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Article

Survey for snake-tick (Ixodida) association in some districts of West Bengal, India

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ABSTRACT
During a study, two tick species viz. *Amblyomma gervaisi* and *Am. helvolum* were collected from snakes covering 15 species belonging to 12 genera. The period of extended survey of snake- tick association was undertaken from 2009 to 2015 covering both natural and captive habitats from six districts of West Bengal, India. It was observed that *Am. gervaisi* mostly prefers *Naja naja*, *Daboia russelii* and *Ptyas mucosa* as host, whereas *Am. helvolum* prefers *N. kaouthia* and *Bungarus fasciatus*. *Naja kaouthia* is preferred as host by both *Am. gervaisi* and *Am. helvolum*. *Eryx johnii* and *Gongilophis conicus* are found to be infested by both *Am. gervaisi* and *Am. helvolum*, whereas *Python molurous* is only infested by *Am. helvolum*. No ticks are found to associate with six snake species viz., *Xenochrophis piscator*, *Lycodon aulicus*, *L. jara*, *Ahaetulla nasuta*, *Chrysopelea ornata*, and *Boiga trigonata*. It is noted that tick loads on host snakes in natural habitats is greater than captivity, with few negligible exceptions. Statistical analysis of tick prevalence and abundance are done stating that *Am. gervaisi* is dominant snake infesting tick compared to *Am. helvolum* in West Bengal. Species population of both *Am. gervaisi* and *Am. helvolum* denote female's domination with low species specificity.

KEY WORDS: Abundance; *Amblyomma*; host-specificity; ixodid tick; prevalence; reptiles.

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INTRODUCTION

Diversity of reptilian ticks is significant in studying transmission of various kinds of infectious diseases (Goodman *et al.* 2005). Ticks also transmit a number of pathogens that can cause diseases and death in humans, domestic animals and wildlife (Anderson and Magnarelli 2008). There are about 32 species of ixodid ticks belonging to nine genera inhabiting on several reptilian, mammalian and avian host species identified from West Bengal, India (Sanyal and De 1992). About 41 species belonging to Ixodidae and Argasidae comprising 10 genera have been collected from North-Western India to date. Twenty-three species of Ixodidae family of ticks have been identified from Uzbekistan of Central Asia, of which 11 species parasitized on cattle. The dominant species were *Hyalomma anatolicum* Koch, 1844 (34.9%), *H. detritum detritum* Schulze, 1919 (31.8%) and *Boophilus kohlsi* Hoogstraal & Kaiser, 1960 (30.7%) (Sanyal and De 1992). Chaiyabutr and Chanhome (2002) worked on the parasites of snakes in Thailand; three hard ticks were recorded, including *Ixodes* and *Amblyomma* from *Naja kaouthia* and *Haemaphysalis* from *Daboia russelii siamensis*. Adeiza and Minka (2013) reported the most prevalent tick species of snakes in Nigeria to be *Amblyomma latum*

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Koch, 1844. They also reported that 29% of total examined snakes were infested by *Am. latum.* Pun and Maharjan (2018) recorded the occurrence of *Am. varanense* on the colubrid, *Othriophis hodgsoni* in Kathmandu of Nepal. They also pointed out that *Am. varanense* is the second snake-infesting Nepalese tick species after *Am. gervaisi* for the genus *Amblyomma*. Ali *et al*. (2019) provided a detailed survey on ticks infesting humans, wild and domestic animals in Pakistan. The authors pointed out the occurrence of *Am. gervaisi* and *A. exornatum* from monitor lizards of the genus *Varanus* and *Am. latum* from Indian Python.

The world tick fauna has been relatively well studied systematically (Keirans 1992; Camicas *et al*. 1998; Guglielmone *et al.* 2014) largely because of the relevance of many species to disease and pathogen transmission. Approximately 825 tick species are known (Oliver 1989), all obligate parasites of vertebrates (Hoogstraal and Aeschlimann 1982). A great deal of work has been done by Russian scientists on the importance of *Ixodes persulcatus* in disease transmission and pathoecology, such as its relationship with migrating birds (Emel'Yanova and Gordeeva 1969; Galimov *et al*. 1971). Ticks are well known vectors for tick borne encephalitis (Netsky and Rabdonikas 1961), Q fever (Pchelkina and Zhmaeva 1966), tularemia (Petrov 1966) and rickettsial diseases (Sidorov *et al*. 1966; Zhmaeva and Pchelkina 1966). Alexsandrov and Yagodinsky (1966) studied the possible reasons for virulence changes in an *Ixodes persulcatus* population. Adeli-Sardau *et al*. (2019) first recorded the occurrence of *Hyalomma marginatum marginatum* Koch and *H. m. rufipes* Koch from the Spur-thighed tortoise, *Testudo graeca* in South-East Iran.

