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Surveillance of ectoparasite of dogs in the State of Tripura

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Abstract
A cross-sectional study was conducted between November 2021 to October 2022, to determine the prevalence of ectoparasites in dogs of different sex, breed and age groups in Tripura. The objectives of the study were to determine the prevalence of ectoparasites, determine associated risk factors and identify the most important ectoparasites species of dogs in four districts of Tripura. A total of 528 dogs were screened for ectoparasites and were identified using standard taxonomic keys.Of 528 dogs, 69.69% (368/528) were positive to one or more ectoparasites. *Rhipicephalus sanguineus* tick was the most prevalent species (54.92%) followed by fleas *Ctenocephalides canis* and *Ctenocephalides felis* (41.47%), lice *Trichodectis canis* (3.03%) and mites *demodex* spp. and *sarcoptes scabies var. canis* (8.90%). No significant difference ($p>0.05$) was seen in the district wise prevalence but during study period significant difference ($p<0.05$) was seen in the association based on age, sex, breed and category. Ectoparasites were found more prevalent in male dogs (75.67%) than in female(62.06%). The prevalence of ectoparasites was more in age groups of 6 month to 1 year (79.66%) and stray dogs (79.80%) compared to puppies and household dogs. It was concluded that ectoparasites, some of which may concern to public health are prevalent in the study area and affect the dogs irrespective of their age, sex, or breed.

Keywords: Prevalence, ectoparasites, dogs, Tripura

Introduction
Dogs are the most successful canids, adapted to human habitation worldwide. They have contributed to physical, social and emotional well-being of their owners, particularly children (Robertson *et al*., 2000) [22]. Various parasitic diseases have been known to affect the health of dogs. Out of these diseases, arthropod infestation is at height of occurrence. This infestation generally does not cause heavy mortality but affects the efficiency of dogs, and thus leads to considerable losses to the owner of the dog and for the animal welfare. Besides, direct host damage, some ectoparasites also act as vectors of veterinary important pathogens such as *Babesia* sp., *Bartonella* and *Rickettsia* species (Heukelbach *et al*., 2012) [10]. Ectoparasites cause life-threatening anemia and occasionally hypersensitivity disorders in young and debilitated animals (Soulsby 1982) [28]. According to Sahu *et al*. (2013) [23], *Rhipicephalus sanguineus* is the most frequent species of tick to parasitize dogs in India, followed by *Rhipicephalus haemaphysaloides*, *Rhipicephalus microplus*, *Haemaphysalis longicornis*, and *Haemaphysalis bispinosa* (Augustine *et al*., 2017) [3]. Ticks can spread bacteria, rickettsiae, viruses, and protozoa, including tick-borne encephalitis, Rocky Mountain spotted fever, Lyme disease, tularemia, Q fever, Babesiosis, Hepatozoonosis (Lema, 2020) [16]. Dogs typically have fleas of the species *Ctenocephalides canis*, *Ctenocephalides felis*, *Pulexirritans*, and *Echidnophaga gallinacea* (from poultry), which are considered to be moderately specific (Wall and Shearer, 2001) [30]. Pruritus, the major clinical signand is more common in dogs infested with mites and fleas. One cause of pruritus in dogs is pediculosis, a disease transmitted by the high infestation of lice. *Trichodectes canis*, also known as canine chewing louse which is found on domesticated dogs and wild canids throughout the world.
T. canis is a well-known vector for the dog double-pored tapeworm, *Dipylidium caninum* (Kim *et al*., 1973) [14]. One of the contagious canine skin illnesses that continues to cause issues for veterinarians and dog lovers is mange. *Demodex* and *Sarcoptes*, two mange mites that cause

scabies and demodicosis, respectively, have already been reported from dogs (Sakina and Mandial, 2011) [24].

Demodex canis, also known as demodectic mange, red mange, or follicular mange, is a common condition that affects the skin of young dogs, particularly those with short hair (Sivajothi *et al*., 2015) [27] Sarcoptic mange, often known as canine scabies, is an infestation of the burrowing mite *Sarcoptes scabiei canis*. Scabies is the human equivalent of burrowing mite infection caused by a closely related species (the "seven-year itch"). Canine scabies is of public health importance as 50% of human cases may result from handling of infected dogs (Diwakar and Diwakar, 2017) [6].

In urban and suburban areas, people traditionally raise dogs as pets. Health check-ups protect pets from infestation by ectoparasites. Thus, knowledge of types of species, density and prevalence of ectoparasites is needed to effectively control them (Scott *et al.* 2001) [25]. Scarce information is available on the ectoparasites of dogs in Tripura. So, the present work was undertaken to ascertain the actual status of ecto-parasites infesting companion dogs of Tripura State.

