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The Distribution and Ecology of *Bakerocoptes cynopteri* (Sarcoptiformes: Bakerocoptidae) in Malaysia

ALBERT J. BECK

The G. W. Hooper Foundation, University of California Medical Center,
San Francisco, California 94122, and The Institute for Medical Research,
Kuala Lumpur, Malaysia

Introduction

Bakerocoptes cynopteri (FAIN, 1962) is an unusual sarcoptiform mite apparently limited to a single host species, *Cynopterus brachyotis*. Originally established in a new subfamily, Bakerocoptinae, by FAIN, it was later raised to family status by LAVOIPIERRE et al. (1967), who described the histopathology of the cystlike swelling, or zoocoecidium, resulting from the invasion and establishment of *B. cynopteri* (referred to in their paper as *B. cynopteris*) in the wings of its host. They also presented infection rates for an endemic area and postulated that infection passes from lactating females to their suckling young. This paper presents further information relating to incidence and ecology of this parasite on *C. brachyotis* in Malaya.

Methods and Materials

Bats were collected with hand nets or mist nets in different localities throughout West Malaysia (see Fig. 1). Among the more than 7000 bats of 43 species that I examined during 2½ years in the country, 450 were *Cynopterus brachyotis* (Muller) and 75 *Cynopterus horsfieldi* (Gray).

The habitats in which *C. brachyotis* were captured included coastal mangrove and coconut areas, lowland villages, large gardens in cities, secondary and lowland forest at several levels, and moss forests at 1940 meters (5800 feet) above sea level. The mist nets, 61 mm mesh, 6 or 12 meters long and 2.4 meters high, were set in areas with ripening fruits, especially chiku (*Achras zapota*), papaya (*Carica papaya*), and rambutan (*Nephelium lappaceum*), in coconut groves or in flightways used by bats near the edges of primary and secondary rain forests.

Many bats were removed from the nets immediately after capture, but some were left in them overnight. A selective increase in the number of *Cynopterus* captured was effected by holding especially noisy bats under the net. This method succeeded in luring down individuals flying high above the zone covered by our nets. A portion of each catch, including most of those infected with *Bakerocoptes cynopteri*, was brought back to the laboratory, rest house, or field camp where bats were examined for total ectoparasite complement. Surplus animals were ringed on the forearm with aluminum bands and released. Infected bats were preserved in formal-alcohol or as museum study skins after removal of the *B. cynopteri* cysts.

Results

B. cynopteri was found only on *C. brachyotis*, in 21 of the 450 individuals of this species that were examined. None of the 6600 bats of the other 42 species bore this parasite. The 21 infected bats were captured in the states of Selangor and Pahang (see Table 1 and Fig. 1).

