Prevalence and Population Structure of Lice (Phthiraptera) on the Indian Red Avadavat

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Prevalences of two phthirapteran species (an ischnoceran, Brueella amandavae, and an amblycera, Myrsidea amandavae) on 150 Red Avadavats (Amandava amandava) were 35.2% and 20.8% in the district of Rampur, India, from September to December 2004. Sample mean abundances of the two species were 3.43 and 1.83, respectively. The frequency distribution patterns of both species were aggregated. The observed distribution conformed to the expected distribution of the negative binomial model, but only in the case of M. amandava. Adults dominated over nymphs in the overall adult-to-nymph ratio. Sex ratios of both species were skewed (female biased).

Key words: Phthiraptera, lice, ischnocera, Amblycera, Mallophaga

INTRODUCTION

Selected workers have provided information on the prevalence and population levels of Phthiraptera on certain avian hosts (Saxena et al., 2004). An analysis of the known distributions of 27 species of lice on 15 avian hosts indicated that phthirapteran ectoparasites generally exhibit aggregated (contiguous or clumped) distributions (Rakesh et al., 1907). The negative binomial distribution is commonly used to describe such patterns (Crofton, 1971). A survey of the literature indicated that there was no report on the population levels of Phthiraptera infesting the Red Avadavat, Amandava amandavae. The present report furnishes information on the prevalences and population structures of two phthirapteran species occurring on this bird.

MATERIALS AND METHODS

One-hundred thirty Red Avadavats (Ploceidae; Passeriformes; Aves) were live-trapped from September 2004 to December 2004 in the district of Rampur (India). Each bird was examined under a stereozoom trinocular microscope, after its legs were tied. Infested birds were subjected to delousing by the modified 'Fair Isle' method (Williamson, 1954). The efficacy of different methods available for quantifying avian lice has already been discussed (Clayton and Drown, 2001). The head was separately examined after delousing. The entire louse load was transferred to 70% alcohol and separated to species, stage, and sex for further analysis. The data were used for recording the prevalence, mean intensity, median intensity, sample mean abundance, and variance-to-mean ratio of the louse populations. The exponent (k) of the negative binomial distribution and index of discrepancy (D) were estimated with software offered by Roza et al. (2000). The goodness of fit between observed and expected frequencies (negative binomial) were determined by the χ² test.

RESULTS

Prevalence

The prevalence of Phthiraptera on Red Avadavats was 35.2%. The prevalence of M. amandava was 20.8%. No bird was encountered that was infested with M. amandava alone. The presence of B. amandavae and M. amandava appear to be associated, as the test of independence of attributes rejected the random occurrence of the two species (χ²=24.91; P=0.01; df=1).

Intensity of infestation

A total of 645 specimens (all stages, both sexes) were collected. The sample mean abundance of Phthiraptera was 3.6 (range 1–32, n=130). Total number of B. amandavae collected was 446 (mean intensity - 9.6; median intensity, 7.5; sample mean abundance, 3.4; range of infestation, 1 to 32, n=130). Likewise, 199 specimens of M. amandava were recovered (mean intensity - 7.4; median intensity, 5.0; sample mean abundance, 1.5; range of infestation, 1 to 27, n=199).

Distribution pattern

The frequency distribution of B. amandavae was the hollow-curve type, in which most of the hosts have few parasites and most of the parasites occur on a few hosts. The variance-to-mean ratio was significantly greater than unity (13.4), indicating overdispersion. Computed values of the binomial exponent (k) and index of discrepancy (D) were 0.15 and 0.68, respectively. Expected frequencies for a negative binomial distribution differed significantly from the observed frequencies (χ²=61.85; P=0.05).

The frequency-distribution pattern of M. amandavae was also the hollow-curve type. The variance-to-mean ratio was 12.8. The values of the binomial exponent (k) and index of discrepancy were 0.08 and 0.88, respectively. The expected frequencies for a negative binomial distribution conformed to the observed frequencies (χ²=41.5; P=0.05). In other words, the negative binomial distribution was a good fit for M. amandavae.

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Population structure

The population composition of both species was analysed at different levels of infestation (Table 1 and 2). Adults dominated over nymphs, as the overall adult-to-nymph ratios were 1: 0.91 (B. amandavae) and 1: 0.76 (M. amandava), respectively. The data further indicated that in the case of B. amandavae, adults outnumbered nymphs at lower levels of infestation (i.e., 1–6, 7–12, and 13–18), while at higher levels of infestation (i.e., 19–24, 25–30, and >30), nymphs either equaled or exceeded adults. A nearly similar pattern existed in the case of M. amandava. At two lower levels of infestation (i.e., 1–5 and 6–10), adults dominated over nymphs, but nymphs outnumbered adults at higher levels of infestation. The ratio of three nymphal instars exhibited considerable variation among different levels of infestation in both species (Tables 1 and 2). However, the overall ratio of first, second, and third instars was 1: 1.23: 0.7 for B. amandavae and 1: 1.29: 0.71 for M. amandava.