Materials and methods

Study area

The study was conducted in four selected districts of Tripura namely West Tripura district, Khowai district, Gomati district and Sepahijala district. The Tripura state is situated between 22˚56' and 24°32' North latitudes and 91˚09' and 92°20' East longitudes with the Tropic of Cancer passing through it. It is the third-smallest state in the country, it covers 10,491.69 km^2 (4,050.86 sq. mi) and is bordered by Bangladesh to the north, south, and west, and the Indian states of Assam and Mizoram to the east.

Study animals

Dogs of all age groups, sexes and breed in four selected districts of Tripura were considered as study animal.

Collection and Identification of Ectoparasites

A total 528 number of dogs screened for the presence of ectoparasites from November 2021 to October 2022. Ectoparasite collections on dogs were made at several district levels, including Veterinary clinics, TVCC, C.V. Sc and A.H., R.K. Nagar, individual dog owners, and private clinics and shelters in Tripura.

Ticks, Fleas and Lice collection

The dogs' entire body was combed with a stainless steel, fine-toothed flea comb to check for ectoparasite infestation. Ticks were carefully removed and collected together along with any fleas and lice in the comb. Then, until they were discovered, these ectoparasites were kept in 70% ethanol. Ectoparasites were identified using descriptions and/or keys indicated by Soulsby (1982) [28]. Before being entered into Microsoft Excel, the age, sex, breed, and category data were recorded in a table.

Fig 1: Collection of ectoparasite by using of flea comb

Skin mite collection (*Demodex* spp. And *Sarcoptes scabiei*)

During the body search, scrapings were gathered from any lesions that seemed to be mite infestations (marked by scaling, scoring, cutaneous encrustations, and hair loss). Skin scrapings were placed in 10% potassium hydroxide and gently heated to macerate scales, crusts and hair or aural material. Thereafter, the material was then centrifuged and the sediment was examined under a microscope for mites and then mites were identified using descriptions and/or keys indicated in Hendrix (1998) [9].

Ear Mites Collection (*Otodectes cynotis*)

Collection of ear mites (*Otodectes cynotis*) ware done by cotton swab method (Hadi *et al.* 2016) [7]. Black color ear wax considered an indication of ear mites. Ear wax is placed into an object glass, covered with another object glass, and examined under a 40X microscope (Hendrix, 1998) [9].

Statistical analysis

Data obtained in the study was entered in to Microsoft Excel sheet. The frequencies of ectoparasites were compared with variables and expressed in percentage and subjected to chi-square ($\chi 2$) test using SPSS statistical package version 27 (2021) [29]. A significant level (p-value) of less than 0.05 was regarded as statistically significant for all statistical analyses. The prevalence rate was determined by dividing the total number of animals evaluated by the number of positive animals.

Result

Overall prevalence of parasite infestation in dogs in the four districts of Tripura

A total of 368 dogs out of 528 dogs examined have ectoparasitic infestation like ticks, fleas, lice and mites, with a prevalence of 69.69%. It has been seen that *Rhipicephalus sanguineus* is the only one species of tick which is found at the rate of 54.92%; whereas two species of flea *viz. Ctenocephalides canis* and *Ctenocephalides felis* were found at the rate of 41.47%, while *Trichodectis canis* lice was seen only in 3.03% during the study period. This study also showed the infestation of mites like *Demodex* spp. and *Sarcoptes scabies var. canis* mites at the rate of 8.90%.

District-wise prevalence of ectoparasite infestation in dog

The present study showed that there is no significant difference in the distribution of ectoparasite of dog in various district of Tripura ($p>0.05$). Overall, the highest prevalence of ectoparasite infestation of dogs was recorded from West Tripura district (72.36%) followed by Gomati district (71.23%), Sepahijala district (70.90%) and Khowai district (63.3%).

Breed-wise prevalence of ectoparasite infestation in dog

This study showed that breed of dog has significant influence ($p<0.01$) in ectoparasitic infestation in Tripura. The order of ectoparasitic prevalence recorded in this study is presented in descending order as, Mongrel (79.6%) followed by Pug (73.8%), Labrador Retriever (73.4%), German Shepherd (73.2%), Cocker Spaniel (60%), Pitbull (60%), Dalmatian (57.1%), Spitz (52.9%), Lasa (52.6%) Pomeranian (50%), Doberman pinscher (42.8%) and Golden retriever (42.3%).

