PRELIMINARY STUDY OF BANDICOOT RAT POPULATION IN PADDY FIELD, KEDAH

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ABSTRACT

Kedah known as the National Granary (Jelapang Padi Negara) as it is the largest rice cultivation and producing state in Malaysia. In terms of rat pest, the ricefield rat (Rattus argentiventer) is commonly present in the state and elsewhere. As recent as from five years ago, the greater bandicoot rat (Bandicota indica) is more prominent as attested by local farmers. The greater bandicoot rat (Bandicota indica) is an extant population of rat introduced in northern peninsular Malaysia from Central Asia. They were found to be vicious and resulted in serious pest damage in multi-agriculture lands such as paddy field, wheat fields, and even vegetable farms. However, there is a lack of information and research them in Malaysia. Therefore, a removal sampling technique was used and evaluated according to its assumptions for estimating the absolute densities of greater bandicoot rat (Bandicota indica) in paddy fields in Kedah. The study was conducted during the land preparation stage of the rice field during the dry season. Removal sampling is a method of absolute density estimation based on the decline in successive catch numbers as individuals are abstracted from a population. A linear regression method was used to calculate the density estimate using the removal sampling data.

Keywords: Bandicoot rat, paddy field, rodent pest, population

INTRODUCTION

The Asian rice plant, *Oryza saiva* L. is the most important food crop in Asia including Malaysia, and cultivated extensively in Peninsular Malaysia states, particularly Perak, Kedah, Perlis, Pulau Pinang and Selangor. The most common vertebrate pests for in paddy in Malaysia are the Ricefield rats, *Rattus argentiventer*. Lim (2005) reported yet another rodent pest commonly found in the northern states i.e the Greater Bandicoot rat, *Bandicota indica* -thought has been introduced in the 40s. There is a dearth of information on the local population of this species in the paddy fields. Thus, study was conducted to understand the ecology of *B.indica* in the ricefield, its potential to cause damage to the rice crop and the pest management aspects of this species in the paddy field in Jitra.

THE GREATER BANDICOOT RAT (*Bandicota indica*)

The Greater Bandicoot rat is larger (HB: 200-350mm) than its cousin, the Lesser Bandicoot Rat (*Bandicota bengalensis*) (HB150m-210mm) and spots a darker pelage compared to the rice rat. The latter possessed lighter and silvery pelage on the underparts while former has a correspondingly grey to dark grey underparts. Both species have a configuration of six pectoral and inguinal mammary glands each. Bandicot rat can weight up to 300g at the juvenile stage, which is heavier than a typical adult Ricefield rat and can weigh as much as one kilogram for a fully grown adult.

Bandicoot rat is typically omnivorous; feeding on plant materials, insects and molluscs. (Lim, 2015; Chakraborty & Chakraborty; 1999). Bandicoot rats are listed as pests in many agriculture lands including paddy (Birah et al, 2013; Borah and Bora, 2012) wheat (Singal & Pasahan, 1993; Hussain et al,2016; Sheikher & Malhi;1983), sugarcane (Tariq et al, 2017), coconut (Yoshida, 1979), Sorghum and groundnut (Hussain et al, 2016). Food preference studies shows bandicoot rat inclinations acceptance towards store food such as flour, maize, rice and wheat (Sheikher& Malhi,1983; Parshad and Jindal, 1991) and high fibre food products (Gong, et al. 2011).

In Malaysia, greater bandicoot rat was found in oil palm plantation in Chuping, Perlis and causing damage up to 30% of the fresh fruit bunch (Shukor, et al, 2018). According to rice field farmers in Kedah, the bandicoot rat population has been noticeably increased since 2015 with correspondingly higher rice crop loss number. Some farmers reported the damage from rodent attack can reach up to 50% per planting season. There is generally a lack of information on the ecology of the bandicoot rat in Malaysia in order to design an effective control strategy. The objectives of this study are to update rodent species found in paddy field Kedah, determine the morphology and physical characteristics of *B. indica* in paddy field, and estimating current larger bandicoot rat's population in paddy field Kedah.

