RECENT PATHOGEN AND MOSQUITO HOST RECORDS FROM PENANG ISLAND, MALAYSIA[1]

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The search for biological control agents of mosquitoes is an important component of the Steering Committee of the Scientific Working Group on Biological Control of Vectors (UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases). Such searches may eventually provide additional biological control agents for use against disease vectors in tropical countries and also further our knowledge of the host range distribution and systematics of such agents.

Because of the absence of records of pathogens in mosquitoes from Penang Island, Malaysia, both the senior and second authors collected and examined larval mosquito populations from many different localities and diverse habitats during three separate 3–4 week consultantship periods in 1983 and 1985. Larval collections were examined in the laboratory against a black background under a bright light for signs of patent infections or abnormal behavior. Additionally, larvae were checked in clear spot plates under a binocular microscope for patency symptoms. Larvae with such symptoms were smeared on a slide and examined under a compound microscope for identification of the pathogen. Tissues from selected specimens were fixed in either Bouin's solution or glutaraldehyde for subsequent examination with light or electron microscopy.

Table 1 contains information on the host, pathogen, date, locality, habitat and percent infection level.

Coelomomyces africanus: This fungus was found principally infecting larvae of *Anopheles nigerrimus* Giles but a few infected larvae of *An. sinensis* Wiedemann were also noted. This is only the second record both of *An. nigerrimus* as a host of *Coelomomyces* and for this fungus in Malaysia. In this collection, 83 of 130 larvae (64%) were infected with this fungus.

Tetrahymena pyriformis: This facultative internal ciliate was noted only in a few larvae of *Aedes (Finlaya)* sp. found breeding in a small tank with mangrove. Infected larvae succumbed in the late fourth instar in a manner similar to that of several mosquito species infected with the same pathogen in Louisiana (Chapman 1974). Past studies have indicated that the lack of invasiveness makes this a poor biological control agent, although no attempt was made to transmit this particular *Tetrahymena* to other mosquito larvae.

Amblyospora spp.: Mosquito larvae of five species in four different genera were found with microsporidian infections typical of *Amblyospora* (cysts with 8 spores). Patent infections varied from being easily visible to being difficult to see as in *Mansonia. Ficalbia minima* (Theobald) is a new host record of microsporidia for both the genus and species. This is also the first host record of *Tripteroides aranoides* (Theobald) with microsporidia. One infected larva of *Culex (Lutzia)* sp. was collected with predominantly spores of *Amblyospora*, but it also contained some pyriform shaped spores similar to those of *Microsporidium aedis.* Whether this represents a dual infection or different stages of the same pathogen is not known. It is very interesting that Hembree (1979) collected two infected larvae of *Cx. (Lutzia)* sp. in Thailand with two similar shaped spores and he also speculated on whether the infection was dual or represented different stages of the same parasite.

Microsporidium aedis: This microsporidian species is undoubtedly the Species No. 1 that Hembree (1979) reported from *Aedes aegypti* (Linn.) in Thailand. Since it does not belong in any of the presently described genera, it has been placed in the "catch-all" *Microsporidium. Aedes albopictus* (Skuse) is a new host record for this parasite.

Vibrio-like bacterium: Septicemic infections of this small gram negative bacterium were noted in many populations of *Culex quinquefasciatus* Say and also in larvae of *Aedes albopictus* and *Armigeres subalbatus* (Coq.). Infected larvae are opaque, often distended with very noticeable white anal papillae, and normally die prior to pupation. Hembree (1979) noted this pathogen in larvae of *Cx. quinquefasciatus, Ae. aegypti* and *Ar. subalbatus* in Thailand. The senior author has noted it from 17 species in 7 different genera of mosquitoes in Louisiana (unpublished data). This parasite lacks invasiveness, and resisted

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Table 1. Pathogens collected on Penang Island, Malaysia, and related data.