Robinson (1926) recorded two ixodid tick species viz., *Am. helvolum* and *Am. javanense* (Supino, 1897) from *Geomyda grandis* and *Manis pentadactyla* respectively in Zoological garden, Kolkata, West Bengal, India. Later the specimens of *Amblyomma helvolum* Koch were also recorded from *Varanus* sp. and *N. naja* in the Zoological Garden, Calcutta, India and it was further noticed that the shoulder region of the host animal is greatly preferred by the ticks (Sanyal *et al*. 1990). Sanyal and De (1992) have made a monograph on the fauna of ixodid ticks in West Bengal, which is based on a large series of collections of different hard tick species made from this state and the specimens collected by the survey parties of the Zoological Survey of India, which are available in National Zoological Collection. Sanyal and De (1992) also included the species which have not been studied by them but are described and recorded from West Bengal by the earlier workers. From their study, the authors have distinguished five different hard tick species viz. *Amblyomma helvolum*, *Am. javanense*, *Am. supinoi*, *Aponomma gervaisi* and *Ap. lucasi* infested on 13 different reptilian species. Voltzit and Keirans (2002) published a review paper on the Asian *Amblyomma* species containing 14 species.

The present study reported tick abundance on snakes of both natural and captive habitats among six districts of West Bengal, India in a period of six years.

MATERIAL AND METHODS

Adult ticks were collected from 15 species of snakes belonging to 12 genera from both natural and captive habitats of six districts of West Bengal, India viz. Hoogly (22.8963° N, 88.2461° E), Bankura (23.2313° N, 87.0784° E), North 24 Parganas (22.6168° N, 88.4029° E), Nadia (23.4710° N, 88.5565° E), Bardhaman (23.2324° N, 87.8615° E), Paschim Medinipur (22.4080° N, 87.3811° E). The host snakes were caught by hand with the help of snake charmers and then the parasite ticks were gently pulled off from the host body surface, using two finger tips. A total of 339 individual snakes covering 15 species of 12 genera were studied and a detail survey on host-parasite association has been undertaken from 2009 to 2015. Local snake experts and snake charmers helped to manage the snakes. The specimens were identified by The Zoological Survey of India, Kolkata, India. Host-parasite associations were studied during specimen collection in the field and records were maintained.

Statistical Analysis

Tick prevalence was determined according to the equation, no. of parasitized snakes/total no. of snakes × 100 and tick abundance was determined according to the equation, no. of ticks/no. of snakes (Margolis *et al*. 1982).

RESULTS

Tick species were identified as male and female of Ixodidae namely, *Amblyomma gervaisi* (Lucas, 1847) (Syn.: *Aponomma gervaisi*) and *Am. helvolum* (Koch, 1844). Ticks were attached on the dorsal and dorso-lateral sides on the host's body surface (Fig. 1). Male and female ticks inhabiting different snake species were collected from various sources, such as snake farms as well as from wild in different districts of West Bengal. Two tick species, *Am. gervaisi* and *Am. helvolum* were found to inhabit 15 different Indian snake species during survey period. Detailed survey report of snake-tick association in both natural and captive habitat is presented in Tables 1 and 2 respectively, which shows the number of host snakes examined as well as the number of the associated ticks on them. Overall, the prevalence of *Am. gervaisi* and *Am. helvolum* in both natural and captive habitats is presented in Table 3. Prevalence of infestation is more in snakes of natural habitat than captive for both species of ticks. The prevalence of *Am. gervaisi* is 37.04% in natural habitats and 15.06% in captive ones, whereas the prevalence of *Am. helvolum* is 18.52% in natural habitats and 11.22% in captive ones. The prevalence of *Am. gervaisi* is higher than *Am. helvolum* in both habitats. Host preference of tick species is compared between natural and captive habitat (Table 4), and this is studied only on snakes kept in confined habitats (Table 5).