Sex ratio

The sex ratio of two species ranged from 1: 1.35 (M. amandavae) to 1: 1.38 (B. amandavae) and was female biased (Table 1 and 2). Except for two categories in the case of B. amandavae and one category in the case of M. amandava, females consistently dominated over males.

DISCUSSION

Lice populations on avian hosts range from nil to thousands per host (Marshall, 1981). Population levels of phthirapterans on selected birds have been occasionally reported (Price and Graham, 1997). However, louse populations on avian hosts rarely reach alarming levels due to various defenses (grooming, dusting, moulting, etc.) employed by the host birds (Price and Graham, 1997).

The population levels of two phthirapteran species occurring on Red Avadavats were comparatively low, as the range of infestation was 1 to 32.

Phthirapteran ectoparasites generally exhibit aggregated distributions that often conform to the negative binomial distribution (Rekasi et al., 1997). The degree of aggregation is usually quantified as the exponent (k) of the negative binomial distribution (Rozsa et al., 2000). Use of index of dispersion (D) has also been recommended, in this regard. In the present study, the observed distribution conformed to the expected distribution of negative binomial model for the ambylozeran species, M. amandava, but not for the ischnoceran louse, B. amandavae.

An examination of the population structure of a species provides useful clues regarding the temporal stability of the population; presence of fewer adults and more nymphs in a population indicates that the population is expanding, and vice-versa (Marshall, 1981). Since avian lice exhibit seasonal population variation, the proportion of nymphs may vary with time. Apart from seasonality, many other factors can affect population structure (Marshall, 1981). During the present study, the adult-to-nymph ratio remained 1: 0.9 for B. amandavae and 1: 0.8 for M. amandava. Thus, the overall adult-to-nymph ratio did not indicate expanding populations.

Skewed sex ratios are quite common among phthirapteran populations. Sampling bias and unequal longevity of the sexes have been considered responsible for sex-ratio biases (Marshall, 1981). In addition, local mate competition reportedly complicates the situation (Clayton et al., 1992). Louse sex ratios have been predicted to be less skewed in colonial birds than in terrestrial ones (Rozsa et al., 1996). Both phthirapteran species infesting the Red Avadavat exhibited a skewed sex ratio, as females outnumbered males.

Table 1. Population composition of Brueelia amandavae on 130 Red Avadavats

<table>
<thead>
<tr>
<th>Number of lice (Classes)</th>
<th>Frequency</th>
<th>Average number of stages (Male</th>
<th>Female</th>
<th>Total</th>
<th>I N</th>
<th>II N</th>
<th>III N</th>
<th>Total</th>
<th>Grand Total</th>
<th>M : F</th>
<th>A : N</th>
<th>I:N</th>
<th>II:N</th>
<th>III:N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–6</td>
<td>20</td>
<td>0.85</td>
<td>1.30</td>
<td>2.15</td>
<td>0.30</td>
<td>0.55</td>
<td>0.25</td>
<td>1.10</td>
<td>3.25</td>
<td>1:1.52</td>
<td>1:0.51</td>
<td>1:1.83</td>
<td>1:0.83</td>
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<tr>
<td>7–12</td>
<td>17</td>
<td>1.76</td>
<td>2.94</td>
<td>4.70</td>
<td>1.11</td>
<td>1.88</td>
<td>0.81</td>
<td>4.11</td>
<td>8.82</td>
<td>1:1.67</td>
<td>1:0.67</td>
<td>1:1.68</td>
<td>1:0.68</td>
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</tr>
<tr>
<td>13–18</td>
<td>3</td>
<td>4.33</td>
<td>3.66</td>
<td>7.99</td>
<td>2.33</td>
<td>2.33</td>
<td>1.33</td>
<td>6.00</td>
<td>14.00</td>
<td>1:0.64</td>
<td>1:0.76</td>
<td>1:0.20</td>
<td>1:0.76</td>
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<tr>
<td>19–24</td>
<td>3</td>
<td>3.50</td>
<td>6.50</td>
<td>10.00</td>
<td>3.00</td>
<td>3.50</td>
<td>3.00</td>
<td>10.50</td>
<td>26.00</td>
<td>1:1.65</td>
<td>1:1.05</td>
<td>1:1.61</td>
<td>1:1.33</td>
<td></td>
</tr>
<tr>
<td>25–30</td>
<td>3</td>
<td>5.00</td>
<td>5.50</td>
<td>12.50</td>
<td>5.00</td>
<td>5.50</td>
<td>3.66</td>
<td>15.50</td>
<td>28.30</td>
<td>1:1.58</td>
<td>1:0.97</td>
<td>1:1.56</td>
<td>1:0.97</td>
<td></td>
</tr>
<tr>
<td>&gt;30</td>
<td>2</td>
<td>6.50</td>
<td>5.50</td>
<td>12.00</td>
<td>9.50</td>
<td>6.00</td>
<td>2.00</td>
<td>19.50</td>
<td>31.50</td>
<td>1:0.84</td>
<td>1:1.62</td>
<td>1:0.74</td>
<td>1:0.82</td>
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<tr>
<td>Total</td>
<td>47</td>
<td>2.08</td>
<td>2.89</td>
<td>4.97</td>
<td>1.53</td>
<td>1.89</td>
<td>1.08</td>
<td>4.51</td>
<td>9.48</td>
<td>1:1.38</td>
<td>1:0.91</td>
<td>1:1.23</td>
<td>1:0.70</td>
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</table>

