

SURVEILLANCE OF SEAPORT RODENTS AND ITS PARASITES AT SEMARANG, CENTRAL JAVA, AND UJUNG PANDANG, SOUTH SULAWESI, INDONESIA.

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ABSTRAK

Survei rodent dan pinjal dilakukan di pelabuhan Semarang dan Ujung Pandang pada bulan Desember 1984 — Mei 1985. Pada survei tersebut ditemukan 3 jenis tikus yaitu *Rattus norvegicus*, *R. r. diardii* dan *R. exulans* dan satu jenis cecurut *Suncus murinus*. Jenis tikus yang banyak ditemukan di pelabuhan Semarang adalah *R. r. diardii* sedang di pelabuhan Ujung Pandang adalah *R. norvegicus*.

Pinjal *Xenopsylla cheopis* ditemukan di kedua daerah yang disurvei, infestasi lebih tinggi pada *R. norvegicus* dan *R. r. diardii* daripada *R. exulans* dan *S. murinus*. Indeks pinjal di pelabuhan Ujung Pandang dan sekitarnya 4 kali lebih besar daripada di Semarang.

Hasil uji kerentanan pinjal menunjukkan bahwa pinjal di kedua daerah pelabuhan tersebut masih peka terhadap DDT 4%, malathion 0,5% dan fenitrothion 1%.

INTRODUCTION

The Directorate of Epidemiology and Immunization, Communicable Diseases Centre (CDC) in Jakarta assisted by the Staff of Health Ecology Research Centre of the National Institute of Health Research and Development (NIHRD), are embarking on surveillance activities on rodents and its parasites of international seaports throughout the country. The first stage of these activities started in Semarang seaport, Central Java and Ujung Pandang seaport, South Sulawesi including its adjacent villages for a period of six months in each study area. The aims of these surveys are (1) to assess the rodent density in

seaports, (2) its flea-indices, (3) insecticide susceptibility to fleas, and (4) for possible control.

Study Areas.

Semarang Seaport

The seaport area covers about 50 hectares. It has 30 godowns, and only 10 of these are active. Trapping was carried out in the active godowns only. The adjoining villages cover 75 hectares with 8 RK and 56 RT. The population in these villages is about 13,228. The village is partly separated from the harbour by a concrete wall, and partly by wire fencing adjacent to the railway line that passes through the harbour. Trapping was carried out in 13 RT of 4 RK in 1170 houses in the villages

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with two traps per house (Fig.1).

Ujung Pandang Seaport

The total area of the harbours is about 113.5 hectares which include part of the residential areas. It is divided into three sections, i.e. the Soekarno, Hatta and Proteri harbours. Altogether 11 godowns (all active) are in the Soekarno and Hatta harbours, and offices are in the Proteri section. The village is separated from the harbour areas by a concrete wall. Trapping was carried out in the 11 active godowns of Soekarno and Hatta harbours only. The adjacent village has 6 RK and 42 RT with a population of approximately 10,500 inhabitants. Trapping was carried out in 6 RT of 4 RK in 359 houses with 2 traps per house (Fig.2).

MATERIALS AND METHODS

Trapping of rodents was carried out during the first week of each month from December 1984 to May 1985 at Semarang Seaport and its adjacent village, and the third week in Ujung Pandang Seaport and its adjacent village. The trapping period of each area was 5 trapping nights with 300 traps only. In Semarang trapping was carried out for three nights in the godowns and two nights in the adjacent village, while in Ujung Pandang it was four nights in the godowns and one night in the village. All traps were baited with baked coconut.

In each of the areas, a field laboratory was provided. During checking, the trapped rat was placed into a cloth bag at the spot of capture to avoid loss of fleas during transportation from the place of capture to the field laboratory. In the laboratory, the rat in the trap was transferred into a

cloth bag and killed following the procedure of Kusharyono et. al. (1). The dead animal was then transferred from the cloth bag to a white plastic basin to recover live fleas. The bag was also checked for fleas which dropped from the rat. The dead animal was then processed, and registered. Ectoparasites, such as chiggers, mites, were collected and preserved in 70% alcohol for identification. Live fleas, identified, were used for insecticide susceptibility tests.

