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Prevalence of Ectoparasitism among Water Birds at *in-situ* and *ex-situ* Conservations of Tamil Nadu, India

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ABSTRACT: Birds may harbor a great variety and number of ectoparasites. In birds, many of the studies have focused on parasites and host reproductive success. Parasitism may affect the reproduction of hosts; nestlings support high numbers of host reproductive success. With this background, a study was conducted to explore the prevalence of ectoparasites in migratory and resident water fowl of wildlife sanctuaries and zoos in and around Chennai, Tamil Nadu state, India. Ectoparasitic fauna such as ticks and lice were identified in fallen feather samples collected from both the free-ranging areas and captive bird areas under study. Ticks have been identified as *Argas persicus* and lice as *Lipeurus caponis*. At Vedanthangal Bird Sanctuary, 17.50% of 40 samples revealed evidence of ectoparasites in water birds, while 10% of 10 samples at Karikili Bird Sanctuary respectively. Study carried out with fallen feather samples (n=40) from Arignar Anna Zoological Park revealed ectoparasitic evidence comprising of ticks and lice in 25% of the feather samples, with 60% obtained from water birds reared at Guindy Children's Corner. In terms of tick prevalence, there were highly significant differences (P<0.01) between these two locations. In comparison between *in-situ* and *ex-situ* areas, highly significant variations (p≤0.01) were revealed in ticks (*Argas persicus*) as well as in the overall positivity of ectoparasitic prevalence.

Keywords: Ectoparasites, *in*-situ, *ex*-situ, Migratory and Resident water birds.

INTRODUCTION

Wetlands are essential for the survival of 20% of threatened species, including water fowl and Indian wetlands are facing a serious threat due to pollution, developmental activities, eco disruption, and increasing human interference into the domain of nature. Such forces along with climate change has led to several changes in the demography and ecosystem of the water birds. The migratory nature of the water birds is important with respect to disease incidence as contamination, infestation and infection could lead to spread of disease over a vast geographic area. Birds may harbor a great variety and number of ectoparasites. In birds, many of the studies have focused on parasites and host reproductive success. Parasitism may affect the reproduction of hosts; nestlings support high numbers of host reproductive success (Merino *et al.*, 1999). Parasites are often categorized into ectoparasites and endoparasites. Ectoparasites infest on or into the surface of their host's epidermis, the main groups of which include mites, ticks, flies, myiasis, fleas and lice (Wall and Shearer 2001). In contrast, endoparasites find a way into the host body cavity or organ, and the main groups contain protozoa, monogeneans, trematodes, cestodes, nematodes, and acanthocephalans (Kamiya *et al*., 2014). In this scenario, it is important to document the nature of pathogens including ectoparasites infesting water birds. Turner (1971) suggested that pediculosis (lice) was the common external parasite of birds and all were Mallophaga, or chewing lice. Wallach and Boever (1983) opined that ectoparasites were among the most common of the clinical problems encountered by the clinician caring for the games birds and water birds. Benbrook *et al.* (1965) opined that the fowl ticks (*Argas persicus*) stayed on the host birds to feed for only five to seven days and then lived in the environment. Wallach and Boever (1983) reported the fowl ticks (*Argas persicus*) in chickens, turkeys, ducks, geese, guinea fowls, pigeons, doves, and quail. The parasitized host body can be stunted or cause gigantism (Frainer *et al.*, 2018).

Wallach and Boever (1983) reported that the clinical signs of pediculosis, air sac mites, flea infestation, depression, anemia, and pruritis in game birds and water birds were limited to increased desire for dust baths and client complaints. Bedbugs, nasal mites, and fowl ticks also produced anemia in game birds and water birds. Avian lice caused restlessness, annoyance, loss of body weight, drop in egg production, feather breakage, and frantic preening. Ectoparasites like fleas and ticks may cause irritation, anorexia, allergic reactions, decrease in animal products, myiasis, and may transmit some parasitic, bacterial, rickettsial, and viral diseases to birds (Dik and Kandir 2021). This study was planned to identify the routinely occurring ectoparasitic infestations in migratory and resident water birds in *in-situ* conservation (Vedanthangal and Karikili Bird Sanctuary) and *ex-situ* conservation (Arignar Anna Zoological Park, Vandalur and Guindy Children Park, Chennai). Wimberger (1984) mentioned that ectoparasite transmission occurs when mammals are taken by birds; owls have been found infested with rodent's fleas.

MATERIALS AND METHODS

Study areas and period. This study included migratory and resident birds from both *in-situ* (Vedanthangal Bird Sanctuary and Karikili Bird Sanctuary) and *ex-situ* (Arignar Anna Zoological Park, Vandalur, and Guindy Children's Corner). The study lasted ten months, from September 2011 through June 2012. The birds were identified as per Grimmett and Inskipp (2005).

Sample collection, preservation and analysis

The fallen feathers were collected from migratory and resident birds of *in-situ* and *ex-situ* sites and stored in air-tight containers with 10% formalin as described by Soulsby (1982) for examination of the evidence of ectoparasite. The containers were sealed with parafilm coverage, labeled and stored properly. Details of the samples collected are presented in Table 1.

