SPECIES COMPOSITION, RELATIVE SEASONAL ABUNDANCE AND SEX RATIO OF COMMENSAL RODENT SPECIES IN PONNASU QUARTER, BAGO TOWNSHIP, BAGO REGION

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Abstract

A survey on commensal rodent species was conducted to determine the species composition, relative abundance and sex ration in Ponnasu Quarter, Bago Township, Bago Region from December 2021 to August 2022. A randomized sampling design was used for this survey. Trapping was conducted two consecutive nights per month in each selected street with 20 local killed traps. A total of five traps were set in each house across inside and outside. Data were analyzed statistically with Excel and SPSS software. Three species of commensal rodent species, *Rattus exulans* (67%), *Rattus rattus* (12%) and *Bandicota bengalensis* (21%) were trapped during the nine- month study period. *Rattus exulans* were observed as the more abundant species inside the house. The results of statistical analysis showed that there was no significant difference in the number of captured species between dry and wet seasons. The number of captured males was not different from females in all captured species. The sex ratio of all recorded species was found to be not different from the 1:1 sex ratio. This first survey of commensal rodent species in this area will provide the basic factors for understanding the abundance of commensal rodents that can transmit pathogens and cause zoonotic diseases.

Key words: abundance, sex ratio, *Rattus exulans*, *Rattus rattus*, *Bandicota bengalensis*

INTRODUCTION

The presence and abundance of commensal rodent species in urban areas reflect the socioeconomic conditions, the abundance of food resources and the standard of infrastructure (Himsworth, Parsons, Jardine, & Patrick, 2013; Feng & Himsworth, 2014). Heterogeneity of habitat and resource availability increases localized abundance across urban environments (Combs, Puckett, Richardson, Mims, & Munshi-South, 2018). Rodents are recognized vectors or reservoirs of a long list of pathogens such as *Salmonella* spp., *Campylobacter* spp., *Leptospira interrogans* and *Toxoplasma gondii* (Vado et al., 2002). They have been affecting human health through the transmission of diseases and causing high economic damage in agricultural areas (Pimentel et al., 2000).

The black rat (*Rattus rattus*), the Norway rat (*R. norvegicus*), and the house mouse (*Mus musculus*) are the most well-known commensal rodent species. The Pacific rat, *R. exulans*, is restricted to Southeast Asia and the Pacific islands. These commensal rodent species may be locally abundant in urban, suburban, and agricultural areas, and they are among the most problematic invasive animals affecting natural resources (i.e., native species) on islands (Towns et al., 2006; Angel et al.; 2009, Witmer and Shiels, 2018). Apart from damage to crops, mice also affect rural townships, damaging equipment (particularly electrical equipment), spoiling and consuming products, causing lost business opportunities from the inability to stock and sell products at risk (such as food and grain), incurring costs for the protection of goods and maintenance of hygiene (Bomford and Hartz, 2002). Studies related to abundance and populations of small rodents in both rural and urban areas are few. The present study is the first to survey some aspects of the commensal rodent community in this quarter of Bago Township. The findings will provide some basic information to prevent and control the abundance of rats and mice. The objective of this study was therefore to determine the relative abundance and species composition of commensal rodents present in the households of the urban community.

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MATERIALS AND METHODS

Study area

This survey was conducted in Ponnasu Quarter, Bago Township, Bago Region (17°19'24.3"N 96°29'04.7"E). This quarter is composed of 19 streets. Each street is 80 ft long and 18 ft wide (Figure 1). Each street includes drainage for sewage and wastewater on both the left and right sides. Most of the drainages are three feet wide and the depth is about three and a half feet. There are 1000 estimated houses in this quarter. Most of the houses are two- storied and built based on bricks mixed with cement. Most of the roofs are tin roofs. Most of the families living this quarter are middle income families. Municipal waste collection is conducted twice a week in this quarter.

Figure 1. Some of the streets in Ponnasu Quarter

Sampling Design

Three streets were selected to conduct this survey. There are three streets separated between the selected streets. A total of five houses were randomly selected from each selected street. The housing styles, the fencing styles, and the waste collection styles of the selected houses were recorded.