Insecticide susceptibility tests of *Xenopsylla cheopis* with 4% DDT, 0.5% malathion and 1% fenitrothion impregnated papers were carried out following the procedures described in WHO/VBC/75, 588, Rev.1. They were exposed for 0.25, 0.5, 1.0 and 2.0 hours time exposure. Dead fleas after these time exposures were removed, and live ones were held for 24 hours. After 24 hours holding period, all dead fleas were removed and counted, and surviving ones killed and likewise counted. During exposure the tubes of fleas were held in darkness of 27° to 28.5° and 78 to 84% relative humidity. Percentage mortality were plotted on logarithmic probability paper, and regression lines eye-fitted to determine LT_{50} and LT_{95} levels.

RESULTS.

Semarang Seaport and its adjacent villages

Four species of animals in the seaport and its adjacent villages were identified. They were *Rattus norvegicus*, *R. exulans*, *R. diardii* and *Suncus murinus*. In the seaport area the monthly trap-success ranged from 2 to 5.9% with an average of 4.2% (Table 1). A total of 185 animals were trapped during the six month period.

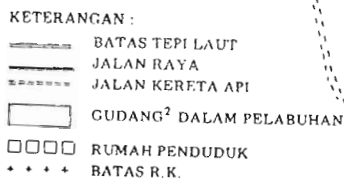


Fig. 1 Showing the locality of the Seaport area and its adjacent village of Semarang.