Sex-wise prevalence of ectoparasite infestation

The prevalence of ectoparasite infestation in dog is significantly ($p<0.010$) influence by the sex (gender) of dog. When sex-wise comparison was made in respect to ectoparasitic infestation, male dogs (75.67%) were found to be higher infested than female dogs (62.06%) (Table1).

Table 1: Demographic characteristics of the dog's population in the study area

Variables	No. of examined	No. of infested	Prevalence%	Chi square analysis
Sex of dogs				
Male	296	224	75.67	$\chi 2$ value 11.401 p = 0.001**
Female	232	144	62.06	
Age Group of dogs				
Puppy	179	122	68.15	$\chi 2$ value 14.616 p = 0.001**
Young	177	141	79.66	
Adult	172	105	61.04	
Categories of dogs				
Stray dogs	203	162	79.80	$\chi 2$ value 22.630 p = 0.000**
Household dogs	201	117	58.20	
Working dogs	124	89	71.77	

*p<0.05 significant at 5%, **p<0.01 significant at 1%, ^{NS} not significant

Age-wise prevalence of ectoparasite infestation:

The present study shows that age of dog has significant influenced ($p<0.01$) in the prevalence of ectoparasitic infestation. Among the different age groups, young (6 months to 1 year) were highly infested (79.66%), followed by puppy dogs (below 6 months, 68.15%) and adult dogs (above 1 year, 61.04%), respectively (Table1).

Category-wise prevalence of ectoparasite infestation

In the present study category was grouped into stray dogs, household dogs and working dogs. Each group of the category showed significant variation ($p<0.01$) in the ectoparasite infestation where stray dogs were highly infested (79.80%) followed by working dogs (71.77%) and household dogs (68.15%), respectively (Table1).

Season-wise prevalence of ectoparasite infestation

In the rainy season ectoparasite 72.9% were the most prevalent in dogs followed by summer season 72.2% and winter season 62.3%. Prevalence of ectoparasite infestation vary nonsignificantly (p value 0.062) among season wise ectoparasitic infestation (Figure 9).

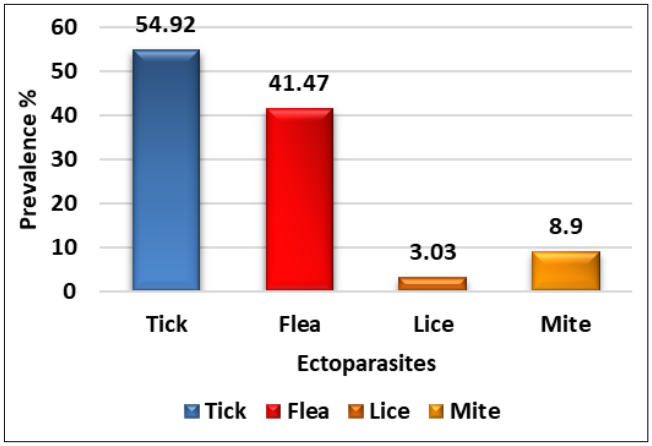

Fig 2: Ectoparasite infestation in dogs

Fig 3: *Rhipicephalus sanguineus*(X40)

Fig 4: *Trichodectes canis* (X40)

Fig 5: *Ctenocephalides canis* (X40)

Fig 6: *Ctenocephalides felis* (X40)

Fig 7: *Sarcotes scabiei* var. *canis* with egg (X40)

Fig 8: *Demodex* spp. with egg (X40)

Discussion

The present study on ectoparasites of dogs in Tripura revealed that they are the important and frequently encountered dermatologic problems. This was evidenced by the outcome of this study which shows us an 69.69% of dogs harboring one or more types of ectoparasite species. However, there was no systematic available data on work done on ectoparasites of dogs, Therefore, we believe that this study was the first in its kind carried in Tripura.The overall prevalence of ectoparasite infestation was higher compared to21.34% by Khurana *et al.* (2016) [13] from Hisar, 49.1% by Ananda and Adeppa, (2017) [2] from Shimoga (Karnataka), 19.28% reported by Katariya *et al*. (2018) [12] from tarai region of Uttarakhand and 27.26% by Kumar and Shekhar, (2020) [15] from Jharkhand. On contrary, Raut *et al.* (2006) [21] reported relatively high incidence of 81.36% from the eastern zone of Maharashtra, Xhaxhiu *et al.* (2009) [31] in Albania and Dantas-Torres *et al.* (2009) [5] in Brazil with prevalence of 79 and 70.4%, respectively. The discrepancy between findings (present study and previous findings) can be attributed to the sample size, geographical area, temperature and humid climate prevailing in the study area of Tripura state.