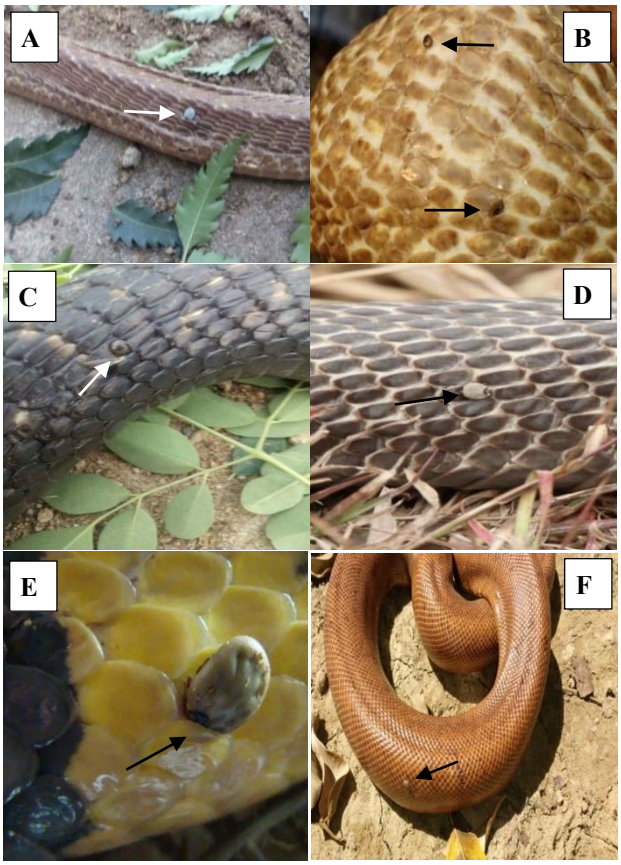

Figure 1. A. Female *Am. helvolum* (white arrow) on *Naja naja*; **B.** Female *Am. gervaisi* (black arrow) on *Naja naja*; **C.** Male *Am. helvolum* (white arrow) on *Naja kaouthia*; **D.** Female *Am. gervaisi* (white arrow) on *Naja kaouthia*; **E.** Female *Am. helvolum* (black arrow) on *Bungarus fasciatus*; **F.** A tick (black arrow) on *Eryx johnii*.

Table 1. The combined survey report of host-parasite association in natural habitats (Survey period: 2009–2015).

Snake host	No. of male	No. of female	Total no.	*Am. gervaisi*		*Am. helvolum*	
				male	female	male	female
Naja naja	3	2	5	5	13	Nil	Nil
Naja kaouthia	4	9	13	4	4	3	11
Daboia russelii	1	1	2	3	6	Nil	Nil
Bungarus fasciatus	2	1	3	Nil	Nil	1	2
Ptyas mucosa	1	0	1	1	2	Nil	Nil
Xenochrophis piscator	1	2	3	Nil	Nil	Nil	Nil
Total no. of snake hosts	12	15	**Total no. of ticks**	13	25	4	13

Table 2. The combined survey report of host-parasite association in captive habitats (Survey period: 2009–2015).

Snake host	No. of male	No. of female	Total no.	*Am. gervaisi*		*Am. helvolum*	
				male	female	male	female
Naja naja	10	18	28	13	35	2	0
Naja kaouthia	17	23	40	2	7	8	27
Daboia russelii	16	23	39	12	17	Nil	Nil
Bungarus fasciatus	19	18	37	Nil	Nil	8	21
Ptyas mucosa	15	12	27	18	20	1	2
Xenochrophi piscator	6	5	11	Nil	Nil	Nil	Nil
Bungarus caeruleus	9	10	19	2	5	Nil	Nil
Eryx johnii	7	13	20	5	7	2	2
Gongilophis conicus	14	33	47	16	40	13	36
Python molurous	4	2	6	Nil	Nil	0	3
Lycodon aulicus	4	5	9	Nil	Nil	Nil	Nil
Lycodon jara	3	2	5	Nil	Nil	Nil	Nil
Ahaetulla nasuta	6	6	12	Nil	Nil	Nil	Nil
Chrysopelea ornata	9	1	10	Nil	Nil	Nil	Nil
Boiga trigonata	1	1	2	Nil	Nil	Nil	Nil
Total no. of snake hosts	140	172	**Total no. of ticks**	68	131	34	91

Table 3. Overall prevalence of tick infestation in both natural (NH) and captive habitats (CH).

Habitat	No. of parasitized snakes	No. of observed snakes	Prevalence of *Am. gervaisi*	Prevalence of *Am. helvolum*
NH	10 (*Am. gervaisi*)	27	37.04	N.A.
NH	5 (*Am. helvolum*)	27	N.A.	18.52
CH	47 (*Am. gervaisi*)	312	15.06	N.A.
CH	35 (*Am. helvolum*)	312	N.A.	11.22

Table 6 displays the overall tick abundance of *Am. gervaisi* and *Am. helvolum* based on different habitats. The comparative study between Tables 7 and 8 represents tick loads on different common snake hosts emphasizing each tick species in natural habitats being greater than captivity, with few negligible exceptions.