The feathers were examined for ticks and nits. They were made into pieces and placed in 10 ml of 10% sodium hydroxide solution. The test tube was cooled and centrifuged at 2000 rpm for 5 minutes. The supernatant was decanted and a small quantity of sediment was placed on a microscopic slide. The slides were examined microscopically under both low and high-power objective lenses.

Analysis of data was carried out scientifically and statistical analysis (Chi-square test) was done (Snecdor and Cochran 1994).

RESULTS AND DISCUSSION

Ectoparasites in free-ranging water birds. The species of external parasites identified in the free-ranging birds were *Argas persicus* (tick) and *Lipeurus caponis* (lice).

Among the collected samples 17.5 percent of the feathers examined indicated evidence of infestation with external parasites. *Argas persicus* (Fig. 1c and d) was the tick encountered in 2 (5%), and *Lipeurus caponis* (Fig. 1a and b) were the lice encountered in 5 (12.5%) samples. The processed lice *Lipeurus caponis* (head) and tick *Argas persicus* (mouth parts) were shown in figure 1.b and figure 1. e, f respectively. Statistical analysis revealed no significant differences between the prevalence of different species of ectoparasites in these sanctuaries. The prevalence of *Argas persicus* ticks on vulture and heron has been reported by Abdussalam and Sarwar (1953); Davis *et al.* (1971). This suggests that the ticks may persist in water birds roaming freely in the sanctuaries or wetlands.

Prevalence of *Lipeurus caponis* species were in agreement with the findings of Wallach and Boever (1983). Urquhart *et al.* (1994) opined that *Lipeurus* sp. lice were grey in colour, found close to the skin, and the wing louse *Lipeuruscaponis* preferred the base of the wing and tail feather and also reported that they could cause irritation in free-ranging water birds like spot-billed grey pelican and open billed stork due to their slow movement patterns in the wings.

Ectoparasites in captive water birds. Out of 40 feather samples obtained from Arignar Anna Zoological Park, Vandalur, 10 of the samples (25%) revealed evidence of external parasites. Out of 20 feather samples obtained from Guindy Children's Corner, Chennai, 12 of the samples (60%) revealed evidence of external parasites. Layers of patches of ticks were also noticed below the barks of the trees found within the aviary enclosure of Guindy Children's Corner, Chennai (Fig. 1c and d). Statistical analysis revealed highly significant variations in tick infestation and overall positivity between the two captive bird areas under study, but the results were non-significant for lice infestation. The lice and plumicolous mites, however, are typically the most abundant forms present on avian hosts (Boyd, 1951). The prevalence of ticks in both sanctuaries was higher than the prevalence of lice. *Argas persicus* ticks were encountered in the fallen feather samples of water birds reared in both captive locations. Turner (1971) suggested that pediculosis was a common external parasitic condition of birds that occurred due to lowered host nutrition, filthy environment, debeaking increased incidence of louse infestation. The overall ectoparasitism was significantly high in Guindy Children's Corner, Chennai compared to that of Arignar Anna Zoological Park, Vandalur. This may be due to the high bird density at Guindy Children's Corner, Chennai over Arignar Anna Zoological Park, Vandalur.

Overall ectoparasitic prevalence in migratory and resident birds of sanctuaries. This study found ticks (*Argas persicus*) and lice (*Lipeurus caponis*) in 1 and 2 feather samples of Spot-billed grey pelicans, open-billed storks, and herons respectively. In one sample of resident birds, tick infestation was revealed in heron, and lice were encountered in 4 samples. The overall positivity of ectoparasitic prevalence in migratory and resident birds of sanctuaries was 3 (37.5% of samples) and 4 (11.11% of samples). Gauthier-Clerc *et al.* (1998) mentioned that *Ixodes uriae* has a circumpolar distribution in both hemispheres and is known to be the vector of a number of arbovirus and of the Lyme disease agent (*Borrelia burgdorferi*).

Overall ectoparasitic prevalence in *in-situ* and *ex-situ* areas. The overall ectoparasitic prevalence of water birds in sanctuaries was16 %, while in captive areas, it was 36.67 %. Ticks and lice were encountered in 2 and 6 samples from *in-situ* areas respectively, while 17 and 5 samples from *ex-situ* areas respectively are presented in Table 2 and 3. Statistical analysis revealed a significant variation in the prevalence of tick infestation and total positivity between *in-situ* and *ex-situ* areas. This may be because the captive birds depend on few perching trees compared to that of free-ranging water birds. Hence the ticks lie under the barks of these perching trees of bird enclosures of *in-situ* areas and feed on water birds. Whereas the free-ranging water birds make themselves free from ectoparasite infestation by behavior like anting, flight, etc. Khater *et al*. (2013) reported that peracetic acid (PAA) inhibits molting effectively (28 %) when compared with that of delta methrin DMT (52 %). Results indicated that PAA is a more potent and promising acaricide against *A. persicus* (in vitro and in vivo) than DMT. Dusts containing commercially prepared *Bacillus thuringiensis* reduced the numbers of chicken body lice, *Menacanthus stramineus*; shaft lice, *Menopon gallinae*; and wing lice, *Lipeurus caponis*, on white leghorn hens treated by direct application or by using dust-bath. One or more direct applications of 3.6 g *B. thuringiensis* per 5.5 kg sand provided incomplete control.

