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A PARASITIC ASSOCIATION OF ODONATA (INSECTA) WITH *ARRENURUS* DUGÉS, 1834 (ARACHNIDA: HYDRACHNIDA: ARRENURIDAE) WATER MITES

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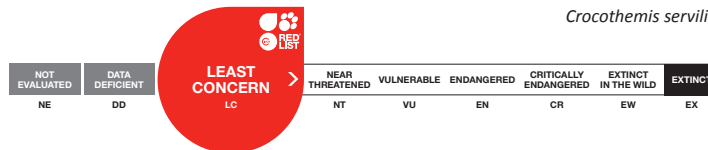
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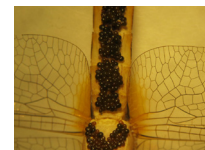
Abstract: The parasitic association between water mites (*Arrenurus* spp.) and Odonata is virtually ubiquitous wherever habitats suitable for both taxa exist. Yet, very little is known about this association within and among the odonate species of India. Here, we present a report on this parasitic relationship in the population of odonates of Wena Dam of Central India observed during the years 2011 and 2012. Of the 376 odonates collected for observation, 35(9.3%) individuals belonging to seven species (*Acisoma panorpoides*, *Brachydiplax sobrina*, *Ceriagrion coromandelianum*, *Crocothemis servilia*, *Diplacodes trivialis*, *Neurothemis tullia tullia*, *Trithemis pallidinervis*) were found to be parasitized by the *Arrenurus* spp. mites. The mites were found attached to the undersurface of the thorax and abdomen. In all the cases, the thorax was found infested while only in seven individuals the abdomen as well as the thorax was found infested with mites. A maximum number of mites on an individual dragonfly was in *C. servilia* (293) followed by *T. pallidinervis* (134) while the highest parasitic load per individual host species was found in *T. pallidinervis* (70.25%) followed by *C. servilia* (32.6%). The average parasitic load per individual female and male was 39.77 and 8.9, respectively.

Keywords: *Arrenurus*, ecto-parasites, Nagpur, Odonata, water mites, Wena Dam.

More than 55 mites of the genus *Arrenurus* mites have been described as ectoparasites of Odonata (Corbet 1999). During the final emergence, the mite larvae crawl from the exuvia to the newly emerged adult and become parasitic (Abro 1982; Andre & Cordero 1998; Zawal 2006) and remain attached to the host throughout the pre-reproductive period of the host but drop off in water when the odonate comes to copulate and oviposit in a water body. But after the study of Andrew et al. (2012a, b) very little is known about the natural history of these parasitic mites. The present paper incorporates the results of an investigation carried out during the year 2011–12 to survey odonate diversity and mite parasitic load on odonates at Wena Dam of central India.



Crocothemis servilia



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METHODS

Wena (Vena/ Wana) dam is a mid-sized reservoir built on Wena River and is situated on National Highway No. 6 between the cities of Nagpur and Amravati in the state of Maharashtra (central India). It is located at 21°9'6"N & 78°52'0"E near Wadgaon Village in Umred Taluka of Nagpur District. It lies 18km west to Nagpur City and provides water to the Ordnance factory and Kalmeshwar MIDC Area. The area lies in the southern fringe of Satpuda mountain range (21°10'N & 79°12'E) and is an undulating plateau with altitudes ranging between 274–305 m. The diurnal temperature varies from a minimum of 10°C in Dec–Jan (winter) to a maximum of 46°C in May–June (summer). The rainfall varies from 100–200 cm which precipitates mostly during the monsoon from June to September.

The odonate specimens were collected, photographed and were identified using standard manuals (Fraser 1933–36; Subramanian 2005; Andrew et al. 2008) to confirm their identity and later released. The details of the odonates parasitized with mites were noted and/or photographed. Some parasitized odonates were preserved in alcohol and Bouin's fluid for further investigation.