Figures 2 and 3 represent the percentage of distribution of male and female host snakes observed in both natural and captive habitats during the survey period. Percentage of distribution of male and female parasite ticks inhabiting snakes in natural habitats and captive states is represented in Figure 4. Females dominate in these two tick species (viz. *Am. gervaisi* and *Am. helvolum*) populations.

Table 4. Percentage of common host snakes species infested by *Am. gervaisi* (*A. g.*) and *Am. helvolum* (*A. h.*) in both natural and captive habitats.

Host snakes	Natural Habitat					Captive Habitat				
	No. of observed host	No. of infected host by		% of infected host by		No. of observed host	No. of infected host by		% of infected host by	
		A. g.	*A. h.*	*A. g.*	*A. h.*		*A. g.*	*A. h.*	*A. g.*	*A. h.*
N. naja	5	3	0	60.00	0.00	28	11	1	39.29	3.57
N. kaouthia	13	4	3	30.77	23.08	40	3	12	7.50	30.00
D. russelii	2	2	0	100.00	0.00	39	10	0	25.64	0.00
Bu. fasciatus	3	0	2	0.00	66.67	37	0	11	0.00	29.73
Pt. mucosa	1	1	0	100.00	0.00	27	8	1	29.63	3.70

Table 5. Percentage of host snake species infested with both *Am. gervaisi* and *Am. helvolum* in captive habitats.

Host Snakes	No. of observed host	No. of infected host by *Am. gervaisi*	% of infected host by *Am. gervaisi*	No. of infected host by *Am. helvolum*	% of infected host by *Am. helvolum*
N. naja	28	11	39.29	1	3.57
N. kaouthia	40	3	7.50	12	30.00
D. russelii	39	10	25.64	0	0.00
Bu. fasciatus	37	0	0.00	11	29.73
Pt. mucosa	27	8	29.63	1	3.70
Bu. caeruleus	19	1	5.26	0	0.00
E. johnii	20	5	25.00	2	10.00
G. conicus	47	9	19.15	7	14.89
Py. molurous	6	0	0.00	1	16.67

Table 6. Overall abundance of tick infestation in both natural (NH) and captive habitats (CH).

Habitat	Total no. of ticks.	No. of observed snakes	Abundance of *Am. gervaisi*	Abundance of *Am. helvolum*
NH	*Am. gervaisi* (38)	27	1.41	N.A.
NH	*Am. helvolum* (17)	27	N.A.	0.63
CH	*Am. gervaisi* (199)	312	0.64	N.A.
CH	*Am. helvolum* (125)	312	N.A.	0.40

Table 7. Abundance of tick infestation for different infected snake hosts in natural habitats.

Name and no. of host snakes	No. of *Am. gervaisi*	Abundance of *Am. gervaisi*	No. of *Am. helvolum*	Abundance of *Am. helvolum*
N. naja (5)	18	3.6	00	00
N. kaouthia (13)	8	0.62	14	1.08
D. russelii (2)	9	4.5	0	00
Bu. fasciatus (3)	0	0	3	1
Pt. mucosa (1)	3	3	0	0

It is seen that in natural habitats *Naja naja*, *Daboia russelii*, and *Ptyas mucosa* are only infested by *Am. gervaisi*. No records of the association of *Am. helvolum* with these host snake species are found in natural habitats. *Naja kaouthia* is infested by both *Am. gervaisi* and *Am. helvolum* in natural habitats but infestation of *Am. helvolum* is much more than *Am. gervaisi*. *Bungarus fasciatus* is only infested by *Am. helvolum* collected from natural habitats.

Table 8. Abundance of tick infestation for different infected snake hosts in captive habitats.

