

Distribution of Rodent Population in the Nankan Area, Matsu Islands

Abstract

Between 1994 and 1996, 53 rodents of four Rodentir species had been caught on Nankan Island of Matsu. They included *Rattus novegicus* (Berkenhout, 1976), *Rattus losea* (Swinhoe, 1871), *Mus musculus* (Linnaeus, 1758), and *Rattus rattus* (Linnaeus, 1758). In addition, 61 rodents of the Insectivore species, *Suncus murinus* (Linnaeus, 1766), had also been caught. *Rattus novegicus* and *Suncus murinus* are rampant on the island. In November 1998, two months before the national mousing week, the rodent densities at Fuhsing and Chiehshou villages of the island estimated by regression analysis were 0.29 and 3.8 rodents per household respectively. In March 1999, two months after the national mousing week, the densities were 0.25 and 0.13 respectively. The effectiveness of the control program was 13.8% and 96.6% respectively. Reasons for the differences are discussed in the following paragraphs.

Key words: Nankan Island of Matsu, distribution of rodent population, rodent density, effectiveness of control program

Introduction

The Matsu Islands are located at the northwestern side of the Taiwan Strait, facing Mm River, Lien River, and Loyuan Bay (between 25.55 and 26.18° N, and 119.51° and 120.20° E). The island group includes Nankan, Peikan, Tachiu, Hsiao chiu, Tungchu, Hsichu, Tungyin, and Hsiyin. The migration control was lifted on 13 May 1994⁽¹⁾. Since then, tourists and visitors have poured in. With changes in the relations between the two sides of the Strait leading to large-scale disarmament, many military compounds and strongholds are left idle. With the increasing out-migration of the population, many houses such as those at Chinsha village are unoccupied. Environmental sanitation of this area has become a serious problem. Infectious diseases in man associated with rodents are plague, murine typhus,

taeniasis, scrub typhus, salmonellosis, shigellosis, Weil's disease, rat-bite fever, trichinosis, and hantavirus diseases⁽³⁻⁵⁾. Rodents, therefore, play an important role in public health. This area is much closer to the mainland China than to Taiwan, the ecology of rodents there is likely to be different from that of rodents on Taiwan. Nankan Island is the administrative center of the Matsu group. Comprehensive surveys of the island on the distribution and density of rodents of various species and *Suncus murinus* (Linnaeus)^(6,7) of the Insectivore were conducted.

Materials and Method

Surveys of the Distribution of Rodent Population

1. Selection of Survey Sites

The terrain of Nankan is wavy, with a land area of only 8.4 square kilometer⁸. Flat areas are limited, and villages scatter around plain areas and in valleys facing the ocean. The surveys focused on villages of Chiehshou, Jenai, Chinsha, Matsu, Siwei, Chuluo, Chingshuei, Fuwuo, and Fuhsing; and around mountain areas of Chunghsingling, Wuchienpai, Chiukueishan, Shengtien reservoir, Niuchiaoling and the garbage plant.

2. Trapping of Rodents

Two kinds of baits were used. In the mountain areas, peanuts in shell were placed in rat cages and deployed after rat traces. In villages, chicken farms and around houses, fried pork and peanuts in shell were used together. The number of cages deployed, ranging from 20 to 60, varied with the size and terrain of the selected site. Each day, eight to ten workers, two in a group, deployed 100 cages. The sites were marked with red plastic ribbons. Cages were deployed at 3 to 6 in the afternoon and collected at 10 next morning. Rodents thus trapped were sent to the Lienchiang County Health Bureau for handling, recording of species and number.

