

THE NATURAL INFECTION OF WILD ANIMALS IN WEST MALAYSIA WITH NYMPHS OF *ARMILLIFER MONILIFORMIS* (DIESING, 1835) SAMBON, 1922

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Summary

The pentastomid, *Armillifer moniliformis* is found to be widespread in Malaysian animals. 5209 animals of 33 species were examined, and 92 were positive for nymphs of *A. moniliformis*. Adult specimens were recovered from 2 of 6 specimens of *Python reticulatus*. Man can acquire the infection by eating insufficiently cooked python meat or drinking contaminated water. It is believed that *P. wedlii* is synonymous with *A. moniliformis*.

INTRODUCTION

Armillifer moniliformis, of the class pentastomida, a parasite modified for an endoparasitic existence in its vertebrate host has been reported from various parts of Asia. According to Sambon¹ the adults are found in the Indian python (*Python molurus*) and the reticulated python (*P. reticulatus*). The immature stages have been reported from a variety of mammals including man.¹⁻⁹ Human infections by this parasite have been reported from several Asian countries. It is especially common in the Malaysian aborigines of Peninsular Malaysia and has been reported in a Dayak and in an European woman in East Malaysia.^{2,6-8,10-12}

This survey of pentastomid infection in the Malaysian fauna was undertaken in view of the several human cases reported from Malaysia.

MATERIALS AND METHODS

Animals were either captured live in wire traps, shot or purchased. The parasites were seen encapsulated in the abdominal cavities involving viscera and omenta of mammals. In reptiles they were recovered from the lungs. After preservation in 70% ethanol to which

was added 2% glycerol, the parasites were studied as temporary mounts in Hoyer's medium or were stained in Mayer's paracarmine, dehydrated in ethanol, cleared in methyl salicylate and mounted in Permount. Collections of Dr. RM Stabler from Colorado College, Colorado Springs, U.S.A., British Museum (Natural History) = (BMNH) and American Museum of Natural History = (AMNH) have been used for comparison in this study.

RESULTS

A total of 5,209 animals of 33 species including 5 orders of hosts were examined, and 92 were positive for nymphal stages of Pentastomes, giving an infection rate of 1.8% (Table 1). This table also shows the adults recovered from 2 of 6 *Python reticulatus* examined. The infection rate in the carnivora was 20.7%. Relatively low infection rates were observed for other orders of animals examined except in Reptilia in which 2 out of 6 pythons examined were positive for adult parasites, an infection rate of 33.3%. Table 2 gives the incidence rate of nymphs in the various species, the total number of nymphs

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TABLE 1
INCIDENCE OF ADULT/NYMPHAL STAGES OF *ARMILLIFER MONILIFORMIS* IN ANIMALS STUDIED

| Order | No. of Examinations | No. Positive | % Infected | No. of <i>A. moniliformis</i> | | Range |
|----------------|---------------------|--------------|------------|-------------------------------|--------|-------|
| | | | | Adults | Nymphs | |
| Reptilia | 6 | 2 | 33.3 | 5 | — | 2-3 |
| Primates | 502 | 7 | 1.4 | — | 39 | 1-4 |
| Insectivora | 145 | 2 | 1.4 | — | 10 | — |
| Carnivora | 121 | 25 | 20.7 | — | 135 | 2-26 |
| Rodentia | 4,377 | 57 | 1.3 | — | 849 | 2-500 |
| Artiodactyla | 64 | 1 | 1.6 | — | 1 | — |
| Total (nymphs) | 5,209 | 92 | 1.8 | — | 1,034 | 1-500 |

