ECTOPARASITIC FAUNA OF BIRDS, AND VOLANT AND NON-VOLANT SMALL MAMMALS CAPTURED AT SRINAKARIN DAM, KANCHANABURI, THAILAND

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Abstract. The investigation of ectoparasitic fauna on birds, and volant and non-volant small mammals at Srinakarin Dam, Kanchanaburi Province, Thailand was carried out under a national biodiversity and disease surveillance program for four consecutive months: January, February, May and June 2009. A total of 122 animals, comprised of 15 species of birds, 9 species of volant small mammals and 8 species of non-volant small mammals were examined for ectoparasite infestation. Of these animals, 1 genus of hard ticks (Ixodidae), 2 species of mesostigmatid mites (Laelapidae), 4 genera in three families of astigmatid mites (Proctophyllodidae, Pteronyssidae and Trouessartiidae), 4 species in three families of lice (Philopteridae, Polyplacidae and Trichodectidae) and 2 families of batflies (Nycteribiidae and Streblidae) were collected. This is the first survey conducted to determine ectoparasites infesting birds and small mammals living in the reserved forest of Srinakarin Dam, Thailand. A lower infestation rate of ectoparasites was observed in mammals, ranging from 3.5% to 10.3% than birds, with infestation rates between 7.3% and 34.2%. No major potential health risks to people who lived in this area were found.

Key words: ectoparasites, bird, small mammal, Srinakarin Dam, Thailand

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INTRODUCTION

Srinakarin Dam is the largest rockfill dam with a clay core in Thailand, situated on the Kwai Yai River in Kanchanaburi Province (Fig 1). The dam is 140 meters high measured from the base, with a ridge measuring 610 meters long and 15 meters wide. The water storage capacity is 17.45 million cubic meters. This multi-purpose

dam is used for irrigation, flood damage relief in the Mae Klong Basin, electricity generation and fishery. The location above the dam ridge is suitable for relaxation, and has many tourist attractions (DNP, 2008). The study area was a hill-forest consisting of approximately 1,025 rai (1 rai = 1,600 m^2) located above the dam along to the Kwai Yai River.

Several studies of ectoparasites on birds or small mammals in Thailand have been conducted (Maclure and Ratanaworabhan, 1973; Uchikawa and Suzuki, 1980; Takada *et al*, 1984; Tanskul and Gingrich, 1986; Coleman *et al*, 2003; Archawaranon and Subinprasert, 2005; Wootta *et al*, 2008; Lerdthusnee *et al*, 2008). Those results demonstrate the distribution and host relationships with ectoparasites in Thailand.

A survey of ectoparasites has not been previously conducted at Srinakarin Dam, Kanchanaburi, Thailand. This study serves as baseline information of ectoparasitic fauna in the area. This study aimed to acquire data regarding the distribution and host interactions of ectoparasites from birds and volant and non-volant small mammals in the reserved forest of Srinakarin Dam, Kanchanaburi Province, Thailand. This study also determined whether the presence of ectoparasites pose a potential public health for people who are living within the vicinity of the reserve forest.

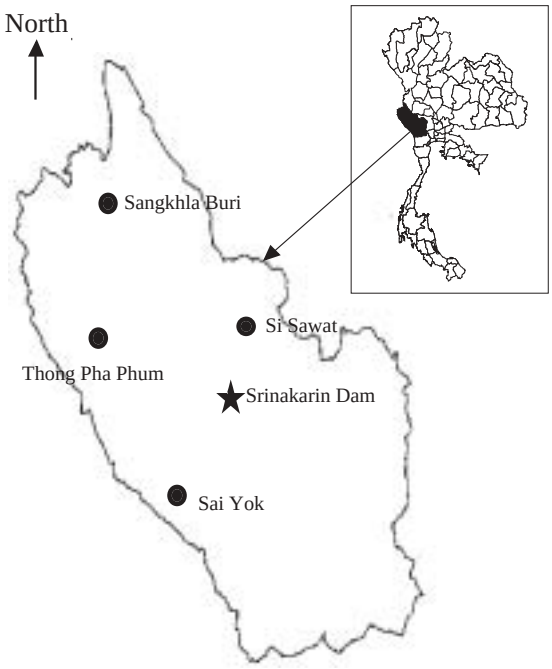

Fig 1–Map of Kanchanaburi, Thailand showing Srinakarin Dam.

