RESEARCH NOTE

ABUNDANCE AND DISTRIBUTION OF *XENOPSYLLA CHEOPIS* ON SMALL MAMMALS COLLECTED IN WEST JAVA, INDONESIA DURING RODENT-BORNE DISEASE SURVEYS

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Abstract. During February 2004 and September 2005, *Xenopsylla cheopis* were collected from small mammal hosts during rodent-bone disease surveys in Jakarta and Bandung, Indonesia. During 4 trap nights in Jakarta, 4 rodent species (*Rattus exulans*, *Rattus norvegicus*, *Rattus tanezumi* and *Mus musculus*) and one shrew species (*Suncus murinus*) were collected. *Rattus tanezumi* had the highest *X. cheopis* load (128 *X. cheopis* from 84 *R. tanezumi*) but *R. norvegicus* had the highest flea index, 1.8. In Bandung, over 6 trap nights 3 rodent species were collected (*R. norvegicus*, *R. tanezumi* and *M. musculus*) and the shrew, *S. murinus,* were collected. *Rattus norvegicus* had the highest number of *X. cheopis* collected (407 *X. cheopis* from 181 *R. norvegicus*) but *R. tanezumi* had the highest flea index, 3.5. During both surveys, *X. cheopis* was the species of flea collected.

INTRODUCTION

Plague has been endemic in Indonesia since at least 1910. During a plague epidemic on the Indonesian Island of Java in 1931 there were over 23,000 recorded human deaths (Kusharyono *et al*, 1980). The main vector of plague in Indonesia is the oriental rat flea, *Xenopsylla cheopis* (Turner *et al*, 1974). In various geographic locations around the world, other species of fleas transmit the bacteria that causes plague and play a role in sylvatic cycles of the disease and in human transmission (Gage and Kosoy, 2005). For example, in Indonesia the flea *Stivalius cognatus* has been reported as a possible secondary vector and was commonly found during ectoparasite surveys of commensal rodents (Turner *et al*, 1974). However, for rodent to human plague transmission in Indonesia, and throughout most of the world, *X. cheopis* is the most important flea species (Gage and Kosoy, 2005).

In addition to its importance as a plague vector, *X. cheopis* is also a vector of *Rickettsia typhi,* the causative agent of murine typhus, and potentially several other rickettsia (Azad and Traub, 1989). With the resurgence of known diseases and the potential for newly emerging infections, it is important to have

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current information on zoonotic disease agents, their reservoirs and vectors (Azad *et al*, 1997). This paper reports the species of fleas and the flea indexes collected during two rodent-borne disease surveys in West Java, Indonesia.

MATERIALS AND METHODS

Fleas were collected during two surveys in West Java, one in Jakarta seeking Spotted Fever Group Rickettsia and the other in Bandung surveying Hantaviruses. In both Jakarta and Bandung, rodents were collected using baited Tomahawk and Sherman traps. Traps were set out in the late afternoon and collected early the next morning. Ectoparasites were collected from euthanized rats using a flea comb. Ectoparasites were placed in 70% EtOH and returned to the laboratory for identification. The rodent and ectoparasite collection protocol was approved by the NAMRU-2 IACUC and the National Institute of Health Research and Development, Indonesian Ministry of Health.

RESULTS

From 19-27 February 2004, traps were set in three areas in and around Jakarta: 1. Bambu Apus village, Tangerang district, Banten Province; 2. Penjaringan village, North Jakarta, DKI Jakarta Province; 3. Ragunan Zoo South Jakarta, DKI Jakarta Province. The total number of trap nights in and around Jakarta was 4. From 14 to 19 September 2005, rodents were collected in 1 village within the city of Bandung and 1 village in Cimahi, subdistrict of Bandung district. The first collection was in the village of Rahayu from 14 to 16 September 2005 while the second took place in the village of Melong Asihm, Cimahi subdistrict, from 17 to 19 September 2005. The total number of trap nights in the Bandung survey was 6.

Four rodent species were collected in Jakarta, *Mus musculus*, *Rattus tanezumi*, *Rattus norvegicus* and *Rattus exulans*. The shrew, *Suncus murinus* was also collected. In Bandung three species of rodents were collected, *R. norvegicus*, *R. tanezumi* and *M. musculus* and one species of shrew was collected, *S. murinus*. Tables 1 provides the total number of individuals of each mammal species, the number of *X. cheopis* collected and the flea indexes for each species of rodent combined for Bandung and Jakarta.

Table 1

Mammal species collected, total number of individual mammals collected, total *Xenopsylla cheopis* collected with flea indexes and range of number of *X. cheopis* collected during rodent surveys in Jakarta, Indonesia from 19 to 27 February 2004 and in Bandung, West Java, Indonesia from 17 to 19 September 2005.

Mammal species	1st rodent surveys from 19-27 February 2004				2nd rodent surveys from 17-19 February 2005			
	Total number of individuals	Total *X. cheopis*	Flea Index	Range	Total number of individuals	Total *X. cheopis*	Flea Index	Range
Rattus norvegicus	49	88	1.8	0-6	181	407	2.2	0-15
Rattus tanezumi	84	128	1.5	0-8	56	195	3.5	0-10
Mus musculus	06	06	1.0	0-5	17	23	1.4	0-19
Suncus murinus	79	22	0.28	0-7	27	23	0.85	0-4
Total	218	244	1.1	0-8	281	648	2.3	0-19

At the three sites in Jakarta, each site varied with respect to the number of mammals trapped and number of fleas collected. When all of the *X. cheopis* data from all mammal species is combined for the Pamulang site, 57 *X. cheopis* were collected for a total flea index of 1.1. *Rattus tanezumi* had a flea index of 0.95, *R. norvegicus* had a flea index of 1.06 and *S. murinus* had a flea index of 0.15. For the Penjaringan site, 43 *X. cheopis* were collected for a total flea index of 0.52. *Rattus tanezumi* had a flea index of 0.83, *R. norvegicus* had a flea index of 1.03 and *S. murinus* had a flea index of 0.89. For the site in Ragunan, only 2 *X. cheopis* were collected from *S. murinus*, for a total flea index of 0.08.