Trapping

This study was conducted from December 2021 to August 2022. A total of 20 local killed traps were used for trapping (Figure 2). Live trapping was also conducted for pre-survey. Trapping was conducted for two consecutive nights for the selected houses in each selected street. Dry fish was used as bait for trapping. Four traps were set at about 6:00 pm and the specimens were collected at about 6:00 am in each randomly selected house. A total of three trapping sessions for the three selected streets were conducted per month.

(A) (B) (C)

Figure 2. Materials used for trapping (A) Brand of local killed trap (B) Live trapping in pre survey (D) Local killed trap

Specie Identification

Species were identified based on morphological characteristics such as fur color, teeth color, and teeth orientation; and morphometric characteristics such as head+body length, tail length, ear length, and foot length, (Figure 3). The identification was followed by Aplin et al. (2003). The collected specimens were sexed and weighed. The maturity stage was also observed to record whether they are adults or juveniles.

(A) (B) (C) (D)

Figure 3. Recording morphological and morphometric characteristics (A) Measuring tail length (B) Measuring head+body length (C) Taking weight measurement (D) Examining fur color

Data analysis

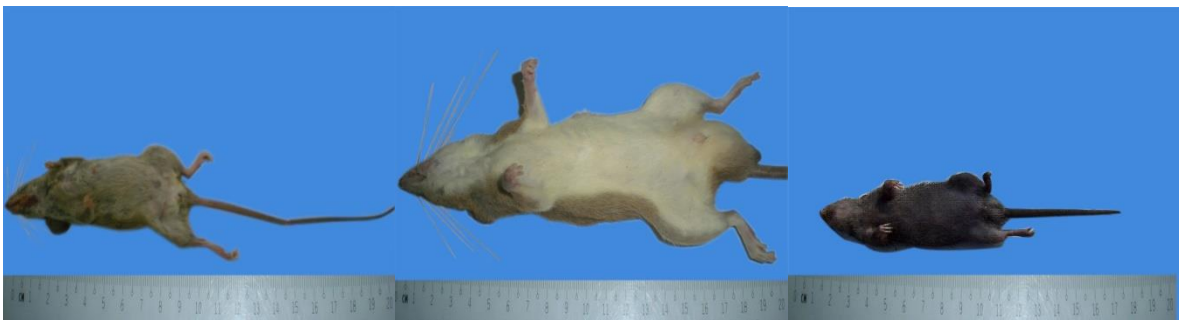
The data analysis was carried out with Microsoft Excel and SPSS 2020. Independent Student T tests were used to analyze the captured numbers of sexes and the captured numbers of adults and juveniles for each species. The chi-square test was used to analyze the sex ratio. A one-way analysis of variance (One-Way ANOVA) test was used to analyze the abundance between the recorded species. The calculation of trap success was followed by Aplin et al. (2003) according to the following formula.

$$\text{Trap success} = \frac{\text{the number of rats trapped}}{Total\ number\ of\ traps} \text{ x } 100$$

RESULTS

Species composition

A total of three commensal rodent species (the root rat *Rattus rattus* and Bengal bandicoot *Bandicota bengalensis* and Polynesian rat *Rattus exulans*) were recorded during this study period (Figure 4). The results of this study revealed that *Rattus exulans* was composed of the highest captured species (n = 180) followed by *B. bengalessis* (n = 56) and *R. rattus* (n = 31). The relative species compositions of *R. exulans* and *B. bengalensis* and *R. rattus* were 67%, 21% and 12% respectively (Figure 5).