During the study period the prevalence of tick was recorded 54.92%, followed by flea was recorded 41.47%, lice was recorded 3.03% and mite was recorded 8.90%. These finding was almost similar with Raut *et al.* (2006) [21], Jamshidi *et al.* (2012) [11], Nasution *et al.* (2018) [19], Abdulkareem *et al.* (2019) [1], Nataraj *et al*. (2021) [20], who recorded tick species having higher prevalence than the other ectoparasites. On contrary, Singh *et al.* (2011) [26] reported high incidence of *demodex canis* and *Sarcoptes scabiei* var *canis* of 19.40 and 8.96% respectively in dogs and Ananda and Adeppa, (2017) [2] reported high prevalence of fleas 37.28%, followed by (30.5%) ticks, (15.2%) lice, (11.8%) sarcoptic mange and 3 (5.0%) demodectic mange conditions. This difference in the distribution of the ticks might be due to change in geographicalregions as well as differentenvironmental conditions.

District-wise prevalence of ectoparasite infestation in dogs:

This research work showed that various districts of Tripura did not significantly ($p>0.05$) differ in the prevalence of ectoparasitic infestation in dogs. Overall, the highest prevalence of ectoparasite infestation of dogs was recorded from West Tripura district (72.36%) followed by Gomati district (71.23%), Sepahijala district (70.90%) and Khowai District (63.3%).This difference in the distribution of the ectoparasitesmight be due to the geographical area, warm and humid climate prevailing in the four districts of Tripura state.

Breed-wise prevalence of ectoparasite infestation in dogs:

Breed wise, the highest prevalence of ectoparasite was recorded in Mongrel (79.6%) followed by Pug (73.8%), Labrador Retriever (73.4%), German Shepherd (73.2%), Cocker Spaniel (60%), Pitbull (60%), Dalmatian (57.1%), Spitz (52.9%), Lasa (52.6%) Pomeranian (50%), Doberman Pinscher (42.8%) and Golden Retriever (42.3%). Raut *et al.* (2006) [21] and Katariya *et al.* (2018) [12] also found highest prevalence of ectoparasites in mongrels.The higher prevalence in mongrels in the present study could be due to their predominate representation in the study. Mongrels may

have a higher prevalence because they were typically ownerless, free roaming and stray. They all stay together, their chances of passing diseases from one to another are also higher.

Sex-wise prevalence of ectoparasite infestation in dogs:
The prevalence of ectoparasites is significantly ($p<0.05$)influence by the sex of dogs, where male showed higher prevalence than female dogs (Table 1). This study corroborates with the previous studies by Makwana *et al.* (2015) [17] from Mhow, Khurana *et al.* (2016) [13] from Hisar, Kumar and Shekhar, (2020) [15] from Jharkhand. Workers from abroad such as Hadi *et al.* (2016) [7] from Indonesia also recorded higher prevalence in male than female dogs. On contrary Chander *et al*. (2020) [4] from Bikaner, Rajasthan reported higher prevalence in female dogs (68%) than in male dogs (32%) and Lema *et al*. (2020) [16] from Nigeria also revealed prevalence rate was in males (31.67%) and the females (43.33%). The significantly higher proportion of ectoparasitic infestation in male may be due to hormonal factors which predispose male dog more susceptible to ectoparasite infection (Sahu *et al*., 2013) [23].

Age-wise prevalence of ectoparasite infestation in dogs:
The prevalence of ectoparasites infestation was higher among dogs with young age group (79.66%) followed by puppy group (68.15%) and the least prevalent is an adult group (61.04%) (Table 1). This finding was supported by previous studies conducted by Kumar & Shekhar (2020) [15], from Jharkhand which reports high prevalence in young dogs (1-3 years) 36.38% than old dogs (above 3 year) 16.64%. The present study revealed that there was statistically significant ($p< 0.05$) difference among age group in the prevalence of ectoparasite infestation. This may be due to lower immunity in young dogs as compared to adult and also their continuous contact with their carrier mothers.

Category-wise prevalence of ectoparasite infestation in dogs:
Category-wise prevalence of ectoparasites showed statistically significant difference ($p<0.05$) among stray dogs (79.80%), working dogs (71.77%) and household dogs (58.20%) (Table 1).The higher prevalence of ectoparasite in stray dogs was also reported by Ananda and Adeppa, (2017) [2] from Karnataka and Mirzaei *et al.* (2016) [18] from Iran also found dogs living outdoors (80.0%) were infested higher than the dogs living indoor.The reason may be due to higher chance of susceptible dog close contact with infested dog, and a practice of keeping pet dogs under better management in comparison to stray dogs which have free wandering behavior and close contact with other street dogs.