Name and no. of host snakes	No. of *Am. gervaisi*	Abundance of *Am. gervaisi*	No. of *Am. helvolum*	Abundance of *Am. helvolum*
N. naja (28)	48	1.71	2	0.07
N. kaouthia (40)	9	0.23	35	0.88
D. russelii (39)	29	0.74	0	0
Bu. fasciatus (37)	0	0	29	0.78
Pt. mucosa (27)	38	1.41	3	0.11
Bu. caeruleus (19)	7	0.37	0	0
E. johnii (20)	12	0.6	4	0.2
G. conicus (47)	56	1.19	49	1.04
Py. molurous (6)	0	0	3	0.5

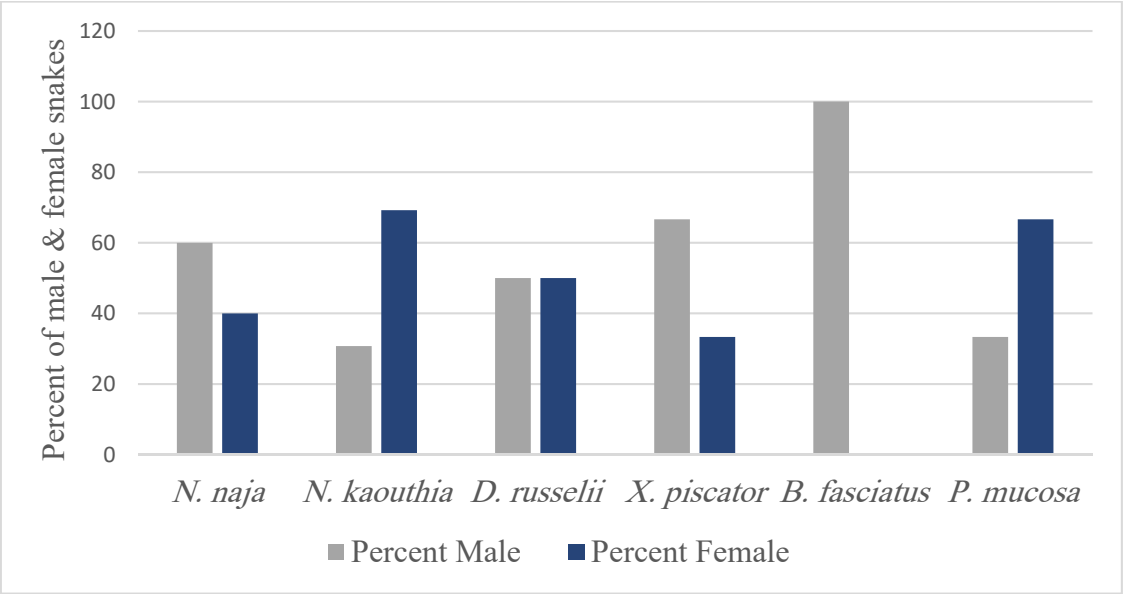

Figure 2. Percentage of distribution of male and female snakes in natural habitats.

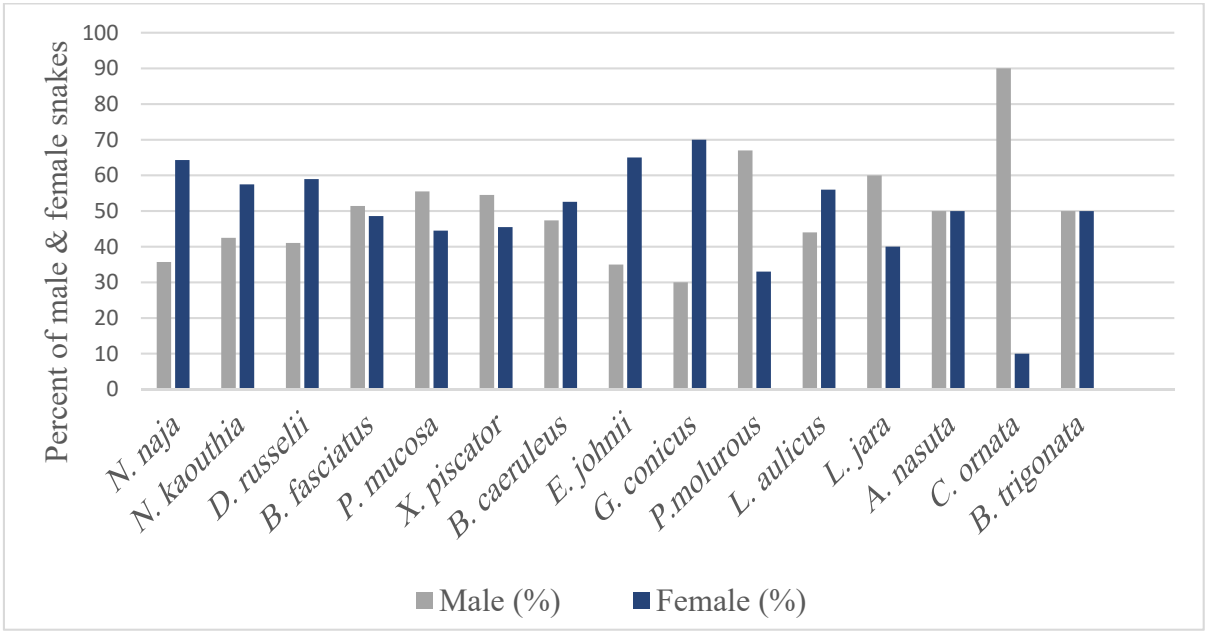

Figure 3. Percentage of distribution of male and female snakes in captive habitats.