(A) *Rattus exulans* (B) *Rattus rattus* (C) *Bandicota bengalensis*

Figure 4. Three recorded commensal rodent species

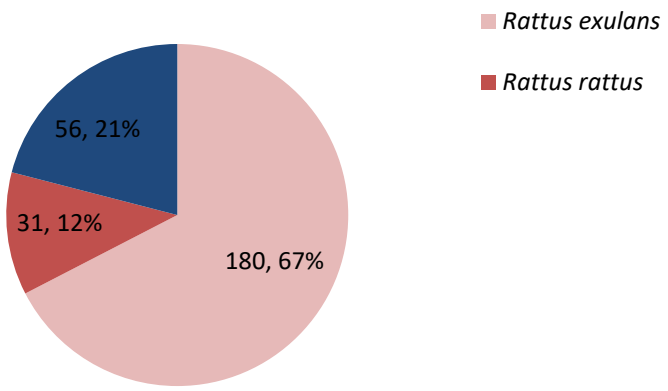


Figure 5. Species composition of rats and mice species during the study period

Relative abundance and trap success

In a total of 1080 trap nights, 267 rats and mice were collected during the study period. The maximum number of specimens was recorded in August (n = 36) and the minimum occurred in December (n = 19) (Figure 6). Overall trap success during the survey period was 24.72%. The maximum trap success occurred in August (30.00%). The monthly collected number and trap success of captured species during the dry and wet season were shown in Table 1 and Table 2. A total of 133 captures were made in 600 trap nights during the dry season. The overall trap success during the dry season was 22.17%. A total of 134 captures were made in 480 trap nights during the wet season. The overall trap success during the wet season was 27.92%.

The total captured number of *R. exulans* during the dry season was 91 with the maximum collected number of 24 that occurred in March. During the wet season, a total of 89 *R. exulans* species were captured. The maximum number was collected in May (n = 24) (Table 1).

A total of 15 *R. rattus* species were captured during the dry season. The maximum capture was observed in April (n = 5). The number of captured *R. rattus* during the wet season was 16 with the maximum capture (n = 6) in August.

The number of *B. bengalensis* captured during the dry season was 27. The maximum number (n = 7) was captured in March and April. During wet season, the number of this species collected was 29 with the maximum (n = 8) in August.

The results of statistical analysis showed that there was a highly significant difference among the captured numbers of the three recorded species ($F_{2,12}$ = 139.7689, P = 0.000, P<0.01).

No significant difference was observed in the captured numbers of all species between dry (December, January, February, March and April) and wet seasons (May, June, July and August) (t = - 2.221, df = 7, P = 0.062, P > 0.05).

Trap success during the dry season was 22.17% and 27.92% during the wet season. Statistical analysis showed that no significant difference was observed between the dry season trap success and the wet season trap success (X^2 = 0.660062, df = 1, P = 0.416538, P > 0.05)

The result of statistical analysis showed that there was no significant difference in the captured numbers of *R. exulans* between the dry and wet seasons (t = - 1.814, df = 7,

P = 0.113, P > 0.05). Similar results were observed in *R. rattus* (t = - 0.805, df = 7, P = 0.447, P > 0.05) and in *B. bengalensis* (t = -1.722, df = 7, P = 0.129, P > 0.05).

Table 1 Number of monthly recorded rat and mouse species and trap success during the dry season

Month	Species			Total Number	Trap Success (%)
	R. exulans	***R. rattus***	***B. bengalensis***		
Dec	13	1	5	19	15.83
Jan	16	3	4	23	19.17
Feb	18	4	4	26	21.67
Mar	24	2	7	33	27.50
Apr	20	5	7	32	26.67
Total	91	15	27	133	
Mean± SD	18±4.15	3±1.58	5±1.52	27±5.94	
Max	24	5	7	33	
Min	13	1	4	19	

Table 2 Number of monthly recorded rat and mouse species and trap success during the wet season

Month	Species			Total Number	Trap Success (%)
	R. exulans	***R. rattus***	***B. bengalensis***		
May	24	4	5	33	27.50
Jun	23	1	9	33	27.50
Jul	20	5	7	32	26.67
Aug	22	6	8	36	30.00
Total	89	16	29	134	
Mean± SD	22±1.71	4±2.16	7±1.71	34±1.73	
Max	24	6	9	36	
Min	20	1	5	32	

Sex ratio and comparison between the captured numbers of males and females

R. exulans

The total number of captured *R. exulans* species was 180 during this study (Table 1and 2). The total number of male *R. exulans* was 94 in contrast to the number of females 86 (Figure 6).

No significant difference was observed between the number of captured male and female *R. exulans* during the study period (t = 0.821, df = 16, P = 0.424, P>0.05).

The results of the chi-square test showed that the sex ratio of collected *R. exulans* species was not different from the 1:1 sex ratio (X^2 = 0.3555, df = 1, P =0.5510, P>0.05).