MALAY PENINSULA

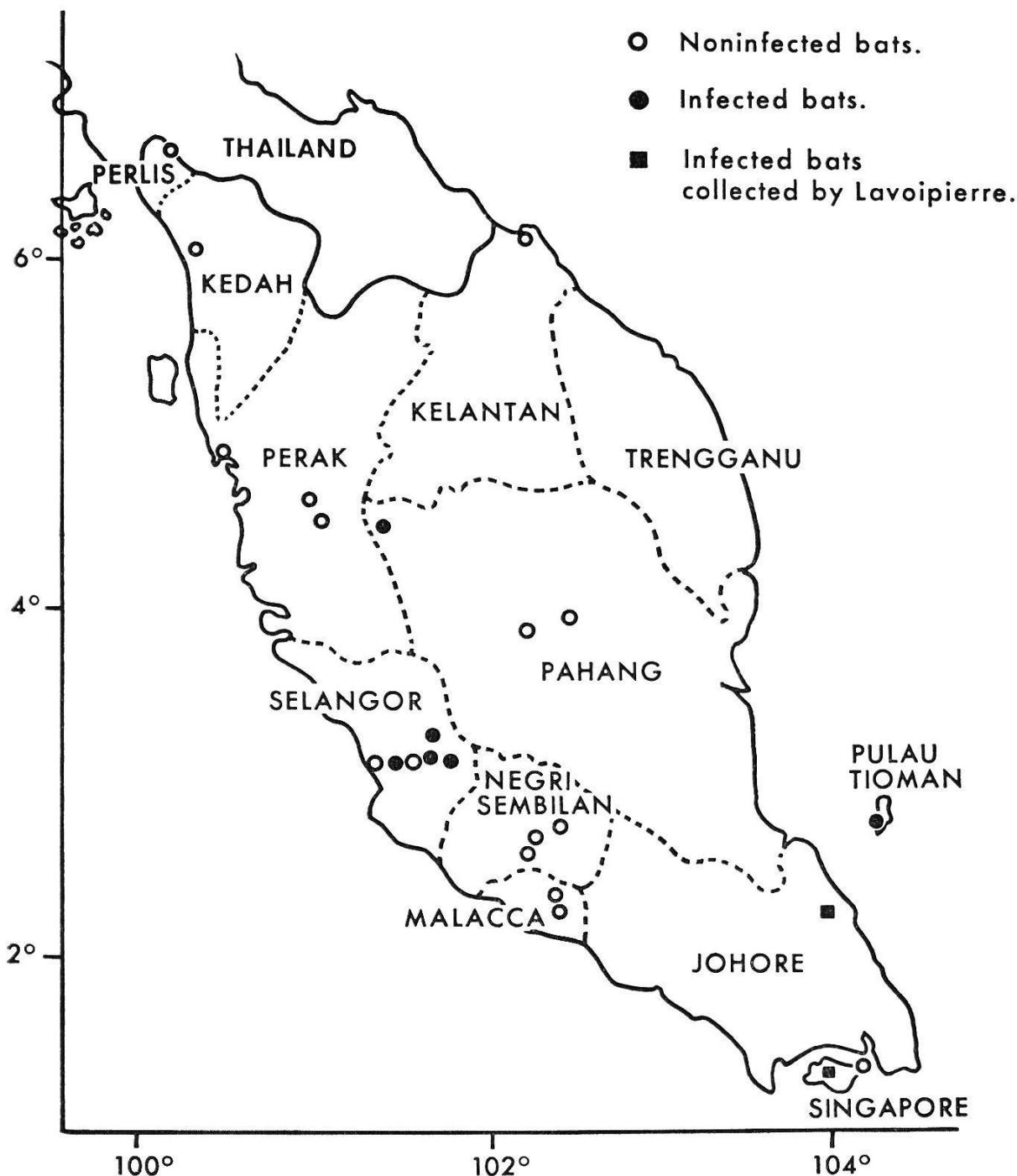


Fig. 1. Outline map of Malaya showing states and localities where bats were collected.

The overall infection rate was less than 0.5%, although the incidence in endemic areas such as the Ulu Gombak region and in Kuala Lumpur was 5.3% (11/206, 6/113). The largest number of cysts in a single individual was 9, with an overall average of 2.4 cysts per infected animal, but one-half of the infected individuals had only one cyst each. More females than males were infected (15/21), although approximately equal numbers of each sex were examined. Infected bats ranged in age from suckling young less than 5 weeks old to adults,

TABLE 1
Distribution of Bakeroceptes cynopteri in West Malaysia

| Locality | Date | 'Age/sex of host | Number of cysts | | |
|---------------------|---------------|---------------------|-----------------|--------------|-------|
| | | | Right wing | Left wing | Total |
| Selangor | | | | | |
| Puchong | 4 Dec. 1965 | adult ♀ | | | 3 |
| 6th mile Ulu Gombak | 16 Feb. 1966 | adult ♀ | 3 | — | 3 |
| | 12 April 1966 | sub adult ♀ | | | 1 |
| | 26 May 1966 | adult ♀ | | | 2 |
| | | immature ♀ | | | 1 |
| | | young adult ♂ | | | 1 |
| | 9 June 1966 | adult ♀ | | 1 | 1 |
| | 28 Oct. 1966 | immature ♀ | | | 4 |
| | 19 Jan. 1967 | adult ♀ | | 1 | 1 |
| | | immature ♂ | 1 | — | 1 |
| | 10 Jan. 1968 | immature ♂ | 1 | — | 1 |
| Setapak New Village | 26 March 1966 | immature ♀ | 4 | 2 | 6 |
| | 14 July 1966 | adult ♀ | — | 1 | 1 |
| Kuala Lumpur | 24 June 1966 | adult ♀ | 2 | 2 | 4 |
| | | adult ♀ | 6 | 3 | 9 |
| | 29 Sept. 1966 | adult ♀ | | | 1 |
| | 2 Feb. 1967 | immature ♂ | 1 | 1 | 2 |
| | 7 Sept. 1967 | adult ♀ | | | 1 |
| | | adult ♀ | | | 1 |
| Pahang | | | | | |
| Pulau Tioman | 29 April 1966 | immature ♀ | 3 | — | 3 |
| Gng. Brinchang | 11 May 1967 | sub adult ♂ | 3 | 1 | 4 |

but no obviously old adults, as judged by tooth wear, were infected. Twice as many cysts were found in the right wing as in the left wing of each bat for which this information was recorded. Bats that roosted in coconut trees seemed to be infected more often than those found under house eaves or in forested areas.