RESULTS

Arrenurus species are the only aquatic mites which form an ecto-parasitic association with adult odonates, the other two species which form a parasitic relationship are terrestrial mites, *Hydraphantes* and *Limnochares* spp. (Corbet 1999). During the study, 376 odonate species were examined for the presence of water mites. We found 35 odonates parasitized with *Arrenurus* mites (Images 1–7). These odonates belonged to the following species: *Acisoma panorpoides* Rambur, 1842 (5), *Brachydiplax sobrina* (Rambur, 1842) (2), *Ceriagrion coromandelianum* (Fabricius, 1798) (2), *Crocothemis servilia* (Drury, 1770) (14), *Diplacodes trivialis* (Rambur, 1842) (4), *Neurothemis t. tullia* (Drury, 1773) (4), and *Trithemis pallidinervis* (Kirby, 1889) (4). The species-wise prevalence of infestation is given in Table 1. The mites were found attached to the undersurface of the thorax and abdomen. In Odonata, the ventral-posterior region of the synthorax is composed of the fused metathoracic epimera sclerites and the central 'V' shaped pseudosternum cuticular plate forming an inverted Y shaped suture (Tillyard 1917; Chao 1953). The mites initially attach themselves to the suture and later invade the pseudosternum and then the ventral region of the epimera thereby invading the complete



Images 1–6. *Arrenurus* mite infestation on the thorax and abdomen of odonates of Wena Dam.

Crocothemis servilia (1M, 2M, 3F, 6F); *Acisoma panorpoides* (4F); *Brachydiplax sobrina* (5M). (M - male; F - female).

Table 1. List of *Arrenurus* aquatic mite infestation on Odonates at Wena Dam

	Species	Thorax		Abdomen		
		Number	Colour	Number	Colour	Segment
1	<i>Crocothemis servilia</i> (M)	06	Dark green	-	-	-
2	<i>C. servilia</i> (M)	02	Black	-	-	-
3	<i>C. servilia</i> (M)	10	Orange	-	-	-
4	<i>C. servilia</i> (M)	07	Orange	-	-	-
5	<i>C. servilia</i> (M)	44	Orange green	1	Orange green	I
6	<i>C. servilia</i> (M)	04	Orange	-	-	-
7	<i>C. servilia</i> (M)	03	Black	-	-	-
8	<i>C. servilia</i> (M)	08	Orange	-	-	-
9	<i>C. servilia</i> (M)	25	Orange	-	-	-
10	<i>C. servilia</i> (F)	05	Dark green	1	-	III
11	<i>C. servilia</i> (F)	01	Orange	-	-	-
12	<i>C. servilia</i> (F)	73	Black	220	Black	All
13	<i>C. servilia</i> (F)	08	Orange	-	-	-
14	<i>C. servilia</i> (F)	32	Black	06	Black	I, II
15	<i>Diplacodes trivialis</i> (M)	02	Dark green	-	-	-
16	<i>D. trivialis</i> (F)	04	Dark green	-	-	-
17	<i>D. trivialis</i> (F)	10	Dark green	-	-	-
18	<i>D. trivialis</i> (F)	08	Dark green	-	-	-
19	<i>Neurothemis tullia tullia</i> (M)	01	Orange	-	-	-
20	<i>N. t. tullia</i> (M)	02	Dark green	-	-	-
21	<i>N. t. tullia</i> (M)	06	Orange	-	-	-
22	<i>N. t. tullia</i> (F)	04	Orange	-	-	-
23	<i>Acisoma panorpoides</i> (M)	02	Orange	-	-	-
24	<i>A. panorpoides</i> (F)	18	Orange	34	Orange	I, IV
25	<i>A. panorpoides</i> (F)	01	Orange	-	-	-
26	<i>A. panorpoides</i> (F)	12	Orange	-	-	-
27	<i>A. panorpoides</i> (F)	08	Orange	-	-	-
28	<i>Brachydiplax sobrina</i> (M)	08	Dark green	-	-	-
29	<i>B. sobrina</i> (M)	05	Dark green	-	-	-
30	<i>Ceriagrion coromandelianum</i> (F)	01	Dark green	-	-	-
31	<i>C. coromandelianum</i> (F)	04	Dark green	-	-	-
32	<i>Trithemis pallidinervis</i> (M)	15	Orange	-	-	-
33	<i>T. pallidinervis</i> (F)	25	Orange	98	Orange	All
34	<i>T. pallidinervis</i> (F)	18	Orange	116	Orange	All
35	<i>T. pallidinervis</i> (F)	09	Orange	-	-	-

postero-ventral surface of the synthorax during severe infestation. Some may even move laterally along the metathoracic pleural sutures. In the abdomen, the mites initially attach themselves to the soft pleural folds between the abdominal sterno-tergum or between the inter tergal membranes. The site of attachment is often chosen where there is less sclerotisation of the host

cuticle (Baker et al. 2007). Although, there are reports of *Arrenurus* attached to the basal region of the wings (Abro 1982), such a condition was never found during the present study.

In all the cases the thorax was found infested, while only in seven individuals the abdomen as well as the thorax was found to be infested with mites. A maximum

Table 2. Prevalence of *Arrenurus* aquatic mite infestation on odonates at Wena Dam.