The overall flea index for the village of Rahayu in Bandung was 2.4, 2.2 for *R. norvegicus*, 3.7 for *R. tanezumi*, 0.5 for *M. musculus* and 1.1 for *S. murinus*. For Melong Asih the overall flea index was 2.2, 2.2 for *R. norvegicus*, 3.1 for *R. tanezumi*, 1.9 for *M. musculus* and 0.7 for *S. murinus*.

When all of the rodent and flea data are combined, the overall flea index in Jakarta was 1.1 and the overall flea index in Bandung was 2.3. The total number of *X. cheopis* and the number of *X. cheopis* per individual mammal was higher in Bandung versus Jakarta. In contrast, more *S. murinus* were collected in Jakarta, but consistent with the rodent data, the *S. murinus* in Bandung carried a higher flea load (0.85 flea index) than in Jakarta (0.2 flea index). In Jakarta, *R. tanezumi* had the highest number of *X. cheopis* collected (47 *X. cheopis*). But in Bandung *R. norvegicus* had the highest *X. cheopis* load, (407 *X. cheopis*).

DISCUSSION

In a survey of Ancol, North Jakarta, Hadi *et al* (1976) also reported very low numbers of *X. cheopis*. During the survey 47 *X. cheopis* were collected from 210 mammals comprised of 6 rodent species and *S. murinus*. Only 1 flea was collected from 8 *R. norvegicus* (flea index 0.13) and 26 fleas were collected from 29 *R. tanezumi* (reported as *Rattus rattus diardii*) for a flea index of 0.9. Five *X. cheopis* were collected from 59 *S. murinus*, for a flea index of 0.08. Ima-Nurisa *et al* (1997) reported the flea indexes for *R. norvegicus, R. tanezumi* (as *R. rattus diardii*)*, R. exulans, M. musculus* and *S. murinus* in human houses in Ancol during the dry season (July to September) were 0.4, 0.6, 0.0 and 0.0, while during wet season (October to March) were 0.9, 1.7, 0.0, 0.0 and 0.7, respectively. In Koja, also located in North Jakarta, during the dry season the flea indexes were 0.2, 0.2, 0.1, 0.0 and 0.0, respectively, and during the wet season survey no fleas were collected from mammals in Koja. In a separate survey, the total flea indexes in small mammals collected in the North Jakarta harbors of Sunda Kelapa and Tanjung Priok were 2.2 and 1.4, respectively (Ima-Nurisa *et al*, 1997).

Thompson (1938) reported on several ectoparasite surveys in the Bandung area from June 1930 to June 1932. A total of 561 *X. cheopis* from were collected during 48 ectoparasite surveys in West Java, with 26 *X. cheopis* reported from 12 surveys in the Bandung area. However, the number of rodents collected during these surveys was not reported so it is impossible to know the flea indexes, considering the number of surveys, the *X. cheopis* load may be higher in these areas now.

Traub (1972) reported a flea index of 3.0 or greater is considered an increased risk for plague transmission. For Southeast Asia, Gratz (1983) reported a flea index of 1.0 or greater from rodents collected in endemic areas with human cases was the threshold necessary for plague transmission.

In West Java, flea indexes can reach levels that would be cause for concern. During trials of insecticides against *X. cheopis* in

Ciloto, West Java, near Bandung, Lim *et al* (1981) reported pre-insecticide application flea indexes were 5.0 for *R. tanezumi* (reported as *R. r. diardii*), 3.1 for *R. exulans* and 3.8 for *S. murinus*.

The risk for epidemic plague transmission in Jakarta and Bandung cannot be fully assessed unless prevalence rate of the bacteria in fleas and mammals is ascertained, but based on the flea data flea indexes are high enough to support plague transmission. Both *Rattus* species and *S. murinus* are susceptible to plague and there is evidence that plague mortality is lower in *S. murinus*, which may allow it to serve as an urban reservoir for the bacteria (Marshall *et al*, 1967). Also, the possible sylvatic plague vector, *S. cognatus*, was not collected, so the importance of this species remains undetermined. The necessary elements for plague transmission are still present in Jakarta and Bandung and with the possibility of plague transmission occurring with flea indexes of 1.0 or greater any newly reported cases of plague should result in an appropriate epidemiologic investigation and plague control operations.

In addition, it is unknown what the critical number of fleas is for sustained transmission of murine typhus or other rickettsia to humans (Azad *et al*, 1997). Ima-Nurisa *et al* (1997) detected *Rickettsia typhi* DNA in pools of *X. cheopis* collected on *R. norvegicus*, *R. tanezumi* and *S. murinus* in Cempaka Putih, Central Jakarta and in *X. cheopis* collected from *R. tanezumi* in Bogor, West Java. The prevelance rate of antibodies to *R. typhi* in *R. norvegicus* and *R. rattus* collected in the Jakarta harbor was 38.7% for *R. norvegicus* and 37.5% for *R. rattus* (Ibrahim *et al,* 1999). More studies need to be conducted to understand the prevalence of *R. typhi* infection in humans and the dynamics of the rodent, flea, human transmission cycle to determine a critical flea index for use in control operations.

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