TABLE 2
 DETAILED ANALYSES OF THE INCIDENCE OF NYMPHS IN INFECTED HOSTS

| Hosts | No. Examined | No. Positive | % infected | No. of Nymphs | |
|-----------------------------------|--------------|--------------|------------|---------------|-------|
| | | | | Total No. | Range |
| PRIMATES | | | | | |
| <i>Macaca fascicularis</i> | 168 | 1 | 0.6 | 1 | — |
| <i>Nycticebus coucang</i> | 37 | 1 | 2.7 | 6 | — |
| <i>Tupaia glis</i> | 198 | 1 | 0.5 | 2 | — |
| <i>Tupaia minor</i> | 63 | 1 | 1.6 | 23 | — |
| <i>Ptilocercus lowii</i> | 36 | 3 | 8.3 | 7 | 1—4 |
| INSECTIVORA | | | | | |
| <i>Echinosorex gymnurus</i> | 72 | 1 | 1.4 | 2 | — |
| <i>Hylomys suillus</i> | 73 | 1 | 1.4 | 8 | — |
| CARNIVORA | | | | | |
| <i>Amblonyx cinerea</i> | 7 | 3 | 42.9 | 12 | 3—6 |
| <i>Arctictis binturong</i> | 18 | 5 | 27.8 | 49 | 3—18 |
| <i>Arctogalidia trivirgata</i> | 29 | 3 | 10.3 | 8 | 2—4 |
| <i>Lutra sumatrana</i> | 4 | 1 | 25.0 | 4 | — |
| <i>Herpestes edwardsii</i> | 2 | 1 | 50.0 | 2 | — |
| <i>Paguma larvata</i> | 8 | 2 | 25.0 | 14 | 0—7 |
| <i>Paradoxurus hermaphroditus</i> | 22 | 2 | 9.1 | 6 | 2—4 |
| <i>Cynogale bennettii</i> | 1 | 1 | 100.0 | 3 | — |
| <i>Felis planiceps</i> | 17 | 4 | 23.5 | 33 | 2—26 |
| <i>Felis temminckii</i> | 12 | 2 | 16.7 | 1 | — |
| <i>Canis familiaris</i> | 1 | 1 | 100.0 | 4 | — |
| RODENTIA | | | | | |
| <i>Callosciurus notatus</i> | 658 | 2 | 0.3 | 2 | 0—1 |
| <i>Lariscus insignis</i> | 82 | 1 | 1.2 | 4 | — |
| <i>Rhinosciurus laticaudatus</i> | 55 | 2 | 3.6 | 9 | 2—4 |
| <i>Ratufa affinis</i> | 36 | 1 | 2.8 | 1 | — |
| <i>Ratufa bicolor</i> | 28 | 1 | 3.6 | 1 | — |
| <i>Rattus sabanus</i> | 522 | 5 | 1.0 | 5 | 1—3 |
| <i>Rattus bowersii</i> | 379 | 7 | 1.9 | 551 | 2—500 |
| <i>Rattus muelleri</i> | 497 | 27 | 5.4 | 251 | 1—43 |
| <i>Rattus edwardsi</i> | 64 | 1 | 1.6 | 1 | — |
| <i>Rattus rajah</i> | 265 | 1 | 0.4 | 1 | — |
| <i>Rattus surifer</i> | 98 | 2 | 2.0 | 5 | 1—4 |
| <i>Rattus cremoriventer</i> | 230 | 1 | 0.4 | 1 | — |
| <i>Rattus whiteheadi</i> | 86 | 1 | 1.2 | 1 | — |
| <i>Rattus tiomanicus</i> | 1,377 | 5 | 0.4 | 16 | 3—8 |
| ARTIODACTYLA | | | | | |
| <i>Tragulus javanicus</i> | 64 | 1 | 1.6 | 1 | — |

recovered from each species and the range of infection. A domestic dog *Canis familiaris* collected around an aborigine settlement harboured 4 nymphs. Fig. 1 shows a massive infection by the parasite, with nymphal stages encysted in the omentum of the giant swamp rat, *Rattus bowersi*. Fig. 2 shows the nymphal pentastome removed from the encapsulated cyst membrane. The cylindrical vermiform body with annular thickenings and cuticle that tapers posteriorly to a bluntly pointed cone is seen.