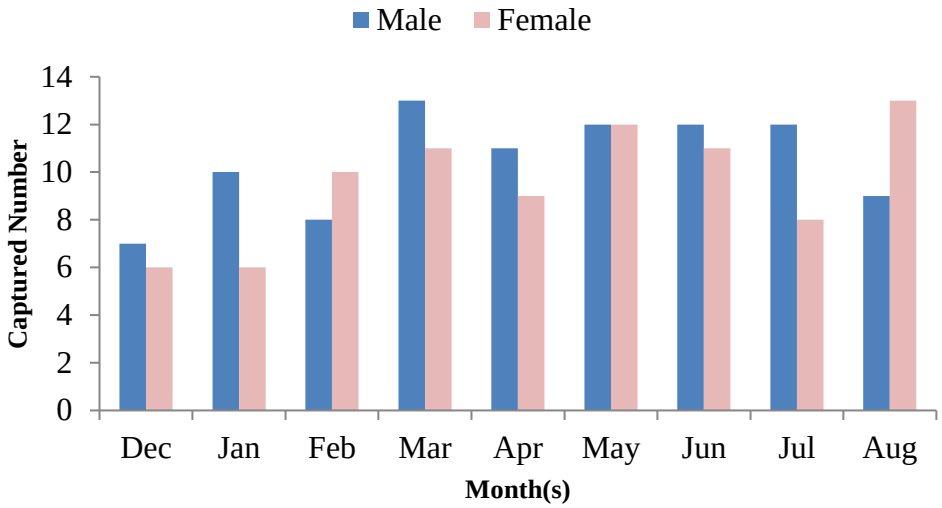


Figure 6. Comparison of monthly captured numbers between male and female *R. exulans* species during the study period

R. rattus

A total of 31 *R. rattus* species were collected during the study period (Table 1 and 2). The number of male *R. rattus* was 18 and the number of females was 13 respectively (Figure 7).

Statistical analysis showed that there was no significant difference between the collected males and females (t = 1.048, df = 16, P = 0.310, P>0.05).

The results of the analysis revealed that the observed sex ratio of the collected *R. rattus* was not different from the 1:1 sex ratio (X^2 = 0.806452, df = 1, P = 0.3709, P>0.05).

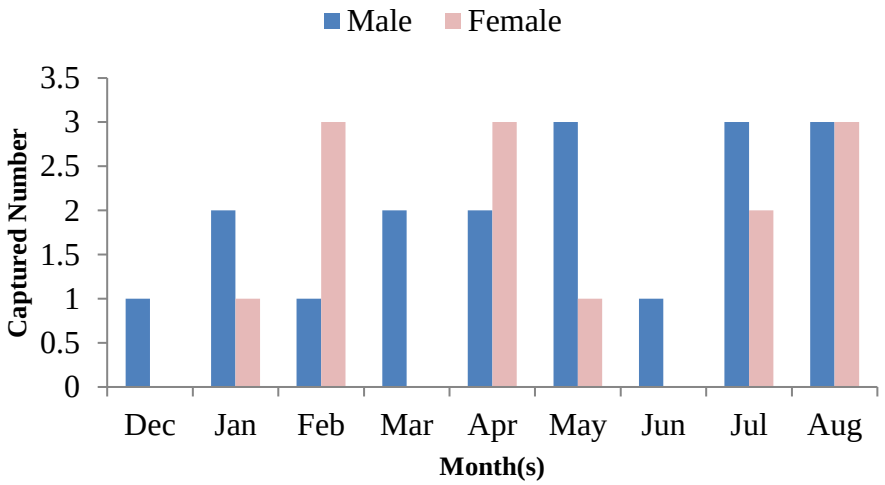


Figure 7. Comparison of monthly captured numbers between male and female *R. rattus* species during the study period

B. bengalensis

A total of 56 *B. bengalensis* species were collected during this study (Tables 1 and 2). The number of males *B. bengalensis* was 25 and that of females was 31 (Figure 8).

The results of statistical analysis showed that there was no significant difference was observed between the captured numbers of males and females ($t = -1.212$, $df = 16$, $P = 0.243$, $P>0.05$).

