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Short Communication

Parasites of larval black flies (Diptera: Simuliidae) in Thailand

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Abstract

Parasites of larval black flies are reported for the first time from Thailand, including mermithid nematodes (Mermithidae), microsporidian fungi (Zygomycota), and the fungus *Coelomycidium simulii* Debaisieux (Blastocladiomycetes). The following nine species of black flies were infected with one or more parasites: *Simulium asakoae*, *S. chamlongi*, *S. chiangmaiense*, *S. fenestratum*, *S. feuerborni*, *S. nakhonense*, *S. nodosum*, *S. quinquestriatum*, and *S. tani*. The prevalence of patent infections per host species per season was 0.1–7.1% for mermithids, 0.1–6.0% for microsporidia, and 0.1–3.0% for *C. simulii*.

Keywords: Black flies, *Coelomycidium simulii*, Mermithidae, Microsporidia, parasitism, *Simulium*, Thailand

1. Introduction

Larval black flies are restricted to running-water habitats, from temporary trickles to large rivers, where they are a major component of the macroinvertebrate fauna (Crosskey, 1990). Approximately 75 species and 22 cytoforms of black flies have been reported from Thailand (Adler and Crosskey, 2010). Larval black flies are hosts of various parasites, such as bacteria, fungi (blastocladiomycetes, hyphomycetes, microsporidia, trichomycetes, and zygomycetes), helicosporidia, ichthyosporeans, mermithid nematodes, nematomorphs, protists (ciliates and haplosporidia), stramenopiles, and viruses (Adler *et al.*, 2004). Some of these parasites, especially mermithid nematodes, have been investigated as potential biological control agents of black flies (Molloy, 1981). No parasites of larval black flies have been recorded previously from Thailand. Our objectives, therefore, were to conduct a preliminary survey of selected parasites of larval black flies in northern Thailand and to determine the prevalence of infection among seasons for each group of parasites.

2. Materials and Methods

A total of 158 collections of 8,522 larval black flies representing 22 species were made in northern Thailand in 2003-2004. Larvae were identified using conventional morphological keys (e.g., Takaoka and Choochote, 2004). They were screened under a dissecting microscope for patent (visually obvious) infections involving mermithid nematodes (family Mermithidae), microsporidian fungi (phylum Microsporidia), and the fungus *Coelomycidium simulii* (class Blastocladiomycetes). The prevalence of infection (%) for each group of parasites was calculated. Voucher specimens of hosts and parasites were deposited in the laboratory of the Department of Biology, Faculty of Science, Mahidol University, Bangkok.

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3. Results

3.1 Mermithid nematodes

Individual black flies were infected with one or more mermithid nematodes, which were visible through the host cuticle (Figure 1). The prevalence of infection per species ranged from 0.1% to 2.1% in the rainy season, 2.2% to 7.1% in the cool season, and 0.6% to 2.7% in the hot season. Five species of black flies had mermithid nematodes and were infected in all seasons: *Simulium chiangmaiense* (prevalence in rainy, cool, and hot seasons = 0.2%, 1.4%, 1.9%), *S. fenestratum* (1.4%, 7.1%, 2.3%), *S. nakhonense* (0.1%, 3.2%, 0.6%), *S. quinquestriatum* (0.7%, 3.4%, 1.5%), and *S. tani* (2.1%, 2.2%, 2.7%).

3.2 Microsporidia

Larval black flies patently infected with microsporidia contained white, irregular cysts (Figure 2) in which spores were densely packed (Figure 3). The prevalence of infection for microsporidia ranged from 0.1% to 6.0%. Only *S. feuerborni* was infected with microsporidia (prevalence = 1.1%) in the rainy season. *Simulium nakhonense* (0.1%) and *S. tani* (0.2%) were infected with microsporidia in the cool season. In the hot season, four species were infected: *S. fenestratum* (0.8%), *S. feuerborni* (6.0%), *S. nodosum* (0.3%), and *S. tani* (0.4%).