Although the bats had many scars and old cysts in the process of regression, I found only 2 presumably immature cysts, less than 1 mm in diameter, both in young adult animals. One infected young adult female *C. brachyotis* was maintained in my laboratory for 2 months and another for 9 months without any visible change in size or shape of active cysts. Attempts to infect other *C. brachyotis* by confining them with this individual failed.

Discussion

My observations support those of LAVOIPIERRE and co-workers with respect to host specificity, incidence of infection in endemic areas, cyst formation, and the probable mode of transmission. The number of species and individuals examined in this study is adequate to assume that *B. cynopteri* in Malaysia and Singapore

is confined to a single host species, *C. brachyotis*. At least 3 host subspecies, *C. b. brachyotis*, *C. b. angulatus*, and *C. b. altitudinus*, are infected with this parasite, but I never found this mite on the closely related *C. horsfieldi*.

The host distribution of many sarcoptiform mites appears to be restricted, at familial, generic, or specific levels. The family Teinocoptidae, in which *Bakerocoptes* was first included as a subfamily (FAIN, 1962), seems to be restricted to bats in the family Pteropidae (FAIN, 1961; MITCHELL & FAIN, 1963). Most teinocoptid species are further restricted to a single host species. Mites of the genus *Notoedres* (family Sarcoptidae) also tend to be species-specific, although a few are found on more than one species in a single genus of hosts (FAIN, 1959).

The infection rate is low, even in endemic areas. LAVOPIERRE found that 9% (7/75) of the *C. brachyotis* he examined bore cysts, while my own collections yielded a 5.3% infection rate in 2 endemic areas. These rates are comparable with the one for species of *Notoedres* found encysted in bats in California (BECK, 1966). Some critical factor, possibly the construction of the cyst or an exceedingly short period during which maturing or recently matured mites can disperse and create new cysts, seems to limit invasion of new hosts. In *B. cynopteri*, the female appears to block the upper portion of the chamber, with her conical posterior protruding into the single orifice of the cyst. Presumably, the larvae or nymphs squeeze past the female and thus emerge, or the shape of the cyst may change during relaxation and flexion of the wings, creating a space between the female and the cyst walls.

Multiple cysts on a single individual seem to be about the same age, indicating a single invasion by several mites rather than multiple invasions by single mites. The few immature cysts observed indicate that cyst formation is rapid, requiring only a few days. Once the zoocoecidium is established, it persists for several months. A single female may have a relatively long life span or may be succeeded by one generation or more of her progeny.

Available evidence suggests that infection usually passes from lactating females to their suckling young. The period of constant contact between mother and young is not known, but my observations indicate that most young of this species in Malaysia remain firmly attached to the female's nipple for 3 or 4 weeks and are dependent upon the female for nourishment for about 8 weeks, during the last 4 of which the young remain behind in maternity clusters while the females forage. Thereafter, the young begin to forage with the adults. Adult males tend to roost separately or in small groups away from the maternity clusters. This segregation may account for the higher infection rates in adult females and in immature males.

The greater numbers of infected individuals in areas where there are coconut trees may be related to higher host densities or to a more favorable microclimate. Macroclimatic factors appear unimportant within the host range; despite the climatic differences between Singapore, Kuala Lumpur and environs, central Pahang, and the Cameron Highlands — a progressively cooler sequence with great variations in rainfall — *Bakerocoptes cynopteri* is found in all these zones.

Conclusion

The infections of *Bakerocoptes cynopteri* found in 21 Malaysian *Cynopterus brachyotis* support the findings of LAVOPIERRE et al. (1967). Females are more often infected than males, possibly due to their more dense roosting aggregations. Infected lactating females presumably transmit the infection to their young. Infections last several months, and new infections are infrequent.

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