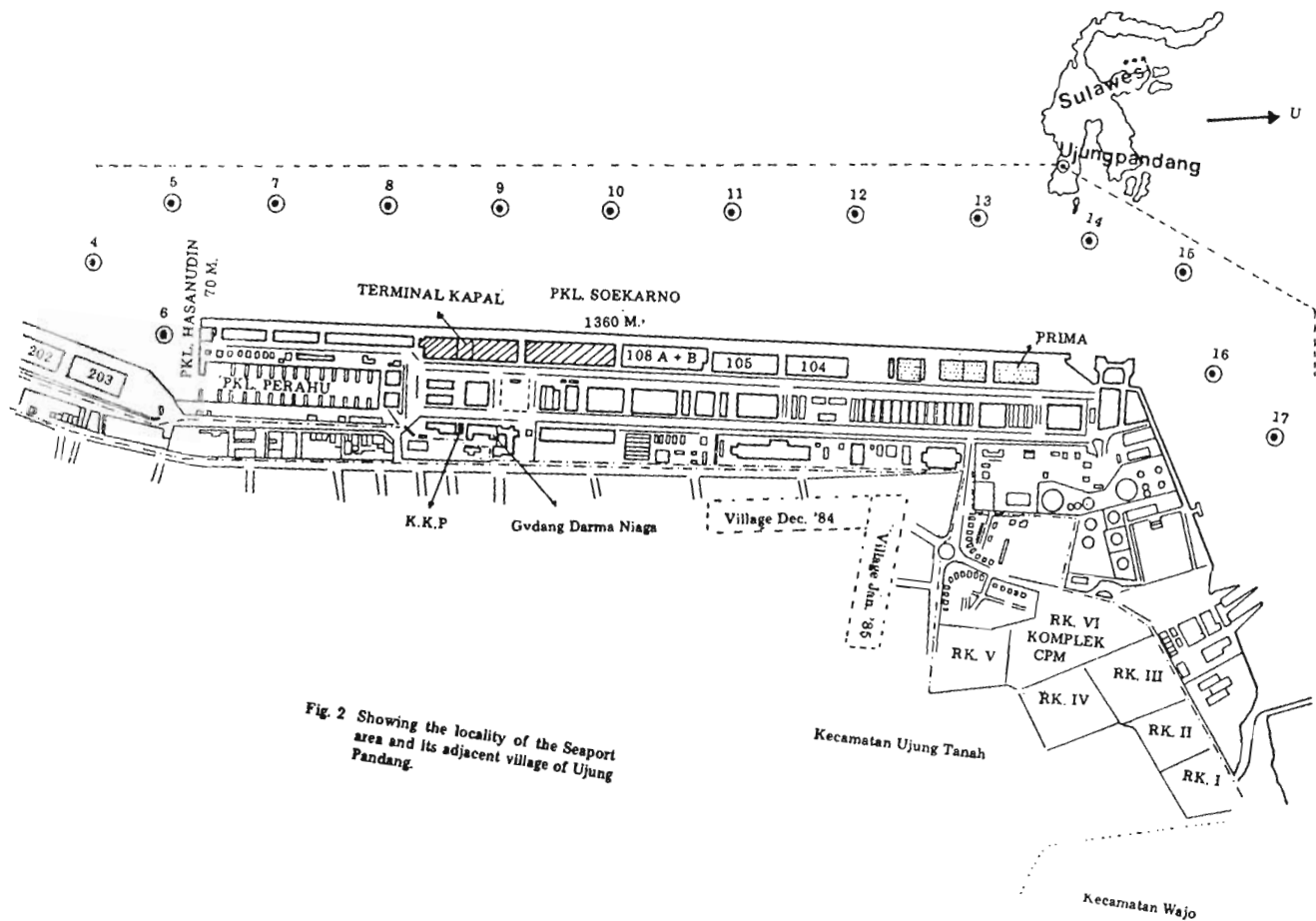


Fig. 2 Showing the locality of the Seaport area and its adjacent village of Ujung Pandang.

Table 1. Percent of trap-success of rats and insectivores from Semarang Seaport and adjacent village from December 1984 to May 1985

Months	No. of trap nights	<i>Suncus murinus</i>		<i>Rattus norvegicus</i>		<i>Rattus r. diardii</i>		<i>Rattus exulans</i>		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Gudang											
December '84	799	10	1.3	2	0.3	35	4.4	0	0	47	5.9
January '85	880	7	0.8	3	0.3	24	2.7	8	0.9	42	4.8
February	900	6	0.7	4	0.4	7	0.8	1	0.1	18	2
March	664	7	1.1	5	0.8	7	1.1	4	0.6	23	3.5
April	600	5	0.8	8	1.3	20	3.3	2	0.3	35	5.8
May	541	3	0.6	3	0.6	12	2.2	2	0.4	20	3.7
	4384	38	0.9	25	0.6	105	2.4	17	0.4	185	4.2
Residential											
December '84	580	8	1.4	16	2.8	40	6.7	38	6.6	102	17.4
January '85	542	31	5.7	15	2.8	22	4.1	72	13.3	140	23.8
February	600	31	5.2	11	1.8	17	2.8	46	7.7	105	17.5
March	394	11	2.8	6	1.5	22	5.6	40	10.2	79	20.1
April	385	8	2.1	6	1.6	24	6.2	14	3.6	52	13.5
May	346	7	2.0	3	0.9	7	2.0	7	2.0	24	6.9
	2847	96	3.4	57	2.0	132	4.6	217	7.6	502	17.6

The percentage of species composition was 20.5 *S. murinus*, 13.5 *R. norvegicus*, 56.8 *R.r. diardii* and 9.2 *R. exulans*. The ratios of male and female were 1 : 1.2, 1 : 2.1, 1.2 : 1 and 1 : 1.2 and the percentage of young animals of the four species examined was 2.6, 40, 20.9 and 0 respectively. This shows that *R.r. diardii* was the predominant rat, followed by *S. murinus*, *R. norvegicus* and *R. exulans*. There were more females caught in each of the species than the males, and more adult than young animals were caught.