DISCUSSION

Two species of *Armillifer*, *A. moniliformis* and *A. armillatus* have been reported from man. *A. armillatus* occurs in Africa and its associated islands.^{6,13,14} Nymphs of *A. armillatus* are parasitic in numerous wild and domestic animals in tropical Africa.¹ *A. moniliformis* is exclusively oriental in its known distribution.^{10,15} The adults of both are easily separated by the number of annuli, *A. armillatus* with 18–22 and *A. moniliformis* with 28–35.

In the past, owing to insufficient data, there has been difficulty in the specific identification of nymphal stages of pentastomes in this region. Since adults of the Oriental species obtained thus far are *A. moniliformis* it is reasonable to assume that nymphs recovered belong to the same species. These nymphs were compared with nymphs of *A. armillatus* from BMNH and nymphs of *A. moniliformis* from AMNH, and their identity confirmed as *A. moniliformis*.

Sambon² confirmed the description of Cobbold³ for nymphs of pentastome under the name of *Pentastoma wedlii*. This nymphal pentastome collected in Malacca (Malaysia) in 1866 was found in the viscera of a flat-headed cat (*Felis planiceps*). The encysted parasite has thirty-three annulations which suggests that *Pentastoma wedlii* might be an immature form of *Armillifer moniliformis*. Therefore, *Pentastoma wedlii* is a synonym of *A. moniliformis*. Furthermore, Stabler and Self,⁵ have identified nymphs recovered from a binturong, *Arctictis binturong*, which they believe originated from Malaysia, as *A. moniliformis*.

The results of this survey indicate that *A. moniliformis* is widespread in the Malaysian

vertebrate fauna and the distribution is nationwide as the animals used in this work have come from many parts of Peninsular Malaysia. The occurrence of this parasite in the Malaysian aborigines reflects their close association with the animals. The aborigines live off the land and eat what they can trap or capture, including the Malaysian python, which is often eaten inadequately cooked.⁸ Drinking water contaminated by pythons is another possible source of infection of these people. The parasite has not been reported from other ethnic groups living in Malaysia. The Chinese in Malaysia are known to eat python as a delicacy but the meat is generally well cooked and this renders it safe for consumption. Honjo *et al*⁴ found an infection rate of 1.7% (6/362) in *Macaca fascicularis* monkeys, but in this survey only 1 out of 168 (0.6%) had the parasite. Although the parasite is widespread in the animal fauna human infection is rare, except in Malaysian aborigines.¹⁶ Since the preparation of this paper, a nymph of *A. moniliformis* was found in the mesentery of a gibbon (*Hylobates lar*).

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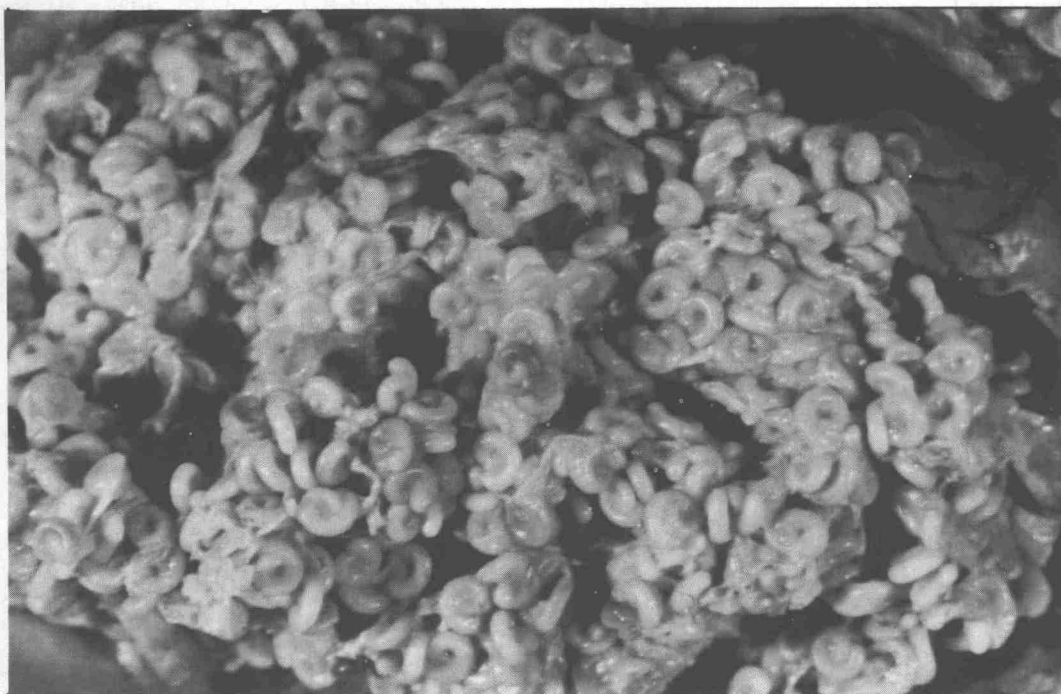