Figure 1: Bandicoot rat Bandicota indica captured in live trap

METHODS

STUDY AREA

The study was conducted at Jitra, Kedah (6°18'56.6"N 100°21'07.6"E), in the northern peninsular Malaysia, less than 35km south of Perlis and close to the Malaysia-Thailand border. It is located to the west of the Bukit Wang Forest Reserve. There are two planting seasons per year; during drier month (Jun-Sept) and rainy and moonsunal (Oct-Feb). In the drier month, paddy fields in Jitra has low water supply, thus no planting activities are carried typically from (March-May).

RODENT SPECIES SURVEY

The survey was conducted once a year from 2017 to 2019. Thirty live traps with spring doors were used for three consecutive nights/ month with dried fish as bait. Traps were distributed at the crossings of bunds in the paddy field. If a burrow is present, the trap entrance will be positioned to face the burrow. The traps ware covered in dried grass to make it less obvious. Traps were checked every morning. Captured rodents will be identified to their species, sexed, weighed and measured. Capture-removal population estimation (Zippin, 1956) was used to estimate bandicoot rat population. Relative abundance of the rodents (Mmetwaly et al, 2009) was estimated using following formula:

$$\% \text{ Population} = \frac{\text{Number of rodents caught}}{\text{Total trap/night}} \times 100$$

Mmetwaly et al (2009) also developed a formula to estimate population abundance by counting active burrows. Active burrows were identified and closed by using fresh mud to seal all burrow entries. Exposed burrow entrance on the following and susbsequent days constitute active burrows. The rodent population was estimated using the following formula:

$$\% \text{ Population} = \frac{\text{Number of active entrance}}{\text{Total number of entrances}} \times 100$$

RESULT AND DISCUSSION

MORPHOLOGY OF *Bandicota indica*

Thirty-one Bandicoot rat captured in 2019 were measured (Table 1). They compromised of 22 (73%) juvenile and 9 (26%) adults. There were (n) 71% males and (n) 29% females. A single female was found to have 8 pups. There is not much differences observed between bandicoot rat from Jitra, Kedah and from Chuping, Perlis. However, Bandicoot rats from Vietnam and Cambodia was found to have darker ventral hair colour compared to the one in Malaysia (Table 1). Only seven ricefield rats were caught using the live traps, where all of them were male and juveniles.

Table 1: Morphology of Greater bandicoot rat (Bandicota indica) in the paddy field.

Parameter and source	Measurements of *B.indica*		
	This Study	Shukor, et al. (2018)	Aplin et al. (2003)
Origin	Jitra, Kedah	Chuping, Perlis	Vietnam and Cambodia
Head body length (mm)	223.5 ± 45.9 (150-270)	201.09±12.8 (156-280)	231 ± 34.9 (167-300)
Tail Length (mm)	180.9 ± 52.2 (130-270)	180±10.4 (151-252)	196 ± 28.6 (147-248)
Hind foot length (mm)	48.9 ± 0.96 (35-63)	43.55 ±1.4 (41-55)	52 ± 4.2 (42-58.5)
Skull length (mm)	65.6 ± 13.9 (40-80)	54.63 ±2.0 (50-70)	-
Weight (g)	407.58±200.99(70-912)	451.81±57.9 (330-875)	370 ± 191.0 (125-870)
Dorsal Hair colour	Blackish brown	Blackish brown	-
Ventral hair colour	Pale grey	Pale grey	Darker colouration
No. or mammae-pectoral	3 pairs	3 pairs	-
No or mammae-inguinal	3 pairs	3 pairs	-

RODENT CLASSIFICATION

The Greater Bandicoot Rat (*B. indica*) was found to be dominant in trapping exercises carried out in Jitra for from 2017-2019, in comparison to other rodents trapped in the area; the Ricefield Rat (*R. argentiventer*), Black rat (*R. rattus*) and Asian House Shrew (*Suncus murinus*). Although bandicoot rats were the highest number trapped, the ricefield rats was also common as they were highly visible but very few entered the trap. The trend in the number of bandicoot rat captured over the trapping session from 2017 to 2019 were increasing from a mere three individuals in 2017 to 30 in 2019.

Table 2 : Survey of rodents by live traps for three consecutive night during 2017-2018.

