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Ectoparasitism of Libellulids by water mite (*Arrenurus*) in Central India: preference of sex and site.

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ABSTRACT
Very little is known about the parasitic association between water mites (*Arrenurus*) and odonate species of India. The parasitic relationship in the population of odonates of Nagpur region was analysed to find sexual dimorphism in parasitic load and choice of site of attachment in anisopteran dragonflies. A total of 580 odonates were screened and 49 (8.44%) were found to be parasitized by *Arrenurus* mites. The following anisopteran dragonflies- *Acisoma panorpoides, Crocothemis servilia, Neurothemis tullia tullia, Trithemis pallidinervis,* were considered because they formed the major bulk of parasitized species. The mites were found attached to the under-surface of the thorax and abdomen. In *A. panorpoides,* all the mites were found at the thoracic region but the female had a heavy load of 86% per individual. In *C. servilia*, 84% of the average total parasitic load was carried by the female. In *N. t. tullia,* only the thorax was infected and the parasitic load was almost equally divided. *Heaviest infection was found in T. pallidinervis at the average rate of 43 (male) and 56 (female) parasites per host.* The thorax of all the infected individuals both male and female carried parasitic load, while the abdomen of all the females (except *Acisoma panorpoides*) and male of *Trithemis pallidinervis* was found to be infected with *Arrenurus* mites. The average percentage parasitic load per individual male and female was 19.7% and 80.3%. For thoracic region it was 32% for male and 68% for female while in the abdominal region it was 9.3% for male and 90.7% for female.

Keywords: *Arrenurus,* anisopteran, odonates, parasitic association, water mites.

INTRODUCTION

Arrenurus spp. are common ectoparasite of dragonflies and damselflies [1] and about 55 species of the mite have been described on Odonata [2]. Arrenurid larvae exploit their odonates hosts not only for food and dispersal but also form a phoretic association with the last instar larvae of the host. As the host emerges out of water during the final metamorphosis, the mite larvae crawl from the exuvia to the newly emerged adult and become parasitic [3],[4]. Mites remain attached to the host throughout the pre-reproductive period of the host and progressively change color almost in unison. They drop off in water when the odonate comes to copulate and oviposit in a water body. In Odonata, mite parasitism can reduce host longevity and fecundity [5],[6]. This paper tries to evaluate the parasites choice regarding the sex of the host and the site of attachment in anisopteran dragonflies.

METHODOLOGY

Dragonflies were collected during the months of August-September (post-monsoon) and March- April, (summer) (2009-2015) from the west border of Telenkhedi pond located on the foothills of the Seminary hillock of Nagpur city of central India. The second site of collection was a mid-sized reservoir, the Wena dam which is built on Wena river and is situated on National Highway No. 6 between Nagpur and Amravati. Only those individuals infected with arrenurids were photographed and some were fixed in the Bouin's fluid for further studies. A total of 580 odonates were screened and 49 (8.44%) individuals belonging to seven species (*Acisoma panorpoides, Brachydiplax sobrina, Brachythemis contaminata, Ceriagrion coromandelianum, Crocothemis servilia, Diplacodes trivialis, Neurothemis tullia tullia, Trithemis pallidinervis*) were found to be parasitized by the *Arrenurus* mites. To study the sexual dimorphism and choice of site of attachment the following four dragonflies- *Acisoma panorpoides, Crocothemis servilia, Neurothemis tullia tullia* and *Trithemis pallidinervis,* were considered because they formed the major bulk of parasitized species (Fig.A).

RESULTS AND DISCUSSION

Arrenurus species are the only aquatic mites who form ecto-parasitic association with adult odonates, the other two species which form parasitic relationship are terrestrial mites, *Hydraphantes* and *Limnochares* spp. [2]. In the present study, mites were found attached to the undersurface of the thorax and abdomen. The ventral-posterior region of the synthorax is composed of the fused metathoracic-epimera sclerites and the central 'V' shaped pseudo-sternum cuticular plate forms an inverted Y shaped suture. In the abdomen, the mites initially attach 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 [7],[8]. Although, there are reports of *Arrenurus* attached to the basal region of the wings [9], such condition was never found during the present study. The details of *Arrenurus* mite infestation on male and female of selected species of odonates along with their distribution in thorax and abdomen is illustrated in Table 1-5.