CONCLUSIONS

Ectoparasites like ticks and lice can affect free-ranging water birds, and the incidence was higher in captive habitats. Preventive measures to control ectoparasites include disposal of dead birds, and breaking the life-cycle of the ectoparasite through interventions in habitat including tree barks. In severe cases, treatment with ectoparasiticide applications or parenteral injections could be advocated. The barks of the trees should be examined for evidence of ectoparasites and acaricides should be used without damage to the tree. Contacts between captive water birds and free-ranging water birds should be prevented to minimize the spread of ectoparasitic infection.

Table 1: Feather samples Collected from the i*n-situ* and e*x-situ* study areas for ectoparasitic examinations.

Birds	*In-situ*		*Ex-situ*	
	Vedanthangal Bird Sanctuary	Karikili bird Sanctuary	Arignar Anna Zoological Park, Vandalur	Guindy Children's Corner, Chennai
Heron	14#	4#	5	4
Egret	14#	4#	5	4
Open Billed Stork	2*	-	-	-
Painted Stork	2*	-	5	-
Blacked-headed ibis	2*	-	2	4
Spot-Billed Grey Pelican	2*	-	2	2
Black-necked stork	-	-	1	-
Rose pelican	-	-	3	2
Other water birds	4#	2#	17	4
Total Number of samples (N)	**40**	**10**	**40**	**20**

***** Migratory # Resident

Table 2: Ectoparasitic prevalence in water birds at *in-situ* and *ex-situ* study areas.

Ecto parasites	*In-situ*			*Ex-situ*		
	Vedanthangal Bird Sanctuary	Karikili Bird Sanctuary	Chi square test	Arignar Anna Zoological Park, Vandalur	Guindy Children's Corner, Chennai	Chi square test
Number of samples	**(N = 40)**	**(N = 10)**	**(X^2)**	**(N = 40)**	**(N = 20)**	**(X^2)**
Ticks (*Argas persicus*)	2(5%)	-	0.52 NS	7(17.5%)	10 (50%)	**6.94****
Lice (*Lipeurus caponis*)	5(12.5%)	1(10%)	0.05 NS	3(7.5%)	2 (10%)	0.11 NS
Total positive samples	7(17.50%)	1(10%)	0.33 NS	10	12	**7.03 ****

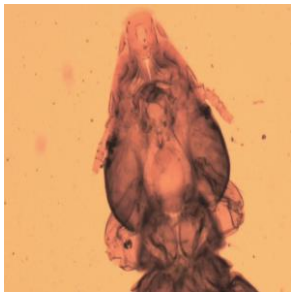
NS – Non significant ****** Highly significant (P ≤0.01).

Table 3: Overall Ectoparasitic Prevalence in water birds at *in-situ* and *ex-situ* study areas.

Parasites	*In-situ* areas (N = 50)	*Ex-situ* areas (N = 60)	Chi square test (X^2)
Ticks (*Argas persicus*)	2(4%)	17(28.33%)	**11.30****
Lice (*Lipeurus caponis*)	6(12%)	5(8.33%)	0.41 NS
Total positive samples	8(16%)	22(36.67%)	**8.75****

****** Statistically highly significant (P ≤0.01)

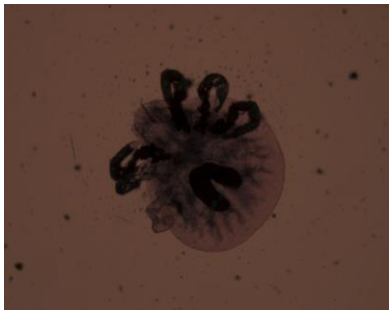
(a) Lice - *Lipeurus* sp.



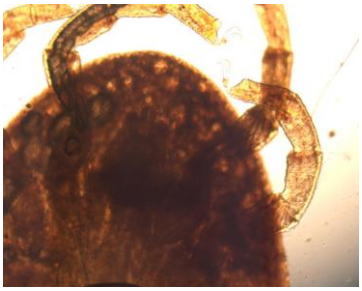
(b) Lice - *Lipeurus* sp.- *Head*

(c) Ticks – below the bark of trees

(d) Ticks –below the barks of trees



(e) Tick – *Argas persicus*



(f) Tick – *Argas persicus* (mouth parts)

Fig. 1. Ectoparasitic identified in water birds at *in-situ* and e*x-situ* study areas.

FUTURE SCOPE

The water birds maintained under captive conditions (*ex-situ*) should be examined for ectoparasites periodically and control measures for the same should be done.

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3. The Wildlife Warden, Guindy Children's Park, Chennai.

Conflict of Interest. None.

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