MATERIALS AND METHODS

Trapping of birds and volant and non-volant small mammals

The trapping of birds and volant and non-volant small mammals was conducted in January, February, May and June 2009, at the hill-forest located around Srinakarin Dam. Trapping sites were selected by foresters in the area based on the availability of food and animal density. The animals were collected once per month per collection site.

The birds and volant small mammals were captured using mist nets, while non-volant small mammals were trapped with cage traps. A total of 40 cage traps were set up per night along a transect line. The traps were baited with banana, papaya, coconut or dried fish. The mist nets were set up from 4:00 to 9:00 PM along trails. The nets were observed every 15 minutes, while cage traps were checked daily in the early morning. Since the ectoparasites were directly collected from host animals, no attempt was made to collect ticks by flagging or dragging methods with towels over vegetation from where the animals were trapped.

Collection of ectoparasites

Animals trapped were placed in cloth bags. Later, those bags were turned inside-out, and their contents were shaken onto a paper and these were examined for ectoparasites. The species of animals were identified using the references: "A guide to the birds of Thailand" by Lekagul and Round (1991), and "A guide to the mammals of Thailand" by Francis (2008).

Non-volant small mammals were individually anesthesized with ether or isoflurane before examining for ectoparasites. The anesthesized animals were placed in a white enamel tray and combed vigorously from the tail end forward with a fine comb. The dislodged ectoparasites that fell from the host to the bottom of the enamel tray were collected with a fine pointed forceps or a wet applicator stick. The ectoparasites that were found around the eyes, ears, nose, nasal cavity, snout and other parts of the body were also removed with forceps. Nasal passages of rodents were dissected and investigated for chiggers (Mariana *et al*, 2005).

All the ectoparasites were placed in labeled collection tubes for further processing. A separate tube was used for each animal.

For volant small mammals, special attention was given to the wing membranes, eyelids, earlobes and nose. The fur of bats was parted with forceps and examined for ectoparasites.

Captured birds were removed from the nets, and placed in separate cloth bags, then carried to a place set aside for ectoparasite collection. After each use, the bags were reversed and shaken out to reduce the chance of parasite-contamination between species. A general examination for ticks, lice, astigmatid and mesostigmatid mites and chiggers was conducted of the skin and primary and secondary feathers of the captured birds. Examination of the skin and feathers under both wings and the anal portion of the birds was also given priority.

After collection of ectoparasites, the animals were marked (leg bands for birds, ear tags for non-volant small mammals and wing tags for bats) before they were released back into the wild. Recaptured animals were not included in this study.

Preservation and mounting of ectoparasites

All the ectoparasites were preserved in 70% alcohol. All preserved ectoparasites, excluding ticks, were later mounted for identification. Astigmatid and mesostigmatid mites were mounted in Hoyer's medium (Krantz, 1978). Mounted slides were then incubated at 40ºC for a week and cover-slips were ringed with paint to prevent desiccation of medium during storage.

Identification of ectoparasites

Ticks were identified directly under a stereoscope, while mesostigmatid mites and lice were mounted before being identified. All mesostigmatid mites and lice were identified to species level using available taxonomic keys (Lane and Crosskey, 1993; Price and Graham, 1997). Ticks, astigmatid mites and bat flies were identified only to genus level using taxonomic keys (Furman and Catts, 1982; Varma, 1993).

Determination of infestation rate and potential health risk

Ectoparasitic infestation rates on birds and volant and non-volant small mammals were determined and expressed in percentages. The potential public risk was documented based on the presence of ectoparasites that can serve as vectors of human diseases.

Table 1A
Ectoparasitic infestation rates on birds at Srinakarin Dam, Kanchanaburi, Thailand (January to June, 2009).