Fig 1: Nymphs of *Armillifer moniliformis* in the omentum of *Rattus bowersii*.

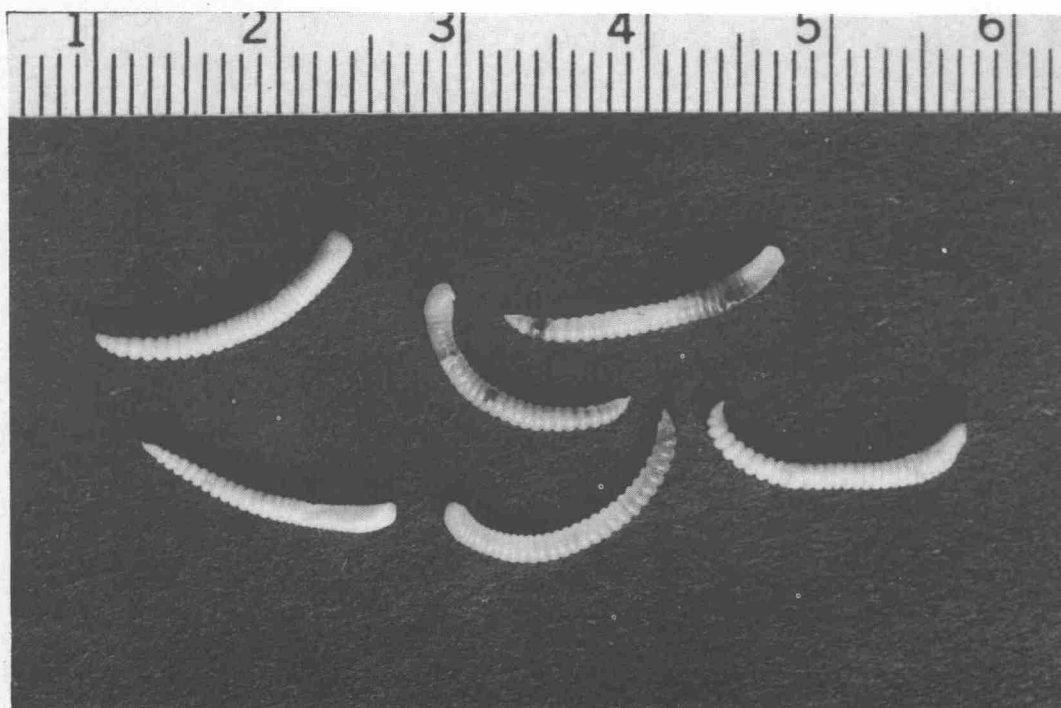


Fig 2: Nymphs of *Armillifer moniliformis* from *Rattus bowersii*.

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