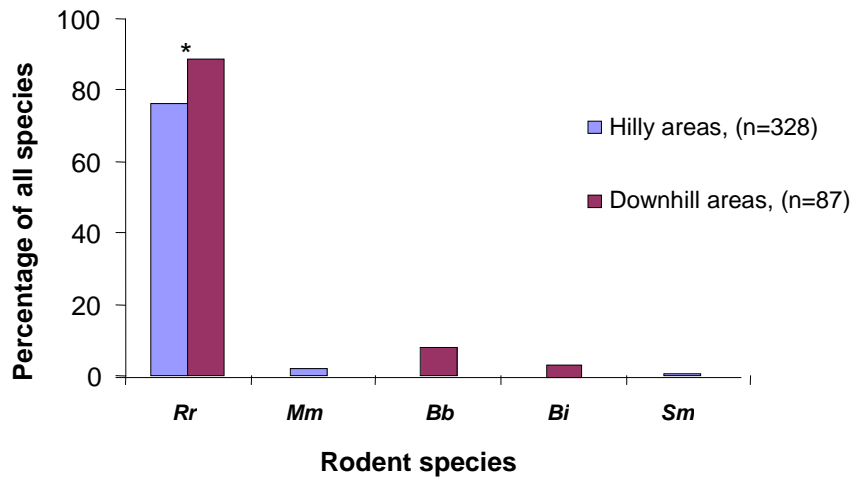
Figure 1. Rodent Trap Positive Rate in Hilly and Downhill Areas

The rodent flea infestation was maximum in hilly areas and it is significantly greater ( $P > 0.01$ ) than downhill areas (Fig. 3). This may be attributed to prevailing micro climatic conditions suitable for the survival and propagation of rodent fleas.

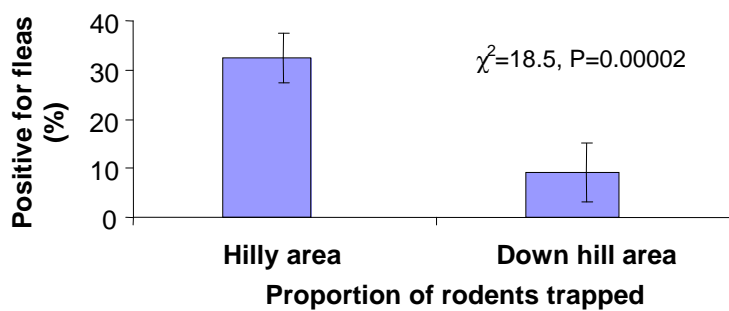
Among the various flea species recorded in the study, *X. cheopis* was the most prevalent in both hilly and downhill areas. *S. ahale* and *N. nilgiriensis* were abundant in hilly areas while in downhill areas, these were either minimum or were absent which is due to their survival in cold climate and their adaptability to higher altitude (Fig. 4). The Nilgiris district has long been recognized as a potential plague-endemic area due to the existence of complex factors of climate and a broad spectrum of rodent and flea fauna.<sup>1</sup> However, in the present study also the Nilgiris hill villages were showing higher rodent and flea density. Some of the rodent species recorded in the earlier study, viz., *M. buduga* and *G. ellioti* were not recorded; similarly flea species like *X. brasiliensis*, *C. Spp*, *P. irritans* and *L. musculi* was also not recorded. This may be attributed to changes in

ecology and climate, cropping pattern, large-scale insecticidal usage and other associated factors.

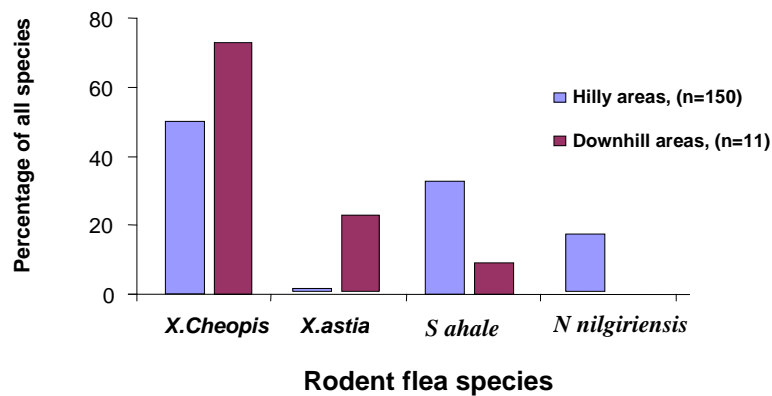
In the present study, when prevalence of flea species are compared between the hilly and downhill villages, *X. cheopis* and *X. astia* were recorded in both areas but the latter was more in the downhill villages. The *S. ahale* and *N. nilgiriensis* are the fleas recorded only in higher altitudes were not recorded in downhill areas. Mohan studied the flea fauna of Nilgiris towns and four species were recorded and all these species were also recorded in the present study.<sup>4</sup> Ghosh and Rahman studied the dynamics of the rodent and flea population in Ooty and Coonor towns of the Nilgiris district and they also recorded all the four species of rodents and five flea species including *P. irritans* which was not recorded in the present study. It was also reported that *X. cheopis* was the most prevalent flea and it was found to be highly resistant to DDT and tolerant to Dieldrin.<sup>5</sup> However Biswas et al., in a recent study on the susceptibility status of various insecticides against fleas collected from the Nilgiris, revealed that the fleas were resistant to most of the conventional insecticides.<sup>6</sup>



Rr-*Rattus rattus*, Bb-*Bandicota bengaliensis*, Bi-*Bandicota indica*, Mm- *Mus musculus* insectivore Sm-*Suncus murianes*  
**Figure 2. Percentage Prevalence of Rodent Species Trapped in Hilly and Downhill Areas**



**Figure 3. Prevalence of Rodent Ectoparasitic Fleas in Rodents in Hilly and Downhill Areas**



**Figure 4. Percentage Prevalence of Rodent Fleas in Hilly and Downhill Areas**

Studies on the prevalence of rodents and fleas have been carried out by several workers from different geographical areas of the country from time to time. Azeez has conducted a survey on synanthropic rodents and fleas in district Dhanbad, Bihar, in which three species of rodents were recorded of which *R. rattus* was the most prevalent and the fleas *X. cheopis* and *X. astia* were also recorded in large numbers.<sup>7</sup> In the aftermath of the 1994 plague outbreak in Maharashtra and Gujarat, studies have been carried out in plague-affected areas as well as in other parts of the country, viz., Beed (Maharashtra), Surat, Vadodara, and district Baruch (Gujarat) and Varanasi (UP) to ascertain the flea indices and plague-negativity in rodents collected.<sup>8,9</sup> A rapid survey has been carried out in Delhi to monitor rodent and flea population and their susceptibility; five species of rodents were recorded in which *R. rattus* was most predominant. In some of the areas surveyed, the absolute and specific flea indices were showing higher values and the fleas were resistant to DDT and Dieldrin, tolerant to Malathion and susceptible to Deltamethrin.<sup>10</sup>

The results of the previous and present study show that the Nilgiri hill villages due to peculiar configuration of land prevailing climatic conditions, abundance of a variety of rodents and fleas attribute to the area's endemicity of plague. However, the present study results show that the sylvatic plague was not recorded recently and the factors that may contribute towards its onset at any time. In order to contain the probable outbreaks of plague, Nilgiri hills, more particularly the erstwhile plague-endemic localities, need to be kept under routine surveillance.

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**Conflict of Interest:** None

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