Host / species	No. of hosts caught	No. of hosts infested by particular ectoparasite				
		Arachnida			Insecta	
		Ticks	Mites		Lice	Bat flies
			Mesostigmatids	Astigmatids		
Birds						
Cyornis tickelliae	3	-	-	-	1	-
Hypothymis azurea	1	-	-	1	-	-
Cyonis hainana	1	-	-	1	-	-
Macronous gularis	1	-	-	1	-	-
Pelloreum ruficeps	3	-	-	1	-	-
Dicrurus leucophaeus	1	-	-	1	-	-
Copsychus malabaricus	5	4	-	5	1	-
Rhipidura javanica	8	-	-	4	1	-
Glaucidium cuculoides	1	-	-	-	-	-
Phylloscopus inornatus	1	-	-	-	-	-
Orthotomus sutorius	1	-	-	-	-	-
Pycnonotus finlaysoni	1	-	-	-	-	-
Pycnonotus blanfordi	12	-	-	-	-	-
Lonchura striata	1	-	-	-	-	-
Pitta moluccensis	1	-	-	-	-	-
Total	41	4	0	14	3	0
Infestation rate (%)		9.8	0	34.1	7.3	0

(-) means no ectoparasites were collected from the particular animal.

RESULTS

A total of 122 animals, comprised of 15 species of birds, 9 species of volant small mammals and 8 species of non-volant small mammals, were captured and examined for ectoparasite infestation. The species of birds, and volant and non-volant small mammals caught, and the ectoparasite infestation rates, are shown in Tables 1A and 1B.

Non-volant small mammals were the most common captured animals. The most common species of volant and non-volant small mammals captured were North Malayan Horseshoe Bats (*Rhinolophus malayanus*) and Long-tailed Giant Rats (*Leopoldamys neilli*), respectively. The most common species of birds was the Stripe-throated Bulbul (*Pycnonotus blanfordi).*

The ectoparasites collected from the different animal hosts were mainly from the class Arachnida – ticks and mites and the class Insecta-specifically lice and bat flies. The ectoparasites found are shown in Table 2.

Arachnids

Ticks. Only one species of tick (*Hemaphysalis* sp) (Ixodidae) was found on birds,

Table 1B
Ectoparasitic infestation rates on volant and non-volant small mammals at Srinakarin Dam, Kanchanaburi, Thailand (January to June, 2009).

Host / species	No. of hosts caught	No. of hosts infested by particular ectoparasite				
		Arachnida			Insecta	
		Ticks	Mites		Lice	Bat flies
			Mesostigmatids	Astigmatids		
Non-volant small mammals						
Order: Rodentia						
Maxomys surifer	4	-	4	-	-	-
Rattus rattus	8	-	2	-	1	-
Leopoldamys neilli	20	-	-	-	-	-
Menetes berdmorei	15	-	-	-	-	-
Callosciurus caniceps	1	-	-	-	-	-
Order: Scandentia						
Tupaia glis	8	-	-	-	-	-
Order: Carnivora						
Paradoxurus hermaphrodites	1	-	-	-	1	-
Order: Primates						
Nycticebus coucang	1	-	-	-	-	-
Total	58	0	6	0	2	0
Infestation rate (%)		0	10.3	0	3.4	0
Volant small mammals						
Order: Chiroptera						
Rhinolophus malayanus	7	-	-	-	-	1
Miniopterus pusillus	3	-	-	-	-	-
Aselliscus stoliczkanus	1	-	-	-	-	1
Tylonycteris pachypus	2	-	-	-	-	-
Hipposideros larvatus	1	-	-	-	-	-
Cynopterus horsfieldii	1	-	-	-	-	-
Megaderma spasma	1	-	-	-	-	-
Cynopterus sphinx	6	-	-	-	-	-
Rhinolophus coelophyllus	1	-	-	-	-	-
Total	23	0	0	0	0	2
Infestation rate (%)		0	0	0	0	8.7

(-) means no ectoparasites were collected from the particular animal.

particularly on the White-rumped Shama (*Copsychus malabaricus*), with an infestation rate of 9.8%.

Mites: Mesostigmatid mites. Mesostigmatid mites were found only on non-volant small mammals with a 10.3% infestation rate. Two laelaptid species, *Laelaps echidninus* and *Laelaps nuttali*, were found on the Roof Rat (*Rattus rattus*), while *L. nuttali* was found only on the Yellow Rajah Rat (*Maxomys surifer*).