Surveys on Rodent Density and Effectiveness of Control Program

As Chiehshou (280 households) and Fuhsing (140 households) are two villages with more population, surveys of the effectiveness of the mousing week were conducted there. In collaboration with the Lienchiang County Health Bureau, 70 rat cages carrying fried pork and peanuts in shell were deployed in each village in indistinct areas around houses, ditches or vegetable yards. By using the Zippin's method⁽²⁾, the site of deployment was decided, cages with baits were placed, and cage gates fastened with wires. Cages were left for two nights, the results observed, and baits replenished. The wires were then removed, cages left for five nights, the results observed. Rodents trapped were brought back in cages. Fresh cages were placed at the same site. Rodents thus trapped were taken to the Lienchiang County Health Bureau for handling, and recording of species and number. Rodent density was calculated by regression analysis method. One each survey was conducted before and after the national mousing week, each time, cages were placed at the same sites, to compare changes in density before and after the campaign.

Result

Surveys of the Distribution of Rodent Population

The surveys were conducted as part of a Hantavirus survey financially supported by the Department of Health. The rodent survey teams of ten persons each visited Nankan three times on 22-26 August 1994, 15-19 May 1995, and 27-31 May 1996 to trap rodents for four nights by deploying 100 rat cages on each visit. In total, 114 rodents had been caught: 39 *Rattus novегicus*⁽⁷⁾, 8 *Rattus losea*⁽⁶⁾, 3 *Mus musculus*^(6,7), 3 *Rattus rattus*^(6,7), and 61 *Suncus murinus*^(6,7). The number of *Suncus murinus* caught was the largest, accounting for 53.5% of all rodents caught; the number of *Rattus novегicus* was 34.2% of all rodents caught. *Rattus losea* was found more in open fields or vegetable yards; and *Mus musculus* more in indistinct areas around houses or in thick grass. *Rattus novегicus* was found everywhere in villages, at military compounds such as Chunghsinglin, Matsu Hospital, the Logistics Command, garbage plant at Niuchiaoling, inhibited areas such as Chinglu and Chiukweishan. *Suncus murinus* was found everywhere except Chunghsinglin, Matsu Hospital, the Logistics Command, and Fuwuo Port (see Table 1). The land area is small, these two species of rodents, as indicated by the surveys, were all over the place on the island.

Surveys of the Rodent Density and Effectiveness of Control Program

The Ministry of Defense and the Lienchiang County Health Bureau financially supported these surveys. Surveys of the rodent density were conducted in collaboration with the Lienchiang County Health Bureau two months before and after the national mousing week. The first survey conducted in November 1998 caught at Fuhsing village three *Rattus novегicus* (10.3%), four *Mus musculus* (13.8%), one *Rattus losea* (3.4%) (whitish belly, different from the *Rattus losea* of usual grayish belly), and 21 *Suncus murinus*, giving a maximum rodent density of 0.29 rodents per household by regression analysis. At Chiehshou village, six *Rattus novегicus* (16.2%), and 31 *Suncus murinus* (83.8%) had been caught. The maximum rodent density by regression analysis was 3.8 rodents per household. The second survey conducted in March 1999 caught at Fuhsing village three *Rattus novегicus* (9.4%), three *Mus musculus* (9.4%), and 26 *Suncus murinus* (81.2%), giving a maximum rodent density of 0.25 rodents per household by regression analysis, the effectiveness of the control program being 13.8%. At Chiehshou village, 10 *Rattus novегicus* (50%) and 10 *Suncus murinus* (50%) had been caught, the maximum rodent density was 0.13 per household, and the control effect, 96.6% (Tables 2 and 3).