Table 2. *Arrenurus* mite infestation on *Acisoma panorpoides*

Acisoma panorpoides	No. infected	No. of mites	Mites/ host	Region	
				Thorax	Abdomen
Male	01 (12.5%)	02 (2.3%)	02 (14%)	02 (2.3%)	00
Female	07 (87.5%)	85 (97.7%)	12 (86%)	85 (97.7%)	00
TOTAL	08	87	14	87	00
Regional Division (%)		100%		100%	00%

Table 1. List of *Arrenurus* mite infestation on male and female of selected species of odonates along with their distribution in thorax and abdomen.

SPECIES	No. infected	No. of mites	Region	
			Thorax	Abdomen
Acisoma panorpoides- Male	01	02	02	00
A. panorpoides- Female	07	85	85	00
Crocothemis servilia- Male	10	111	111	00
C. servilia- Female	08	465	205	260
Neurothemis t. tullia- Male	04	20	20	00
N. t. tullia- Female	01	04	04	00
Trithemis pallidinervis- Male	02	85	37	48
T. pallidinervis- Female	05	274	64	210
Total	38	1046	528	518
Male	17 (45%)	218 (19.7%)	170 (32%)	48 (9.3%)
Female	21 (55%)	828 (80.3%)	358 (68%)	470 (90.7%)

Table 3. *Arrenurus* mite infestation on *Crocothemis servilia*

Crocothemis servilia	No. infected	No. of mites	Mites/ host	Region	
				Thorax	Abdomen
Male	10 (55.5%)	111 (19%)	11 (16%)	111 (35%)	00
Female	08 (44.5%)	465 (81%)	58 (84%)	205 (65%)	260 (100%)
TOTAL	18	576	69	316	260
Regional Division (%)		100%		55%	45%

Table 4. *Arrenurus* mite infestation on *Neurothemis t. tullia.*

Neurothemis t. tullia	No. infected	No. of mites	Mites/ host	Region	
				Thorax	Abdomen
Male	04 (80%)	20 (83%)	05 (55%)	20 (83%)	00
Female	01 (20%)	04 (17%)	04 (45%)	04 (17%)	00
TOTAL	05	24	9	24	00
Regional Division (%)		100%		100%	-

Table 5. *Arrenurus* mite infestation on *Trithemis pallidinervis*

Trithemis pallidinervis	No. infected	No. of mites	Mites/ host	Region	
				Thorax	Abdomen
Male	02 (29%)	85 (24%)	43 (44%)	37 (36.5%)	48 (18.5%)
Female	05 (71%)	274 (76%)	55 (56%)	64 (63.5%)	210 (81.5%)
TOTAL	07	359	98	101	258
Regional Division (%)		100%		(28%)	(72%)

In *A. panorpoides,* all the mites were found at the thoracic region but the female had a heavy load of 86% per individual. In *C. servilia*, 84% of the average total parasitic load was carried by the female. In *N. t. tullia,* only the thorax was infected and the parasitic load was almost equally divided. *Heaviest infection was found in T. pallidinervis at the average rate of 43 (male) and 56 (female) parasites per host. To summarise,* the thorax of all the infected individuals both male and female carried parasitic load, while the abdomen of all the females *(*except *Acisoma panorpoides)* and male of *Trithemis pallidinervis* was found to be infected with *Arrenurus* mites. The average percentage parasitic load per individual male and female was 19.7% and 80.3%. For thoracic region it was 32% for male and 68% for female while in the abdominal region it was 9.3% for male and 90.7% for female. The average parasitic load of female is four times higher than the male clearly indicating that mites preferred female to male. Reproductive behaviour is supposed to favour the female as a preferential host as postulated by some workers [10],[11],[12],[13]. In female, vitellogenesis during egg maturation results in passage of nutritive rich material through the haemolymph during the pre-reproductive period [14]. 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 of those infecting the male. Secondly, being hitched to female is ethologically more beneficial to the mite, since she is bound to come in much closer contact with water then the male during oviposition, which makes it easier for the mite to re-enter in the aquatic body since it is a prerequisite for the further development of the parasite.

CONCLUSION

- The parasitic relationship in the population of odonates was evaluated in order to find sexual dimorphism in parasitic load and choice of site of attachment in anisopteran dragonflies.
- *Arrenurus* species are the only aquatic mites who form ecto-parasitic association with adult odonates.
- The average parasitic load of female is four times higher than the male clearly indicating that mites preferred female to male.
- The mites feeding on haemolymph chose females as host because in vitellogenesis during egg maturation results in passage of nutritive rich material through the haemolymph during the pre-reproductive period
- The mites engorge on this nutritive material and probably develop faster in comparison of those infecting the male.
- Being hitched to female is ethologically more beneficial to the mite.

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