Mites: astigmatid mites. Four genera of

Table 2
Number of ectoparasites found on birds and volant and non-volant small mammals at Srinakarin Dam, Kanjanaburi, Thailand (January to June, 2009).

Species	Birds								Non-volant Small mammals			Bats	
	Cyornis tickelliae	*Hypothymis azurea*	*Cyonis hainana*	*Macronous gularis*	*Pelloreum ruficeps*	*Dicrurus leucophaeus*	*Copsychus malabaricus*	*Rhipidura javanica*	*Maxomys surifer*	*Rattus rattus*	*Paradoxurus hermaphrodites*	*Rhinolophus malayanus*	*Aselliscus stoliczkanus*
Ticks													
Haemaphysalis sp	-	-	-	-	-	-	10	-	-	-	-	-	-
Mesostigmatid mites													
Laelaps echidninus	-	-	-	-	-	-	-	-	-	33	-	-	-
Laelaps nuttali	-	-	-	-	-	-	-	-	24	12	-	-	-
Astigmatid mites													
Montesauria sp	-	60	-	43	37	-	-	-	-	-	-	-	-
Proctophyllodes sp	-	-	86	-	-	-	367	298	-	-	-	-	-
Pteronyssus sp	-	-	-	-	-	24	-	-	-	-	-	-	-
Trouessartia sp	-	-	-	-	-	-	145	-	-	-	-	-	-
Lice													
Brueelia sp	2	-	-	-	-	-	-	1	-	-	-	-	-
Philopterus sp	-	-	-	-	-	-	4	-	-	-	-	-	-
Polyplax spinulosa	-	-	-	-	-	-	-	-	-	4	-	-	-
Felicola bengalensis	-	-	-	-	-	-	-	-	-	-	6	-	-
Bat flies													
Strebid	-	-	-	-	-	-	-	-	-	-	-	2	-
Nycteribid	-	-	-	-	-	-	-	-	-	-	-	-	2

(-) means no ectoparasites were collected from the particular animal.

astigmatid mites were recovered from the primary and secondary feathers of birds with a 34.2% infestation rate. Those genera were *Montesauria, Proctophyllodes*, *Pteronyssus* and *Trouessartia. Montesauria* sp was found on the Black-naped Monarch (*Hypothymis azurea*), Striped Tit-Babbler *(Macronous gularis)* and Puff-throated Babbler (*Pellorneum ruficeps*); whereas *Proctophyllodes* sp was found on the Hainan Blue Flycatcher (*Cyonis hainana*), White-rumped Shama (*Copsychus malabaricus*) (Fig 2), and Pied Fantail (*Rhipidura javanica*). *Pteronyssus* sp and *Trouessartia* sp were present only on the Ashy Drongo (*Dicrurus leucophaeus*) and White-rumped Shama (*Copsychus malabaricus*), respectively.

Insects

Lice. Lice were found on birds and non-

volant small mammals. Infestation rate (7.32%) on birds was higher than that of the non-volant small mammals (3.45%). Two genera of lice, the *Brueelia* sp and *Philopterus* sp were found on birds. The former was found in Tickell's Blue Flycatcher (*Cyoruis tickelliae*) and Pied Fantail (*Rhipidura javanica*), and the latter was found only on White-rumped Shama (*Copsychus malabaricus*).

The Spined rat louse (*Polyplax spinulosa*), a sucking louse, was found on the Roof Rat (*Rattus rattus*) and *Felicola bengalensis* was found on the Common Palm Civet (*Paradoxurus hermaphrodites*).

Bat flies. Two species of bats, North Malayan Horseshoe Bat (*Rhinolophus malayanus*) and *Stoliczka's* Trident Bat (*Aselliscus stoliczkanus*) (Fig 3) were found to be infested with two genera of bat flies, *Strebid* and *Nycteribid*, at an 8.7% infestation rate.

Fig 2–Feather mite (*Proctophyllodes* sp) on tail of White-rumped Shama bird (*Copsychus malabaricus*).