In the adjacent villages, the monthly trapping rate ranged from 13.5% to 25.8% with an average of 17.6% (Table 2.). A total of 502 animals were trapped, and the species of animals caught were identical to those collected in the godowns. This comprised of 19.1% *S. murinus*, 11.4% *R. norvegicus*, 26.3% *R.r. diardii* and 43.2% *R. exulans*. The ratios of males against females were 1 : 1.2, 1 : 1.3, 1 : 1.3 and 1 : 1.8, and the percentage of young animals caught for each of the species was 1.1, 14.0, 33.3 and 2.4 respectively. It was apparent from these that *R. exulans* was the predominant rat, followed by *R.r. diardii*, *S. murinus* and *R. norvegicus*. Like in the godowns, there were more females than males, and more adults than young were caught.

Eighty-one percent of 99 female animals examined from the godowns were mature adults. These consisted of 17 *S. murinus*, 11 *R. norvegicus*, 43 *R.r. diardii* and 9 *R. exulans*. Gravid females in each of the species were found in 4 of the 6 months examined and with a percentage of 47.1, 18.2, 48.8 and 55.6 respectively. *R. norvegicus* had the largest mean litter-size (9.0 embryos), followed by *R.r. diardii* (7.1), *R. exulans* (4.8) and *S. murinus* (3.6) respectively.

In the villages 7% of 199 female animals examined were adults which consisted of 54 *S. murinus*, 29 *R. norvegicus*, 63 *R.r. diardii* and 136 *R. exulans*. Gravid females for each of the species were found throughout the six month period with a percentage of 48.1, 72.4, 71.4 and 50.0% respectively. *R. norvegicus* had the largest mean litter-size (8.2 embryos), *R.r. diardii* (6.6), *R. exulans* (4.9) and *S. murinus* (3.0) which is similar to those found in the godowns.

Ujung Pandang Seaport and its adjacent villages

The animal species in these two areas were identical to those identified in Semarang and its adjacent villages. The monthly trapping rate in the Soekarno Seaport ranged from 1.6 to 13.4% with an average of 3.3% (Table 2). A total of 123 animals were trapped which composed of 1.6% *S. murinus*, 88.6% *R. norvegicus*, 7.3% *R.r. diardii* and 2.5% *R. exulans*. The ratios of male against female for *R. norvegicus* was 1 : 1.5, and the percentage of young was 2.9. There were too few of the other species for evaluation. However, based on the present collection, *R. norvegicus* was the predominant rat, followed by *R.r. diardii*, and about an equal number for both *R. exulans* and *S. murinus*. In Hatta Seaport the monthly trapping rate ranged from 0.5 to 9.9% with an average of 4.4% (Table 2). Sixty-five animals were trapped, and it comprised of 3.1% *S. murinus*, 86.2% *R. norvegicus*, 10.8% *R.r. diardii*. The ratio of male against female for *R. norvegicus* was 1 : 1.4, and the percentage of young was 14.3. For the other species too few numbers were trapped for any evaluation. *R. norvegicus* in Soekarno godowns, was the predominant rat, followed by *R.r. diardii*, and about an

Table 2. Percent of trap-success of rats and insectivores from Ujung Pandang seaports and adjacent village from December 1984 to May 1985.

Months	No. of trap nights	<i>Suncus murinus</i>		<i>Rattus norvegicus</i>		<i>Rattus r. diardii</i>		<i>Rattus exulans</i>		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
Gudang Soekarno											
December '84	239	0	—	32	13.4	0	—	0	—	32	13.4
January '85	890	0	—	22	2.5	5	0.6	0	—	27	3.0
February	900	1	0.1	18	2	0	—	1	0.1	20	2.2
March	753	1	0.1	11	1.5	0	—	0	—	12	1.6
April	661	0	—	13	1.9	3	0.5	2	0.3	18	2.7
May	278	0	—	13	4.7	1	0.4	0	—	14	5.0
	3721	2	0.05	109	2.9	9	0.2	3	0.08	123	3.3
Gudang Hatta											
December '84	253	2	0.8	20	7.9	3	1.1	0	—	25	9.9
January '85	298	0	—	7	2.3	1	0.3	0	—	8	2.7
February	274	0	—	2	0.7	1	0.4	0	—	3	1.1
March	278	0	—	14	5.0	2	0.7	0	—	16	5.8
April	203	0	—	12	5.9	0	—	0	—	12	5.9
May	185	0	—	1	0.5	0	—	0	—	1	0.5
	1491	2	0.1	56	3.6	7	0.5	0	—	65	4.4
Residential											
December '84	100	0	—	29	29	0	—	1	0.1	30	30
January '85	299	3	1.0	46	15.4	17	5.7	2	0.7	68	22.7
February	300	7	2.3	31	10.3	5	1.7	1	0.3	44	14.7
March	239	0	—	15	6.3	2	0.8	1	0.4	18	7.5
April	244	0	—	14	5.7	0	—	0	—	14	5.7
May	175	1	0.6	17	9.7	0	—	0	—	18	10.2
	1357	11	0.8	152	11.2	24	1.8	5	0.4	192	14.1