The results of the chi-square test showed that the male and female sex ratio of this species was not different from the 1:1 sex ratio ($X^2 = 0.642857$, $df = 1$, $P = 0.422678$, $P>0.05$).

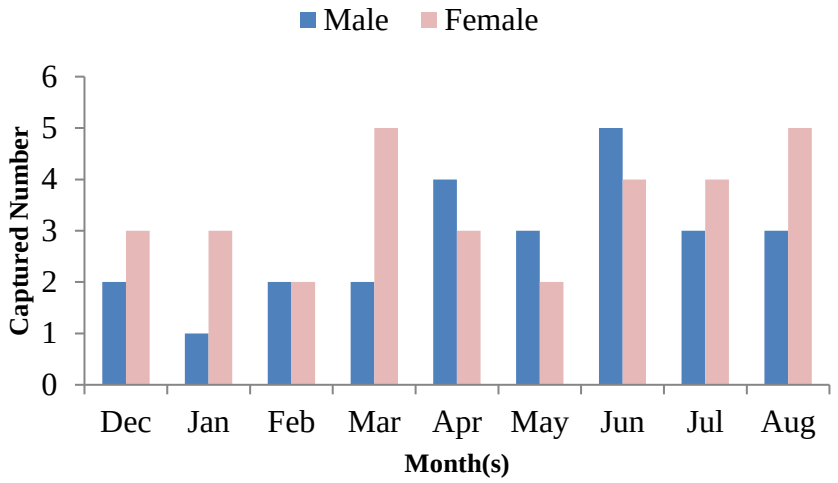


Figure 8. Monthly captured numbers between male and female *B. bengalensis* species during the study period

DISCUSSION

Localized differences may occur among the composition of small mammal communities. This fact reflects human behaviours, cultures and technologies (Hulme-Beaman et al., 2016). The findings of this survey during the nine-month study period in this urban area suggested that the three common rodent species *R. exulans*, *R. rattus* and *B. bengalensis* occurred. Monthly higher recorded numbers and the results of the statistical analysis suggested that *R. exulans* may be assumed as the more abundant species than *R. rattus* and *B. bengalensis* species. But it cannot be assumed that *R. exulans* as the most dominant species in this area as the habitat of these three species are different. *R. exulans* and *R. rattus* were captured inside the houses and no *B. bengalensis* was trapped inside the houses. The species *R. exulans* can be regarded as the more dominant species than *R. rattus* inside the houses.

Although statistical analysis showed that no significant difference was observed in the trap success between the dry and wet seasons, the gradual higher number of trap successes in June, July and August suggested that these three species are more active in the wet season. More studies should be conducted to confirm this fact.

There was no overall difference in the mean relative abundance of all rats between the dry and wet seasons. This finding suggests that the same conditions for the availability of food and shelter for these species occurred throughout the year in this study area. This result also suggested that the three species were responding to the same seasonal availabilities of food and shelter. This finding was different from the study conducted by Bridgman et al. (2018) in which mice were more likely to be captured during the dry season while Goedert et al. (2020) reported that the populations of *R. rattus* reached higher relative abundances during the wet

season. These differences may be because of different study areas and different environmental conditions.

It is believed that the sex ratio reflects the ability of the species to respond to natural selection (Wu et al., 2006). In the present study, this factor was observed in all recorded three rodent species showing a 1:1 sex ratio. A 1:1 sex ratio is found in polygamous species when food is abundant (Wright et al., 1988). The findings of the present study supports this factor as there was no significant difference between the captures of males and females in all three commensal rodent species.

Understanding aspects of the biology and ecology of some pathogenic rodent species that can transmit zoonotic diseases is important to facilitate the implementation of measures for reducing the risk of disease transmission. A complex network of interactions exists between the host and the pathogen. Species composition and the interactions between species influence host species abundance and host and pathogen contact rate. Major risk to human health can arise from close contact with commensal rodents in abundant areas. This study is the first to examine the abundance of commensal rodents in Ponnasu Quarter, Bago Township. This study revealed that commensal rodents are still abundant although sanitation and infrastructure are regarded as in good condition in this human-dwelling area. Further studies should be carried out to evaluate the factors that favor rat and mouse populations and to examine rodent carried pathogens that can transmit to humans and domestic animals.

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