Discussion

Surveys of the Distribution of Rodent Population

In cities, three major species of Rodentir coexist with humans, *Rattus novegicus*, *Rattus rattus*, and *Mus musculus*. In some areas, *Rattus novegicus* are seen more often along seacoast in or around houses⁽⁹⁾. In a survey of rodents for hantavirus in the Taiwan-Fukien area conducted in collaboration with the National Quarantine Service of the Department of Health, it was found that *Rattus navegicus* species often bred along food sources and came out to search for food in the night. In cities, their usual habitats were ditches or sewers; and at harbor areas, sewers and cracks or holes on breakwaters. On the dry, hard land such as the areas around chicken farms and pigsties, they dig tunnels to access the chicken farms and pigsties. They were alert to rat cages, ratttraps were used on chicken farms and pigsties instead. Using fried pork than peanuts as baits caught more rodents. *Rattus novegicus* were the most of the Rodentir species caught on Nankan, 73.6% of all rodents caught, they were the majority. In another survey on the distribution of antibody positive rates of hantavirus in the Taiwan-Fukein areas conducted in collaboration with the National Quarantine Service of the Department of Health, *Rattus novegicus* were found to have the highest rate of 23.6%⁽¹⁰⁾. *Rattus novegicus* were, therefore, an important medium for the transmission of hanta hemorrhagic fever⁽⁴⁾. This species was, in addition to being destructive to economy, an important public health issue. Nankan is small in land area, and most villages scatter along seacoast. This geographic characteristic meets the special habitude of *Rattus nevegicus* in their distribution. The surveys had found traces of *Rattus nevegicus* in all villages and areas inhabited on the island. Another species of public health concern, *Suncus murinus*, moves around in dry fields and in and around houses. They hide under rocks, woods, and in dark places such as under the bed and piles of household junk. They feed on insects, earthworms, meat, chicken, birds, potatoes, and vegetable seeds, though they prefer meat to vegetables. They are less alert to rat cages, they can be easily caught by using fried meat as bait. The used cage can be used again without any processing. They often mix with Rodentir species. As most of them hide in thick grass in the open fields, they are infested with mites and fleas. Unlike other species in their ears mites gather, mites gather on their legs. They move in and about houses, they are an important medium of hantavirus. The mites and fleas on them can also transmit scrub typhus and *Bacillus pestis*. Their control is an important issue in public health^(4,11,12,13).

Surveys of Rodent Density and Effectiveness of Control Program

Surveys showed that the mousing campaign was significantly effective in Chiehshou village by changing the distribution of the *Suncus murinus* species. McNeill's 1968 report showed that *Suncus murinus*, being omnivorous, were in Penghu all year round, their growth changed little during a year, increased slightly in October and declined in May and June^(1,3). *Suncus murinus* though prefer meat, they can live on vegetables. Seasons seem to have little effect on the growth of the population. Seasonal effects, therefore, were not considered in the surveys on the

effectiveness of the mousing campaign at Chiehshou village. The wax-coated peanuts as baits prepared by the Lienchiang County Health Bureau seemed to have been effective in the control of *Suncus murinus*, though Wang CH in his survey report of rodent density in Chinmen did not recommend the use of wax-coated peanuts in *Suncus murinus* infested areas⁽¹⁴⁾. The overall control effectiveness at Chiehshou village was 96.6%. In five days, 31 *Suncus murinus* were caught before the campaign, but only 10 were caught after the campaign (Table 2). In contrast, at Fuhshing village in five days, 29 rodents were caught before the campaign, and 32 were caught after the campaign. However, the number of rodents caught had declined day by day after the campaign, their overall control effectiveness by regression analysis was 13.8%. The reason was that the number of *Rattus novегicus* had declined sharply from an indefinitely large number to only 0.01 per household, the number of *Rattus losea* and *Mus musculus* had declined slightly. However, unlike Chiehshou village, the number of *Suncus murinus* had increased from 0.17 to 0.20 per household (Table 3). Surveys of the distribution of rodent population showed that some major species of rodents on the island were *Rattus novегicus* of the Rodentir and *Suncus murinus* of the Insectivore. *Rattus novегicus* were highly alert, they could not be easily trapped even at places where there were many traces of them. The number caught did not decline day by day either (Table 2). The number of *Rattus novегicus* caught at Chiehshou village in fact had increased from 0.02 to 0.04 per household (Table 3). Though the number of *Rattus novегicus* caught at Fuhshing village had declined significantly, the total number caught in five days remained unchanged. For the effective trapping of *Rattus novегicus*, the feeding before trapping and the duration of trapping period should be prolonged to reduce their alertness. The present surveys of the density of rodent population involved rodents of all species including *Suncus murinus*, the feeding period was therefore not prolonged. For *Suncus murinus*, the significant differences noted at the two villages, though surveys were conducted at the same time under same conditions, were because of geographic and human factors. The two villages though were separated by a small hill, were quite different geographically and in humanities. For geographic factors, Chiehshou village is flat and U-shaped, and people live close to each other. Fihshing village, on the other hand, is steep and V-shaped, and people live on the hill. In humanities, Chiehshou village, a small and densely populated town by itself, is the site of the county government and commercial center of Nankan with markets. There are fewer unoccupied houses. Vegetable yards are in front of the county government building surrounded by streets and stores. The environment is less sophisticated and can be easily organized. Fuhshing village is agrarian, with many conventional stone houses, often dark and humid inside. Many people have moved out, and houses are left unoccupied. Vegetable yards are on the hill next to a slaughterhouse and a winery. The environment is not as simple as that of Chiehshou village. The number of rodents caught at Fuhsiung was therefore more