Fig 3–Bat flies (Nycterbiid) on the skin of *Stoliczka's* Trident bat (*Aselliscus stoliczkanus*).

DISCUSSION

The ectoparasite fauna study at Srinakarin Dam, Kanchanaburi yielded a large profusion of birds and volant and non-volant small mammals. The greatest numbers of caught animals were the non-volant small mammal *Leopoldamys neilli*, and the bird, *Pycnonotus blanfordi*. Only a few of other species were collected. A total of 122 animals were captured. Of the captured animals, only a few individuals harbored ectoparasites. Most collected ectoparasites (ticks, astigmatid and mesostigmatid mites, lice and bat flies) corresponded with those obtained in previous studies. The patterns of ectoparasite infestation, especially on small mammals and birds, have been previously described by Uchikawa and Suzuki (1980) and Maclure and Ratanaworabhan (1973).

Of the ectoparasites, only ticks were observed to infest birds. The adult ticks were identified as genus *Hemaphysalis*. The same genus was also reported by Maclure and Ratanaworabhan (1973) to be commonly found on birds. Tunskul *et al* (1983) surveyed tick species in Thailand and found *Hemaphysalis wellingtoni* infesting birds.

The lice collected in this study belonged to the families Philopteridae,

Polyplacidae and Trichodectidae. They are known to be permanent ectoparasites of birds and mammals, spending their entire life cycle on the bodies of their hosts. This close association of lice and its hosts makes lice a suitable model to study co-evolution between host and parasite (Johnson and Clayton, 2003).

The presence of lice and astigmatid mites on birds was in accordance with a report by Maclure and Ratanaworabhan (1973). They found *Brueelia* sp and *Proctophyllodes* sp on the Pied Fantail (*Rhipidura javanica*) and *Philopterus* sp and *Trouessartia* sp on the White-rumped Shama (*Copsychus malabaricus*). In the present study, the first incidence of bird lice (*Brueelia* sp) in Thailand was found, which was observed to infest the Tickell's Blue Flycatcher (*Cyoruis tickelliae*) and the bird mite *Proctophyllodes* sp was found on the Hainan Blue Flycather (*Cyornis hainana*).

Two species of mesostigmatid mites of the family Laelapidae were found on non-volant small mammals. Of the mesostigmatid mites identified, *Laelaps nuttali,* was highly prevalent on rats. This parasite has been observed all over the body of its host, including the base of the hair follicles. This species has a cosmopolitan distribution and parasitizes many species of rats in tropical and warm temperature areas. In Thailand, the abundance of *Laelaps nuttali* on rats collected from five provinces along the Thailand-Myanmar, Lao PDR and Cambodia borders had been reported by Wootta *et al* (2008).

Bat flies, in the families Streblidae and Nycteribidae, were collected in this study. Ectoparasites on bats in Thailand had been recorded earlier (Papp *et al*, 2006).

Fleas, such as *Xenopsylla cheopis* (vector of murine typhus, rickettsiae and plague bacilli) and the chiggers mite *Leptotrombidium deliense* (scrub typhus vector) were not collected in this study. They have been found on rodents caught in many areas of Thailand (Lerdthusnee *et al*, 2008). The chance of collecting them depends on the season, animal species, ectoparasite species, location, method of catching, geographical situation, ecological condition, rodent predator, seasonal activities, and population dynamics (Telmadarraiy *et al*, 2007).

In terms of public health importance, none of the ectoparasites found has a major potential health risk to humans. *L. echidninus* and *L. nuttali* have been reported to bite man and can cause irritation (Azad, 1986). The tick *Haemaphysalis* sp can be a pest to livestock (Vatandoost and Hanafi Bojad, 2002).

The findings of this survey confirm the presence of ectoparasites on birds and volant and non-volant small mammals at Srinakarin Dam, Kanchanaburi Province, Thailand. Generally, the infestation rates of ectoparasites was relatively low, comparing the two groups, the infestation rates in mammals was lower than in birds. There appears to be no cause for public concern regarding ectoparasites found in this study because they are not known to normally infest humans.

For future surveys, collection of host animals and their ectoparasites relatives with seasonal variation should be considered. Other methods of collection may also be considered in future studies.

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