equal number for both *R. exulans* and *S. murinus*.

In the adjacent villages, the monthly trapping rate ranged from 5.7 to 22.7% with an average of 14.1% (Table 2). A total of 192 animals were trapped, which consisted of 5.7% *S. murinus*, 79.2% *R. norvegicus*, 12.5% *R.r. diardii* and 2.6% *R. exulans*. The ratios of male against female were 1.2 : 1, 1 : 1.3, 1 : 1.4 and there were too few *R. exulans* being sampled. The same dominancy of the animal species followed that of Soekarno and Hatta godowns.

Ninety percent of 112 females examined from Soekarno and Hatta godowns were mature adults which consisted of 2 *S. murinus*, 87 *R. norvegicus*, 9 *R.r. diardii* and 3 *R. exulans*. Gravid females of *R. norvegicus* were found through-out the six month period and *R.r. diardii* in 3 of the 6 months only. None of the females of *R. exulans* and *S. murinus* examined was gravid. Gravid females for *R. norvegicus* was 58.6% and 7 of 9 *R.r. diardii* were found to be pregnant with a mean litter-size of 8.3 and 6.1 respectively.

In the villages, 95.4% of 110 females examined were mature adults which comprised of 5 *S. murinus*, 82 *R. norvegicus*, 14 *R.r. diardii* and 4 *R. exulans*. Gravid females of *R. norvegicus* were found throughout the six month period of study; *R.r. diardii* 3 of the 6 months, *R. exulans* 2 of the 6 months and *S. murinus* 1 of the 6 months. Gravid females for *R. norvegicus* was 65.9%, for *R.r. diardii* 42.9% and only 1 out of 5 *S. murinus* and 2 out of 4 *R. exulans*. The mean litter-size of *R. norvegicus* was 8.6 and that of *R.r. diardii* was 6.3, while the only *S. murinus* had 2 embryos, and that of the 2 *R. exulans* had 4 embryos each.

Flea indices

The monthly specific and crude flea-indices of individual animal species from Semarang seaport and its adjacent villages are presented in Table 3. In the seaport area, the crude flea-index was highest in *R. norvegicus* 8.4 as compared to 4.9 in *R.r. diardii* and 0.7 each of *R. exulans* and *S. murinus*. In the adjacent villages, the crude flea-index was also highest in *R. norvegicus* and *R.r. diardii*, being 1.5 and 1.4 respectively, and 0.8 in *S. murinus* and 0.7 in *R. exulans*.

In Ujung Pandang, the crude flea-index of the predominant *R. norvegicus* in Soekarno seaport was 9.4 and that of Hatta seaport was 10.3 (Table 4). There were too few of the other animal species examined for assessment of their flea indices in both these seaports. In the village the crude flea-index of the dominant *R. norvegicus* was 2.9 only. Like in the seaports, the other animal species examined were too few for any assessment.

Insecticide Susceptibility Tests

The results of the susceptibility tests of *Xenopsylla cheopis* with various insecticides in Semarang and Ujung Pandang are presented in Tables 5 and 6 respectively. In Semarang *X. cheopis* was shown to be susceptible to all the three kinds of insecticides impregnated papers (Table 5) and also similarly found in Ujung Pandang (Table 6).