Host	Date	Locality	Habitat	No. of infected specimens	Percentage infection
		Coelomomyces africanus (fungus)			
Anopheles nigerrimus and *An. sinensis*	Feb. 3, 1983	Genting	rice field	84	64
		Tetrahymena pyriformis (internal ciliate)			
Aedes (Finlaya) sp.	Sept. 10, 1985	Muka Head	small tank	3	<1.01
		Amblyospora spp. (Microsporidia)			
Culex sitiens	Aug. 28, 1985	Muka Head	large tank	6	<0.01
Ficalbia minima[1]	Feb. 5, 1983	Jalan Baru	drain canals	5	0.01
Mansonia uniformis	Feb. 8, 1983	Permatang Damarlaut	water hyacinth	10	2.0
	Mar. 6, 1985	Sg. Penang	water hyacinth	1	6.0
Tripteroides aranoides[1]	Sept. 10, 1985	Muka Head	bamboo	4	0.01
Culex (Lutzia) sp.	Mar. 7, 1985	Bell Close	roadside ditches	1	<0.01
		Microsporidium aedis (Microsporidia)			
Aedes albopictus[1]	Mar. 2, 1985	Perak Road	container	1	0.03
		Vibrio-like Bacterium			
Aedes albopictus	Sept. 12, 1985	Batu Ferrighi	construction site	38	0.1
Armigeres subalbatus	Sept. 12, 1985	Batu Ferrighi	construction site	65	0.01
Culex quinquefasciatus	Feb. 3, 1983	Genting	septic area	2	<0.01
	Sept. 12, 1985	Batu Ferrighi	construction site	7	<0.01
	Feb. 28, 1985	Bayan Lepas	septic area	1	<0.01
	Mar. 7, 1985	Telok Kumbar	septic area	7	<0.01

[1] New host record.

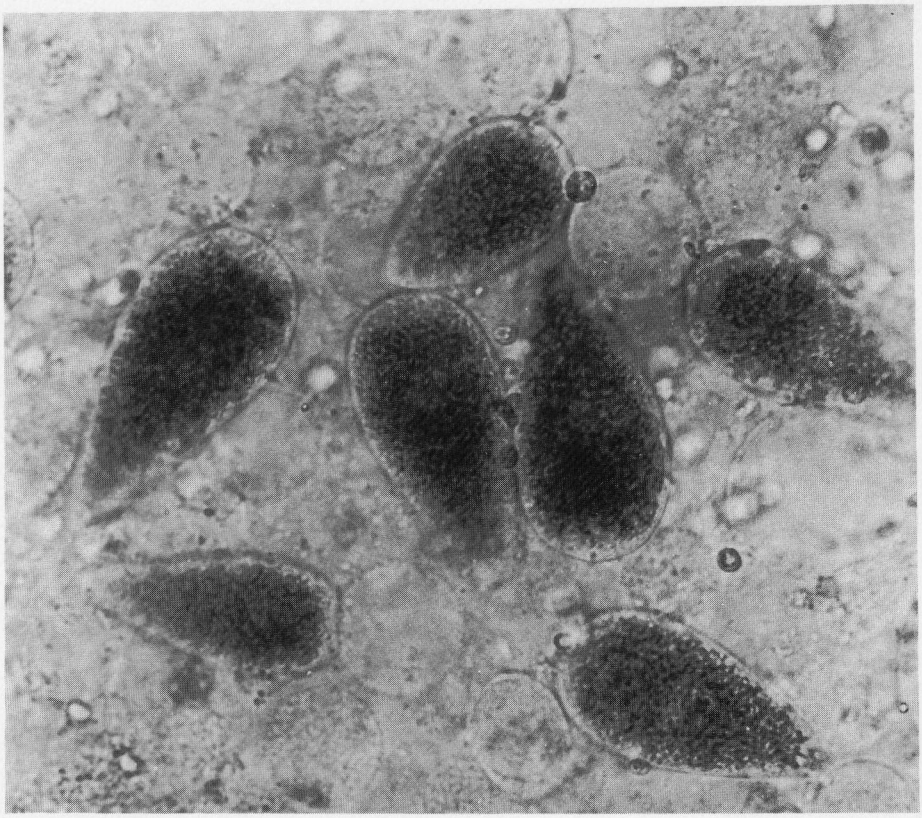

Fig. 1. Occlusions in posterior midgut cells of *Aedes albopictus*, 1,100×.

culturing on artificial media. It has thus far not been described.

Miscellaneous organisms: An interesting observation by the second author was that all maturing fourth instar larvae of *Aedes albopictus* contained unique pyriform inclusions (25–35 μ long, 10–18 μ wide) in many of the nuclei of their posterior midgut cells. Infected cells ruptured easily under the pressure of a cover slip but the inclusions remained intact (Fig. 1). Preliminary electron microscopy indicated that the inclusions were surrounded by host nuclear membrane. Attempts to infect first instar *Ae. aegypti* in the laboratory with inclusions harvested from heavily "infected" *Ae. albopictus* were unsuccessful. Further study of this entity will be necessary before its exact nature can be determined.

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