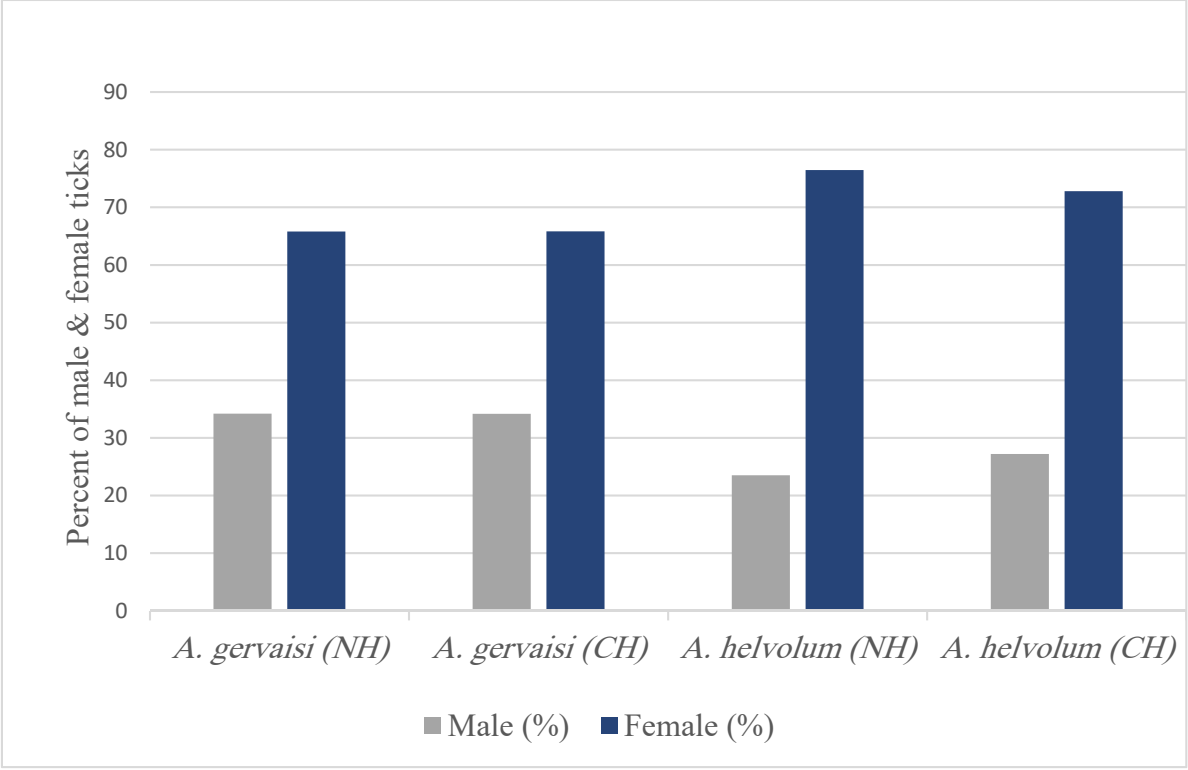

Figure 4. Percentage of distribution of male and female ticks in both natural (NH) and captive habitats (CH).

Natural infestation of *Am. helvolum* is found on *N. naja* and *Pt. mucosa* only in captive states.

It is noted that *Am. gervaisi* mostly prefers *N. naja*, *D. russelii* and *Pt. mucosa* as host, whereas *Am. helvolum* prefers *N. kaouthia* and *Bu. fasciatus*. *Naja kaouthia* is preferred as host by both *Am. gervaisi* and *Am. helvolum*. Interestingly, *Xenochrophis piscator* is found to be not infected by either of the tick species.