DISCUSSION

Based on the present results of rodent and flea surveillance in seaports and its adjacent villages, rodent density was shown to be significantly higher in Semarang than that found in Ujung Pandang (Chi-square, $p = < 0.05$). The house rat (*R.r. diardii*)

Table 3. Flea-indices of rats and insectivores of Semarang Seaport and adjacent village from December 1984 to May 1985

Months	<i>Suncus murinus</i>				<i>Rattus norvegicus</i>				<i>Rattus r. diardii</i>				<i>Rattus exulans</i>			
	1)	2)	3)	4)	1)	2)	3)	4)	1)	2)	3)	4)	1)	2)	3)	4)
Gudang																
December '84	10	3	1.7	0.5	2	2	14.5	14.5	35	24	4.9	3.4	0	—	—	—
January '85	7	3	1.7	0.7	3	1	76	—	24	20	6.2	5.2	8	3	2.3	0.9
February	6	1	1	0.2	4	3	8	6	7	6	3.5	3	1	0	—	—
March	7	2	3.5	1	5	2	2.5	1	7	3	5	2.1	4	1	1	—
April	5	2	1	1	8	7	11	9.6	20	10	6.7	3.4	2	1	1	1
May	3	2	2.5	1.7	3	2	1.5	1	12	7	3.1	1.8	2	2	1	1
	38	13	1.9	0.7	25	17	12.4	8.4	105	70	4.9	3.3	17	7	1.7	0.7
Residentials																
December '84	8	0	—	—	16	4	1.8	0.4	40	19	3.8	1.8	38	20	1.7	0.9
January '85	31	20	2.7	1.7	15	3	1.3	0.3	22	7	2.1	0.7	72	28	1.7	0.7
February	31	12	1.7	0.6	11	7	2	1.3	17	8	1.9	0.9	46	14	2.2	0.7
March	11	1	2	—	6	2	1	0.3	22	11	2.9	1.5	40	16	1.7	0.7
April	8	1	2	—	6	2	3.5	1.2	24	10	2.3	0.9	14	6	1.8	0.8
May	7	0	—	—	3	2	2.5	1.7	7	6	3.3	2.9	7	2	1	0.3
	96	34	2.2	0.8	57	20	4.3	1.5	132	61	2.9	1.4	217	86	1.8	0.7

1) Number of animals examined

2) Number of animals infested

3) Specific flea-index

4) Crude flea-index

Table 4. Flea-indices of rats and insectivores of Ujung Pandang seaports and adjacent village from December 1984 to May 1985.

Months	<i>Suncus murinus</i>				<i>Rattus norvegicus</i>				<i>Rattus r. diardii</i>				<i>Rattus exulans</i>			
	1)	2)	3)	4)	1)	2)	3)	4)	1)	2)	3)	4)	1)	2)	3)	4)
Gudang Soekarno																
December '84	0	—	—	—	32	31	10.8	10.5	0	—	—	—	0	—	—	—
January '85	0	—	—	—	22	18	10.6	8.7	5	0	—	—	0	—	—	—
February	1	1	1	—	18	15	6.3	5.2	0	—	—	—	1	1	2	—
March	1	0	—	—	11	10	21	19.0	0	—	—	—	0	—	—	—
April	0	—	—	—	13	12	13.1	12.1	3	1	4	—	2	1	1	—
May	0	—	—	—	13	9	4.4	3.1	1	1	1	—	0	—	—	—
	2	1	1	0.5	109	95	10.8	9.4	9	2	32.5	7.2	3	2	1.5	1.0
Gudang Hatta																
December '84	2	0	—	—	20	18	11.1	10	3	3	11.3	11.3	0	—	—	—
January '85	0	—	—	—	7	5	8.8	6.3	1	1	4	—	0	—	—	—
February	0	—	—	—	2	2	3.5	3.5	1	0	—	—	0	—	—	—
March	0	—	—	—	14	12	10.7	9.1	2	1	5	—	0	—	—	—
April	0	—	—	—	12	10	4.1	3.4	0	—	—	—	0	—	—	—
May	0	—	—	—	1	1	20	—	0	—	—	—	0	—	—	—
	2	0	0	0	56	48	12	10.3	7	5	8.6	6.1	0	—	—	—
Residential																
December '84	0	—	—	—	29	21	6.7	4.8	0	—	—	—	1	1	1	—
January '85	3	0	—	—	46	28	4.1	2.5	17	5	3.6	1.1	2	2	1.5	1.5
February	7	1	1	0.1	31	18	3.8	2.2	5	5	10.2	10.2	1	0	—	—
March	0	—	—	—	15	4	2.8	0.7	2	1	8	—	1	0	—	—
April	0	—	—	—	14	5	2.6	0.9	0	—	—	—	0	—	—	—
May	1	1	1	—	17	10	9.3	5.5	0	—	—	—	0	—	—	—
	11	2	3	0.5	152	86	5.1	2.9	24	11	6.4	2.9	5	3	1.3	0.8