Season-wise prevalence of ectoparasite infestation in dogs:
In the present study, the prevalence of ectoparasites recorded in three different seasons were: Summer 72.2%, Rainy 72.9% and Winter62.3%.The prevalence was found more in rainy season and lowest in winter season which can be explained by warm and humid climate in the rainy season that favoured the growth and multiplication of ectoparasites (Soulsby, 1982) [28] .Similar kind of work has been done by Kumar and Shekhar, (2020) [15] in dogs in Jharkhand, prevalence was in rainy season (33.69%) followed by summer season (21.14%). Hassissen *et al*. (2019) [8] in Bejaia province, north-eastern Algeria, reporthigher prevalence was seen in spring (22.55%) and summer (22.54%) followed by autumn (8.62%) and winter (0.9%). From these findings, it was apparent thattemperature and humidity plays an essential role in the growth and development of ectoparasites. During summer and rainy season, the temperature remained high and relative humidity was also ideal for the rapid multiplication of ectoparasite which in terms resultedin high population of ectoparasites. Whereas, during the winter season, dry environment andlow temperature slowed down the multiplication of ectoparasites which resultedin low prevalencerate.

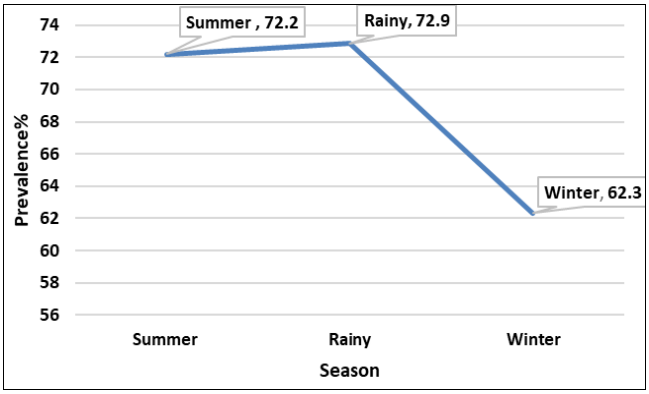

Fig 9: Season wise prevalence of ectoparasite infestation in dogs

Conclusion
The present study was conducted on dog population of both sexes belonging to different age groups and breeds in four districts of Tripura, India. Assessment of ectoparasites infestation were carried out in 528 randomly selected dogs, following conventional techniques. While parasites on dogs received significant attention for several reasons, much less is known about the prevalence and associated risk to humans of these parasites in Tripura. Out of 528 dogs, prevalence of ectoparasite recorded in 368 number of dogs (69.69%). The results indicated that, the dogs of the four selected districts were very much susceptible to ectoparasite infestation. Mainly, 4 types of ectoparasites infestations on dogs were recorded. These included one species of tick (Rhipicephalus *sanguineus*), two species of fleas (*Ctenocephalides canis* and *Ctenocephalides felis*), one species of lice (*Trichodectis canis*) and two different species of mites (*Demodex* spp. and *Sarcoptes scabiei*), with a prevalence rate of 54.92%,41.47%, 3.03% and 8.90%, respectively. The prevalence was high (79.80%) in stray dogs' population followed by working dogs (71.77%) and household dogs (68.15%). Male dogs were found to harbour more ectoparasite (75.67%) in comparison to female (62.06%). On the other hand, based on age group, young dogs were more prone (79.66%) for ectoparasitic infestation than puppy (68.15%) and adult (61.04%). Again, amongst various breeds of dogs, prevalence was found to be highest in Mongrel (79.6%). Further, in the present study encountering *Sarcoptic* and *Demodectic* mites in dogs might threatened to pet owners for many skin problems. This study revealed that majority of dogs in the study area harbor ectoparasites of public health importance. The result of the present study expected becomes information for the owners and veterinarians to prevent and control ectoparasites infestation.

Recommendations
Dog owners should regularly deworm and spray or dip their

pets with an acaricide solution to reduce worms and tick-borne diseases. Also, fumigation of dog kennels and houses would help to reduce the occurrence. Meat and fish should be properly cooked before serving to pets. Dog handlers in the markets should handle dogs with care to avoid contacting any infection from the dogs and finally a regular visit to the veterinary clinic is highly recommended.

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