	Species	Total number of infected host	Prevalence of infestation
1	<i>Acisoma panorpoides</i>	5	14.28%
2	<i>Brachydiplax sobrina</i>	2	5.71%
3	<i>Ceriagrion coromandelianum</i>	2	5.71%
4	<i>Crocothemis servilia</i>	14	40%
5	<i>Diplacodes trivialis</i>	4	11.42%
6	<i>Neurothemis tullia tullia</i>	4	11.42%
7	<i>Trithemis pallidinervis</i>	4	11.42%

number of mites on an individual dragonfly was in *C. servilia* (293) followed by *T. pallidinervis* (134) while the highest parasitic load per individual host species was found in *T. pallidinervis* (70.25%) followed by *C. servilia* (32.6%). In *D. trivialis*, *N.t. tullia*, *A. panorpoides*, *B. sobrina* and *C. coromandelianum* the parasitic load per individual host species was found to be 6, 3.2, 15, 6.5 and 2.5, respectively. Among the 35 infected individuals 17 were males and 18 were females. The average parasitic load of female was 39.77/individual and for the male it was 8.9/individual (Tables 2, 3).

DISCUSSION

Water mites have three active stages: larva, deutonymph and adult. Deutonymph and adult mites are predators and the larva of most species is parasitic. Several orders of aquatic insects are hosts for water mites: Colembolla, Coleoptera, Diptera, Heteroptera, Odonata, Plecoptera and Trichoptera (Martin 2008). In *Arrenurus* Dugés, the initial period of attachment by the larva to its larval host (phoretic period) is followed by a parasitic stage on adult odonates. *Arrenurus* is one of the most speciose water mite genera, occurring in most zoogeographic regions (Zawal 2008). The overall prevalence of *Arrenurus* mite infestation on odonates was 9.3% at Wena Dam. While it is 6.86% at Telenkhedi pond of Nagpur City (Andrew et al. 2012a) suggesting that the mite population of Wena Dam is higher than that of Telenkhedi Pond. The present paper reports the first record of *Arrenurus* infestation in a zygopteran odonate i.e. *C. coromandelianum*. In the present study it has been observed that the mite prefer the thoracic region as the site of attachment. A similar situation was reported by (Botman et al. 2002; Zawal 2006; Zawal & Dyatlova 2006) although in the Zygoptera *Lestes sponsa*, the mites exclusively prefer the abdominal region (Zawal

Table 3. Number of *Arrenurus* aquatic mites on male and female odonates of Wena Dam

Host species	Infected host	Number of mites		
		Male	Female	Total
<i>Acisoma panorpoides</i>	1M, 4F	02	73	75
<i>Brachydiplax sobrina</i>	2M	13	-	13
<i>Ceriagrion coromandelianum</i>	2F	-	05	05
<i>Crocothemis servilia</i>	9M, 5F	110	346	456
<i>Diplacodes trivialis</i>	1M, 3F	02	22	24
<i>Neurothemis tullia tullia</i>	3M, 1F	09	04	13
<i>Trithemis pallidinervis</i>	1M, 3F	15	266	281
Total	17M, 16F	151	716	867

F - females; M - males

2004, 2006).

The mite infestation was not host or sex specific since the ratio was almost equal (17 males, 18 females), but the parasitic load per female (39.77%) was much higher than the male (8.9%) indicating that the mites preferred females to males although reproductive behaviour is supposed to favour the female as a preferential host as postulated by some workers (Forbes et al. 2004; Robb & Forbes 2006; Andrew et al. 2012a). In the female, vitellogenesis during egg maturation results in the passage of nutritive rich material through the haemolymph during the pre-reproductive period (Tembhare 2012). Since the mites feed on haemolymph, we believe that it is more beneficial to the mite to choose a female as host. The mites engorge on this nutritive material and probably develop faster in comparison with those infecting the male. The mites were found in three colours, orange (18 individuals), dark green (11), and black (4). The mites progressively change colour almost in unison and therefore the colour pattern on an individual host is uniform as found in the present study. This contention was further strengthened by the observation that there was no colour differentiation between the thoracic and abdominal mites and all the mites of the individual simultaneously change colour during their growth and development. In one dragonfly *C. servilia*, all the 45 mites on the hosts thorax and abdomen were found in a transitional stage with a green centre and an orange fringe along the border. The only infected Zygoptera found in Wena reservoir were two females of *C. coromandelianum*.

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