DISCUSSION

Ticks act as a link for different disease-causing agents between animal reservoirs and human hosts. Norval *et al.* (2009) reported an accidental transportation of ticks into Taiwan on imported king cobra, *Ophiophagus hannah*. Disease contamination among snakes may be mediated by snake ticks which should be properly taken care of. Catherine *et al*. (2017) reported the infestation of *Am. gervaisi* on reticulated python (*Python reticulatus*), Indian Rock python (*Py. molurus*), Spectacled cobra (*N. naja*) and Rat snake (*Pt. mucosa*) from captive snakes at Chennai snake park Trust (Guindy), Arignar Anna Zoological Park (Vandalur) and Rescue Centre (Velachery) in Tamil Nadu. They also mentioned that prevalence of ticks is more on captive snakes (70.37%) than the free ranging snakes (37.5%). However, the reverse result was obtained in this study, where infestation on snakes is more prevalent in natural habitat than those of captive states.

Ghosh and Misra (2012) and Ghosh *et al*. (2018) reported the occurrence of snake associated ticks, *Am. gervaisi* and *Am. helvolum* from both natural and captive habitats. They described the sexual dimorphism of *Am. gervaisi* and *Am. helvolum* by using SEM observations and made a comparison with other available SEM studies on ixodid tick species. Ghosh *et al.* (2016) also elaborated on the detail anatomy of Haller's organ of *Am. gervaisi* and *Am. helvolum* by using SEM and TEM.

The survey of tick species infesting snakes from six districts of West Bengal is novel. The snake species and the tick species recorded in this study are the known fauna of West Bengal. Earlier, only three tick species viz., *Am. gervaisi*, *Am. helvolum,* and *Ap. lucas*, were recorded mainly from snake hosts kept in captivity (Sanyal and De 1992). Pandit *et al*. (2011) examined 167 individuals of 30 species of snakes belonging to 22 genera and five families from Northern part of Western Ghats of India from November 2008 to March 2010 and reported only two species of snakes, *Pt. mucosa* and *N. naja* to be infested by *Am. gervaisi*. They also mentioned that female Indian rat snakes showed highest rate of tick infestation than males. According to them (Pandit *et al*. 2011) the nymphs and males of *Am. gervaisi* were predominant. However, in present study, the populations of *Am. gervaisi* and *Am. helvolum* are female dominating tick species - in both natural and captive habitats (Fig. 3). All the ticks were found on the dorsally, and no ticks were recorded on the head, tail, or ventral parts (Pandit *et al*. 2011). Average prevalence of *Am. gervaisi* was 29.16% in *Pt. mucosa* and 30% in *N. naja* (Pandit *et al*. 2011). However, in this study, dorsal and dorso-lateral sides of nine snake species were mainly infested by both *Am. gervaisi* and *Am. helvolum*. The infestation on the head of *N. naja* was also recorded in the present study. *A. lucas* has not been found in none of the 339 individual snake hosts covering 15 species of 12 genera.

Natural infestation of *Am. helvolum* is found on *N. naja* and *Pt. mucosa* only in captive states. Such situation may be due to contamination of parasites from other captured snake species. *Amblyomma helvolum* is not a common infestation to *D. russelli* in either habitat. However, *Am. gervaisi* infestation is common in *D. russelli* in both the habitats. Captive *Bu. fasciatus* is found to be infested by *Am. helvolum* like the natural habitat. *Naja kaouthia* in captivityis infested by both *Am. gervaisi* and *Am. helvolum*. Like the natural habitat, the infestation of *Am. helvolum* is much more than the *Am. gervaisi* on *Naja kaouthia* in captivity. *Eryx johnii* and *Gongilophis conicus* in captured states are found to be infested by both *Am. gervaisi* and *Am. helvolum*, whereas *Py. molurous* is only infested by *Am. helvolum*.

No ticks were found to associate with six snake species viz., *X. piscator*, *L. aulicus*, *L. jara*, *Ah. nasuta*, *C. ornata*, and *Bo. trigonata*. *D. russelii* and *Bu. caeruleus* are infested with *Am. gervaisi*, whereas *Py. molurous* act as a host of *Am. helvolum* in captivity. On the other hand, both *E. johnii* and *G. conicus* are hosts of both *Am. gervaisi* and *Am. helvolum* in captive habitats. A notable snake-tick association between natural and captive states is uncovered. Table 3 states that prevalence of *Am. gervaisi* is higher than *Am. helvolum* in nature: 37.04% (*Am. gervaisi*) > 18.52% (*Am. helvolum*) and captivity: 15.06% (*Am. gervaisi*) > 11.22% (*Am. helvolum*). The abundance of *Am. gervaisi* is greater

than *Am. helvolum* in both nature: 1.41 (*Am. gervaisi*) > 0.63 (*Am. helvolum*) and captivity: 0.64 (*Am. gervaisi*) > 0.40 (*Am. helvolum*) (Table 6). From this, we can conclude that *Am. gervaisi* is dominating snake infesting tick in West Bengal.