1) Number of animals examined
2) Number of animals infested

3) Specific flea-index
4) Crude flea-index

SEMARANG

Table 5. Percentage mortality and LT₅₀ and LT₉₅ for *Xenopsylla cheopis* with various insecticides 1)

Concentration of insecticides	Number of fleas tested	Exposure time (hour)					LT ₅₀ (hours) 2)	LT ₉₅ (hours) 2)
		Number of fleas in control (% mortality)	% mortality					
			0.25	0.5	1.0	2.0		
DDT 4%	210	80 (1.3)	54	61	90	100	0.35	1.33
Malathion 0.5%	170	50 (0)	65	96	100	100	0.20	0.57
Fenitrothion 1%	210	70 (1.4)	50	69	92	100	0.31	0.83

- 1) Four duplicates with ± 10 fleas for each exposure time.
- 2) Percent mortality were plotted on logarithmic probability papers and degression line eye-fitted.

UJUNG PANDANG

Table 6. Percentage mortality and LT₅₀ and LT₉₅ for *Xenopsylla cheopis* with various insecticides 1)

Concentration of insecticides	Number of fleas tested	Exposure time (hour)				LT ₅₀ (hours) 2)	LT ₉₅ (hours) 2)	
		Number of fleas in control (% mortality)	% mortality					
			0.25	0.5	1.0	2.0		
DDT 4%	330	70 (2.9)	58.6	70.9	96.7	98.3	0.25	1.33
Malathion 0.5%	280	50 (2)	77.7	85.6	86.1	96.2	0.05	1.83
Fenitrothion 1%	250	60 (1.7)	82	90	93.6	98.9	0.06	1.03

- 1) Four duplicates with ± 10 fleas for each exposure time.
- 2) Percent mortality were plotted on logarithmic probability papers and degression line eye-fitted.

was the predominant species in Semarang seaport, and the seaport rat (*R. norvegicus*) in Ujung Pandang. In its adjacent villages, the Burmese house rat (*R. exulans*) was the predominant species in Semarang, and *R. norvegicus* in Ujung Pandang. In both these areas three species of rodents and

one species of insectivores (*S. murinus*) were identified. Lim et. al. (2) found an additional species of house mouse (*Mus musculus*) in the Tanjung Priok seaport, Jakarta and its surrounding villages. The failure to capture this mouse was due to the trapping technique rather than the absence of

this creature in the two areas.

The density of rodents and insectivores varies between seaport areas and its surrounding villages. In Semarang, there were 2.7 times more animals trapped and the trapping rate was 4.2 times greater in the villages than the seaport. In Ujung Pandang it was 1.5 and 2.9 times more animals in the Soekarno than Hatta seaports. The trapping rate was 3.2 and 4.3 times greater in the villages than the seaports. Lim et. al. (2) also found more animals in the surrounding villages of Tanjung Priok, Jakarta than in the seaport areas.

More than eighty percent of the adult females examined in the seaports and its surrounding areas were found gravid. The occurrence of gravid females were found to be more frequent in *R. norvegicus* and *R.r. diardii* than the other two species of animals. This indicates that there is a quick turn-over of the density of these two predominant species in the seaport areas. The relatively low number of young and sub-adult animals trapped indicates that there is probably some natural predation within the population in its natural surroundings.

