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Tick infestation on wild snakes in northern part of western Ghats of India.

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Hard ticks are hematophagous parasites that are important vectors of many viral, bacterial, rickettsial, and protozoal diseases of humans and domestic animals. They are known to parasitize a variety of vertebrate hosts, including wild animals. Hard ticks belong to subfamily Ixodoidea, order Acarina, class Arachnida (Sharif 1928). Although there are numerous articles on the infestation of ticks on different hosts, both domestic and wild animals, information on tick infestation on reptiles is rare or scanty in India. Ticks found on reptiles generally belong to genus Amblyomma (formerly Aponomma). The Life cycle of Amblyomma lucasi Warburton has been studied under laboratory conditions (Bhat and Nikam 1986). In the previous reports from India by Geervarghese and Dhandha (1995) and Ghosh et al. (2007), Aponomma gercaisi (Lucas, 1847), Aponomma lucasi Neumann, Aponomma lucasi Warburton, and Aponomma pattoni (Neumann) have been recorded on reptile hosts. Some of these species are either synonyms or invalid as per the recent classification (Horak et al. 2011). The average prevalence of these ticks on Indian rat snakes (n = 48) was 29.16%, with abundance of 7.62 ticks per individual; on spectacled cobras (n = 20), average prevalence was 30.00%, with abundance of 6.9 ticks per individual. The nymphs and males were predominant. All the ticks were found on the dorsal aspect of the body of the snake, and no ticks were recorded on the head, tail, or ventral body. The rate of tick infestation was highest in scrubland and was lowest in evergreen forests. Female Indian rat snakes showed higher tick infestation rates than male Indian rat snakes. Using Mann–Whitney U test, we found that longer snakes of both species had significantly higher rate of tick infestation in both the species of snakes.

**KEY WORDS** Amblyomma, Aponomma, Indian rat snake, spectacled cobra

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Materials and Methods

**Study Area.** The study was conducted in the northern part of western Ghats area from November 2008 to March 2010, covering different seasons, i.e., winter, summer, and monsoon. The study localities included Pune (18°31’6.34”N, 73°51’24.14”E), Saswad (18°20’34.60”N, 74°1’47.52”E), Lonavala (18°44’53.00”N, 73°24’26.00”E), Jejur (18°16’35.85”N, 74°9’43.79”E), Tahmini (18°26’48.85”N 73°25’49.96”E), Shirwal (18°9’9.24”N, 73°58’46.94”E), Amboli (15°57’52.98”N, 74°0’12.86”E), Bhimashankar (19°42’21.11”N, 73°32’39.81”E), Badlapur (19°9’0.00”N, 73°16’0.00”E), Kas (17°41’60.00”N, 73°49’60.00”E) in Maharashtra state and Agumbe (13°30’25.76”N, 75°5’40.89”E) in Karnataka state of India. In brief, the study area covered different habitats, including evergreen forest, semi-evergreen forest, dry deciduous forest, scrubland, and agricultural and human habitations.

**Collection of Ticks.** Snakes were randomly sampled for tick infestation as and when they were rescued with the help of local snake rescuers from different...
localities. Description of various habitats from where the snakes were examined and other details were recorded in a field book. Snake species were identified with the help of field guides (Whitaker and Captain 2004) and from prior experience. The length, sex, and body parts where ticks were collected, and certified snake rescuer’s names were recorded. Overall body condition, including emaciation, wounds, and status of molt of the snake, also was noted. Emaciated snake was easily identified by palpating the whole body for muscle thickness. Snakes during molt were reexamined for tick infestation before and after the molting.

Each rescued snake was carefully restrained physically by experience rescuers, and head, body, and tail (ventral and dorsal sides) were carefully examined for ticks or any other ectoparasitic fauna, such as other acarines or insects, lodged in between the scales of Indian rat snake. (Photo credit: Rohan Pandit; online figure in color.)

**Table 1. Snake species collected, habitat-wise, with prevalence of tick infestation**

<table>
<thead>
<tr>
<th>Habitat</th>
<th>No. snake specimens</th>
<th>Snake species</th>
<th>Prevalence of A. gervaisi (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry deciduous forest</td>
<td>9</td>
<td>IRS, BR, CTS, RV, SK</td>
<td>11.111</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>53</td>
<td>BCS, MPV, CVS, BPV, CKS, BTS, FCS, LSNS, MS, PS, UB, SC, YSWS</td>
<td>0</td>
</tr>
<tr>
<td>Human settlement</td>
<td>54</td>
<td>CKS, BR, LSS, SK, CTS, CWS, DBS, GK, RIS, RV, SC, RKS, SSV</td>
<td>9.260</td>
</tr>
<tr>
<td>Scrubland</td>
<td>40</td>
<td>BR, BCS, CKr, CSB, IRS, RSB, SSV, SC, SK</td>
<td>27.5</td>
</tr>
<tr>
<td>Semi-evergreen forest</td>
<td>11</td>
<td>BPV, BK, BTS, GK, IRS, MTS, SC</td>
<td>27.272</td>
</tr>
</tbody>
</table>


**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). Differences in the prevalence of *Ptyas mucosa* (L., 1758) (Indian rat snake) and *Naja naja* (L., 1758) (spectacled cobra) infestation, prevalence in males and females of Indian rat snake, and prevalence of infestations in different habitats with the overall prevalence observed were compared using Fisher exact test. Lengths of Indian rat snakes and spectacled cobras were correlated with presence of tick infestation using Mann-Whitney *U* test. Statistical analyses were carried out using the XLSTAT statistical package and the results were considered significant at *P* < 0.05.

**Results**

**Representativeness of Samples and Prevalence.** We examined 167 snakes of 30 species belonging to 22 genera and five families (*Uropeltidae*, *Boidae*, *Colubridae*, *Elapidae*, and *Viperidae*) for tick infestation. Habitat, number of snakes and species sampled, and number of ticks collected from all the localities are depicted in Table 1.

Only two species, Indian rat snake and spectacled cobra, were found to be positive for tick infestation in this study. No other ectoparasitic infestations were found. All ticks collected from snakes were identified as *A. gervaisi* (Fig. 1a and b). The prevalence and abundance of tick infestation for Indian rat snake was 29.16% and 7.02 (%), whereas for spectacled

**Fig. 1.** Photos of *A. gervaisi*. (a) *A. gervaisi* female dorsal view. (b) *A. gervaisi* female ventral view. (c) *A. gervaisi* lodged in between scales of Indian rat snake. (Photo credit: Rohan Pandit; online figure in color.)
The prevalence of infestation in different habitats (Table 1), such as dry deciduous forest (11.11%; n = 9) (P = 1.00), semi-evergreen forest (27.27%; n = 11) (P = 0.15), and human habitations (9.25%; n = 54) (P = 0.80), was found to be almost similar with that of prevalence observed irrespective of habitat (11.97%; n = 167). However, prevalence in evergreen forest (0.0%; n = 53) (P = 0.004) was significantly less, and prevalence in scrubland (27.5%; n = 40) (P = 0.024) was significantly higher than the overall observed prevalence (11.97%; n = 167).

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