The general idea is that overall infestation of ticks is much more in snakes kept in captive state than those in nature. Density of the snake population is always high in captivity, so infestation of ticks is likely to be more as a result of contamination; as is always found in snakes kept in zoo gardens. Specificity of host choice is obligatory. Conditions in captivity such as poor husbandry, inadequate diet and overcrowding can lead to stress that weakens the immune system of host snakes. Whereas, the overall statistical analysis in this study proves that prevalence (Table 3) and abundance (Table 6) of both *Am. gervaisi* and *Am. helvolum* in natural habitats is higher than captivity, it may be assumed that snakes are well maintained in the farms of West Bengal, India.

The outcome of this observation is that both the tick species collected during this investigation have low species specificity. Ticks introduce blood parasites into human beings from other vertebrate hosts. So, they act as viaduct of several zoonotic diseases. Several ixodid tick species are capable of transmitting *Coxiella burnetii*, *Francisella tularensis*, and *Ehrlichia chaffeensis*, the etiologic agents of Q fever, tularemia and human monocytic ehrlichiosis respectively.

From medical point of view, ticks are important vectors as well as reservoir host of diseases in human beings. The importance of the present work is of twofold. Firstly, it provides basic information on the occurrence of snake ticks caught in wild (Pandit *et al*. 2011) that would help in the quarantine process during trading of snakes. Secondly, it shows that snake ticks have low species specificity that would increase the disease contamination among the snakes and to develop awareness to the authorities of Zoo garden and Snake Park for management of the snakes caught from the wild. Wild-caught snakes frequently have ticks. There are only two ways the snake could pick up ticks - either through the wild or through direct contact with another snake that already has ticks. Increase in international wildlife trade, especially reptiles (Auliya 2003; Pietzsch *et al*. 2006; Soorae *et al*. 2008), will cause high risks of introduction of exotic ticks along with the pathogens in new geographic areas (Burridge 2001; Karesh *et al*. 2005; Norval *et al*. 2009).

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بررسی ارتباط مار-کنه (Ixodida) در برخی از مناطق بنگال غربی، هند

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چکیده

در این بررسی، دو گونه کنه یعنی *Amblyomma gervaisi* و *Am. helvolum* از ۱۵ گونه مار از ۱۲ جنس جمع‌آوری شدند. دورهٔ بررسی طولانی مدت ارتباط کنه-مار از سال ۲۰۰۹ تا ۲۰۱۵ انجام شد که زیستگاه‌های طبیعی و محبوس را از شش منطقه بنگال غربی هند پوشش می‌دهد. مشاهده شد که *Am. gervaisi* بیشتر *Naja naja*، *Daboia russelii* و *Ptyas mucosa* را به عنوان میزبان ترجیح می‌دهد درحالی‌که *Am. helvolum*، *N. kaouthia* و *Bungarus fasciatus* را ترجیح می‌دهد. گونهٔ *N. kaouthia* را به عنوان میزبان هر دو گونهٔ *Am. gervaisi* و *Am. helvolum* ترجیح دادند. گونه‌های *Eryx johnii* و *Gongilophis conicus* به هر دو گونهٔ *Am. gervaisi* و *Am. helvolum* آلوده می‌شوند درحالی‌که مار *Python molurous* تنها به *Am. helvolum* آلوده می‌شود. هیچ کنه‌ای در ارتباط با شش گونهٔ مار یعنی *Xenochrophis piscator* ، *Lycodon aulicus*، *L. jara*، *Ahaetulla nasuta*، *Chrysopelea ornata*، و *Boiga trigonata* یافت نشد. قابل اشاره است که تعداد کنه روی مارهای میزبان با چند مورد استثنای ناچیز در زیستگاه طبیعی بیشتر از اسارت است. تجزیه و تحلیل آماری شیوع و فراوانی کنه در این بررسی انجام شده است که بیان می‌کند *Am. gervaisi* کنهٔ غالب آلوده کنندهٔ مار نسبت به *Am. helvolum* در بنگال غربی است. جمعیت گونهٔ هر دو گونهٔ *Am. gervaisi* و *Am. helvolum* با تخصص گونه‌ای کم به سمت جنس ماده تمایل دارد.

واژگان کلیدی: فراوانی؛ *Amblyomma*؛ تخصص میزبانی؛ کنه‌های ایکسودید؛ شیوع؛ خزندگان.

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