Table 2. Population composition of Myrsidae amandavae on 130 Red Avadavats

<table>
<thead>
<tr>
<th>Number of lice (Classes)</th>
<th>Frequency</th>
<th>Average number of stages (Male</th>
<th>Female</th>
<th>Total</th>
<th>I N</th>
<th>II N</th>
<th>III N</th>
<th>Total</th>
<th>Grand Total</th>
<th>M : F</th>
<th>A : N</th>
<th>I:N</th>
<th>II:N</th>
<th>III:N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–5</td>
<td>10</td>
<td>0.61</td>
<td>1.50</td>
<td>2.12</td>
<td>0.28</td>
<td>0.31</td>
<td>0.06</td>
<td>0.56</td>
<td>2.68</td>
<td>1:1.61</td>
<td>1:0.28</td>
<td>1:1.72</td>
<td>1:0.33</td>
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</tr>
<tr>
<td>6–10</td>
<td>4</td>
<td>2.00</td>
<td>2.50</td>
<td>4.50</td>
<td>0.75</td>
<td>2.00</td>
<td>0.75</td>
<td>3.50</td>
<td>8.00</td>
<td>1:1.25</td>
<td>1:0.20</td>
<td>1:1.28</td>
<td>1:0.20</td>
<td></td>
</tr>
<tr>
<td>11–15</td>
<td>3</td>
<td>2.33</td>
<td>3.00</td>
<td>5.33</td>
<td>2.33</td>
<td>2.33</td>
<td>2.33</td>
<td>7.00</td>
<td>12.33</td>
<td>1:1.28</td>
<td>1:1.31</td>
<td>1:1.00</td>
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</tr>
<tr>
<td>16–20</td>
<td>2</td>
<td>3.50</td>
<td>5.50</td>
<td>9.00</td>
<td>3.50</td>
<td>3.00</td>
<td>2.00</td>
<td>8.50</td>
<td>17.50</td>
<td>1:1.57</td>
<td>1:0.94</td>
<td>1:1.88</td>
<td>1:0.57</td>
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</tr>
<tr>
<td>21–25</td>
<td>1</td>
<td>4.00</td>
<td>7.00</td>
<td>11.00</td>
<td>4.00</td>
<td>7.00</td>
<td>3.00</td>
<td>14.00</td>
<td>25.00</td>
<td>1:1.75</td>
<td>1:1.27</td>
<td>1:1.75</td>
<td>1:0.75</td>
<td></td>
</tr>
<tr>
<td>&gt;25</td>
<td>1</td>
<td>6.00</td>
<td>3.00</td>
<td>9.00</td>
<td>7.00</td>
<td>7.00</td>
<td>4.00</td>
<td>18.00</td>
<td>27.00</td>
<td>1:0.50</td>
<td>1:2.00</td>
<td>1:0.10</td>
<td>1:0.71</td>
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</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>1.66</td>
<td>2.25</td>
<td>3.92</td>
<td>1.14</td>
<td>1.48</td>
<td>0.81</td>
<td>3.44</td>
<td>7.37</td>
<td>1:1.35</td>
<td>1:0.76</td>
<td>1:1.28</td>
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</tbody>
</table>
Prevalence of Lice on Indian Birds


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REFERENCES