The *X. cheopis* flea density revealed high indices among rodents and insectivores in both seaport areas than those observed in its surrounding villages. In the seaports *R. norvegicus* and *R.r. diardii* were shown to have much higher flea-indices than *R. exulans* and *S. murinus*. Despite its low indices among the animals examined in the villages, *R. norvegicus* and *R.r. diardii* were also found to have slightly higher flea indices than *R. exulans* and *S. murinus*. The crude flea-indices of 185 animals from Semarang seaport and 502 in its adjacent village were 2.4 and 0.8 respectively. Of 123 and

65 animals from Soekarno and Hatta seaports, the indices were 8.9 and 9.5 as compared to that of 192 animals examined in its adjacent villages. This revealed that animal flea-index in Ujung Pandang seaport and its adjacent village was 4 times greater than that in Semarang.

Insecticide susceptibility tests of *X. cheopis* with impregnated papers from both Semarang and Ujung Pandang showed that the flea was susceptible to DDT, malathion and fenitrothion.

RECOMMENDATION

1. The low trapping rates in both Semarang and Ujung Pandang seaports, indicate that more attention should be given to the supervision of trapping methods in the godowns of seaports. With better supervision it will increase the catchability rate, and also prevent frequent losses of traps.
2. In Semarang, the fencing between the adjacent villages and the seaport was left with a stretch of land unfenced. Thus emi- and immigration of rodents between the seaport and the village occurs. Because of this it will be difficult for control measures of rodents to be undertaken in the seaport area.
3. In Ujung Pandang, where a wall between the seaport and adjacent village was constructed, emi- and immigration of rodents to and from are limited. Thus, rodent control measures in this seaport area is applicable.
4. The present findings in both the seaport areas revealed high crude flea indices, particularly in Ujung Pandang seaports. Rodent density, on the other hand, was shown to be fairly low. Instead of rodent control, it may be better to execute flea control in the seaports in Ujung Pandang in-

cluding Semarang seaport also.

5. Insecticide susceptibility tests of *X. cheopis* revealed that the flea is susceptible to all three kinds of insecticides, DDT, malathion and fenitrothion. Thus, DDT which is easily available and being the cheapest insecticide should be used as the choice for flea control.

SUMMARY

A rodent and flea survey was carried out in Semarang and Ujung Pandang seaports and its adjacent villages from December 1984 to May 1985. Three species of rodents, *Rattus norvegicus*, *R.r. diardii* and *R. exulans* and a species of insectivore, *Suncus murinus* were identified. In Semarang seaport 185 of these animals and 502 from the village were examined, while in Ujung Pandang, 123 from Soekarno, 95 from Hatta seaports and 192 from the village were also trapped. *R.r. diardii* was the predominant rat in Semarang seaport and *R. norvegicus* in Ujung Pandang seaport. In the Semarang village *R. exulans* was predominant while *R. norvegicus* was predominant in the Ujung Pandang village. In Semarang there were 2.7 times more animals trapped with a trapping rate of 4.2 times greater in the village than that in the seaport. In Ujung Pandang, it was 1.5, and 2.9 times more animals with trapping rate of 3.2, and 4.3 times greater in the village than that in the Soekarno and Hatta seaports. More than eighty percent of the adult female animals examined were gravid in both localities.

The *Xenopsylla cheopis* density showed high indices among rodents and insectivores in both seaport areas than that observed in its surrounding

villages. Among the animal species, *R. norvegicus* and *R.r. diardii* have much higher indices than those of *R. exulans* and *S. murinus* in both localities. Flea-indices of animals in Ujung Pandang seaport and its adjacent village was 4 times greater than those found in the Semarang areas.

Insecticide susceptibility tests with impregnated papers of 4% DDT, 0.5% malathion and 1% fenitrothion to *X. cheopis* showed that the flea from both localities was susceptible to the insecticides.

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