than that of Chiehshou (Tables 2 and 3). The effectiveness of a mousing campaign, it seems, depends not only on the use of baits alone, environmental factors of the area should be the major concern. The environmental sanitation of the two villages had improved considerably after the mousing campaign, particularly in the disposal of piled junk. However, Fuhsing village, which is hilly with more stairs, ditches, unoccupied houses, and complicated vegetable yards, is more suitable for the breeding of *Suncus murinus*. Less manpower available as a result of out-migration was also a contributing factor to the difficulties of the rodent control program.

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Table 1. Number and Species of Rodents Caught, Nankan, 1994-1996

Village	<i>Rat. novegicus</i>	<i>Rat. losea</i>	<i>Mus. Musculus</i>	<i>Rat. rattus</i>	<i>Sun. murinus</i>	Total
Chiehshou	1	1			3	5
Jenai	2				4	6
Chinsha	6	4			5	15
Matsu	4				3	7
Siwei	1				17	18
Chuluo	2				4	6
Chingshuei	3				5	8
Fuwuo	1			1		2
Fuhsing	5		2		2	9
Subtotal	25	5	2	1	43	76
Chunghsingling	1					1
Wuchienpai		1	1		3	5
Chiukweishan	2				1	3
Logistics Com	1			1		2
Matsu Hospital	2					2
Shentien Dam	1				2	3
Niuchiaoling	1	2			5	8
Chinlu	6			1	7	14
Subtotal	14	3	1	2	18	38
Total	39	8	3	3	61	114

Table 2. Number and Species of Rodents Caught by Day, Chiehshou Village

Date	November 1998			March 1999		
	<i>R. novegicus</i>	<i>S. murinus</i>	Total	<i>R. novegicus</i>	<i>S. murinus</i>	Total
1 st day	3	5	8	5	2	7
2 nd day	0	8	8	0	1	1
3 rd day	0	5	5	1	3	4
4 th day	2	6	8	1	1	2
5 th day	1	7	8	3	3	6
Total	6	31	37	10	10	20

Table 3. Number and Species of Rodents Caught, Fuhsing Village

Date	November 1998					March 1999			
	(1)	(2)	(3)	(4)	Total	(1)	(2)	(4)	Total
1 st day	0	1	1	7	9	1	2	11	14
2 nd day	0	1	0	7	8	2	0	6	8
3 rd day	0	1	0	1	2	0	0	5	5
4 th day	0	0	0	5	5	0	1	2	3
5 th day	3	1	0	1	5	0	0	2	2
Total	3	4	1	21	29	3	3	26	32

(1) *Rattus novegicus*, (2) *Mus musculus*, (3) *Rattus losea*, (4) *Suncus murinus*