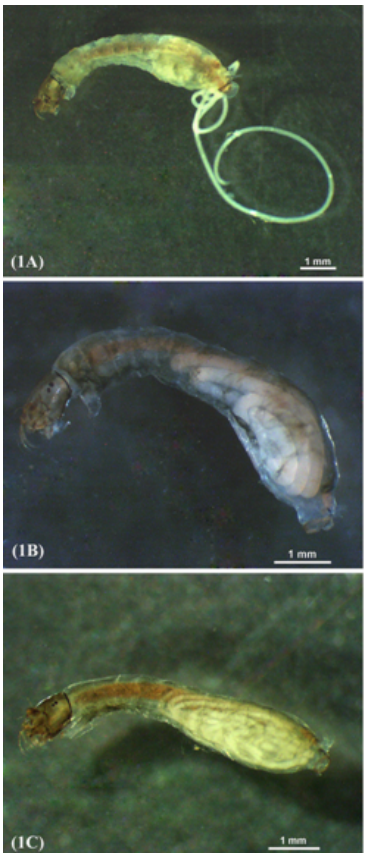

Figure 1. Larval black flies with patent infections of mermithid nematodes. A, *Simulium tani* with a single, extruded mermithid. B, *Simulium quinquestriatum* with single mermithid. C, *Simulium quinquestriatum* with multiple mermithids.

Figure 2. Larval black flies with patent infections of microsporidia. A, *Simulium feuerborni*. B, *Simulium nodosum*. C, *Simulium nakhonense*, lateral view (left), ventral view of posterior abdomen (right).

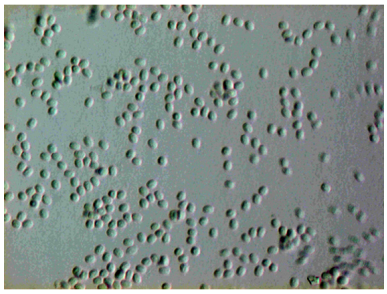

Figure 3. Microsporidia from *Simulium nakhonense*, spread in 50% acetic acid.

3.3 *Coelomycidium simulii* Debaisieux

Larval black flies patently infected with *C. simulii* were packed with minute, spherical thalli throughout the body cavity (Figure 4). The prevalence of infection ranged from 0.1% to 3.0%. *Simulium chiangmaiense* (prevalence = 1.1%) and *S. quinquestriatum* (0.4%) were infected in the rainy season. *Simulium chiangmaiense* (0.6%), *S. fenestratum* (0.1%), *S. nakhonense* (0.8%), *S. quinquestriatum* (0.8%), and *S. tani* (0.2%) were infected in the cool season. In the hot season, the fungus was found in *S. asakoae* (0.1%), *S. chamlongi* (0.4%), *S. chiangmaiense* (0.9%), *S. fenestratum* (0.8%), and *S. quinquestriatum* (3.0%).

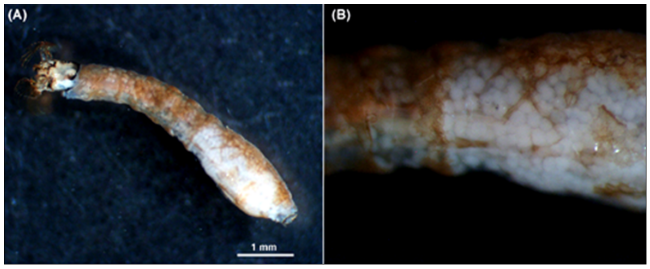

Figure 4. Larva of *Simulium chamlongi* patently infected with *Coelomycidium simulii*, showing spherical thalli. A, lateral view; B, ventral view of anterior abdomen.

4. Discussion

Less than 8% of the larvae of each species of black fly in northern Thailand carried patent infections of each of the three parasitic taxa in any season. The levels of prevalence in Thailand, therefore, correspond with those in other zoogeographic areas of the world (Crosskey, 1990). Mermithid infections were more prevalent in the cool and hot seasons than in the rainy season, whereas infections by *C. simulii* and microsporidia generally were more prevalent in the hot season. Seasonal differences in infection might reflect different stream conditions, such as water temperature, velocity, and food availability. Environmental factors in other areas of the world have been shown to play a role in the distribution of parasites infecting larval black flies (McCreadie and Adler, 1999; St-Onge and Charpentier, 2008).

Species-level identification of the parasites could reveal additional patterns of seasonality or host specificity. The taxonomy of these groups, however, requires ultrastructural or molecular techniques, is complicated by the probable existence of cryptic species, and for mermithid nematodes, is poorly resolved because only the juvenile stage, which has limited morphological features, is parasitic. We expect that future taxonomic studies of the parasites of black flies in Thailand will reveal a wealth of biodiversity as great as that discovered for their hosts (Jitklang *et al.*, 2008; Tangkawanit et al., 2009).

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