Genera	Common name	Scientific name	Jitra		
			2017	2018	2019
Bandicota indica Bechstein	Greater Bandicoot rat	*Bandicota indica*	3	8	30
Rattus argentiventer Fischer	Ricefield rat	*Rattus argentiventer*	*D	*D	6
Rattus rattus Linnaeus	Black rat	*Rattus rattus*	-	-	1
Suncus murinus Linnaeus	Asian House Shrew	*Suncus murinus*	-	1	1
		Total	3	17	38

. * Present. (Sight seen through day / Trapping through night). - Non-present. D. Diurnal: activity through day. N. Nocturnal: activity through night

There are many ways to determine rodent population. One of the most widely used in capture-mark-recapture (CMR). It requires ones to capture the rat, marked in most humane way with long-lasting signage and released back in nature. However, releasing back the rats would give discomfort to local farmers as the rats already causing severe damage, and there are zero number of recaptures, perhaps due to trap shyness. Therefore, in this study, we decide to use capture-removal method (figure 4). Capture-removal population estimation suggests that the number of greater bandicoot rat captured are increasing from six in 2017 to 60 in 2019. (Table 3).

ACTIVE BURROW IN PADDY FIELD

The number of active burrows can be used as corresponding to the population density and relative surface activity levels of the rodents. Survey on four random paddy plots each year shows that there is small increase in density based on 29% and 31% active burrows respectively from 2018 and 2019 respectively. The increase in percentage of active burrows was too small to indicate any changes in population density or status of infestation. The proportion of active burrows which were about 30% indicated that level of infestation remains substantial.

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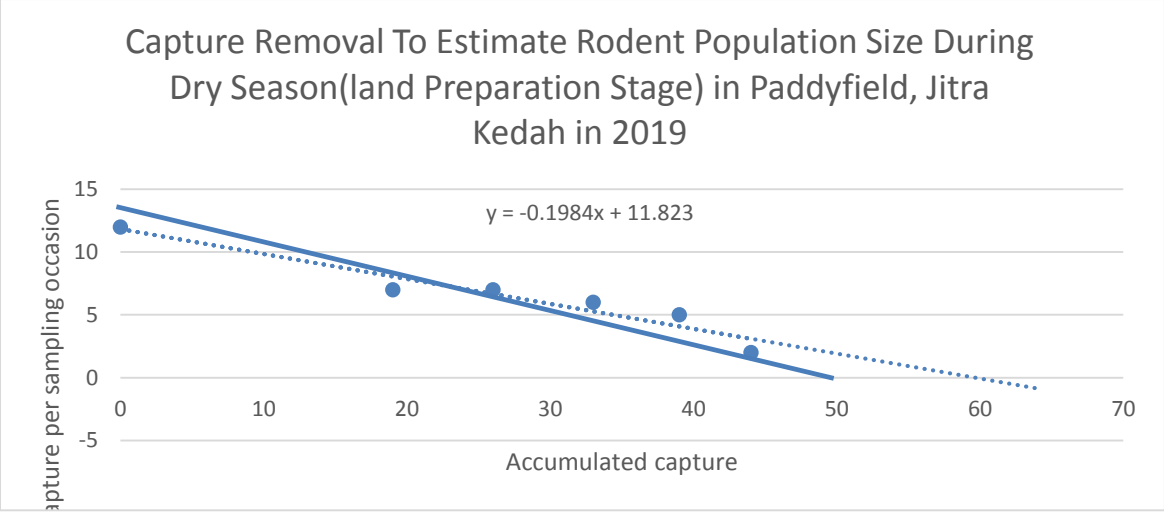
Table 3: Comparative between live trap method, active burrows method and population estimation in Jitra Kedah for three consecutive night during 2017 to 2018.

Type	Live trap Method			Active Burrows Method			Capture removal (*Bandicota indica*) population estimation
Year	No of Rats Caught	Total traps/ Night	% Population	Total Burrows	Active Burrows	% Population	
June 2017	3	30	3	94	28	29	6
June 2018	8		8	91	26	29	21
April 2019	30		33	95	30	31	60

Figure 2 Capture-removal to estimate rodent population size. Accumulating number of captures per occasion and accumulate number of captures gives an estimated number of populations in the area.



FUTURE STUDIES AND CONTROL

The consistently high infestation level of bandicoot rat through a small-scale assessment here in Jitra, Kedah is more prominent elsewhere. (Aplin, 2016). With a wide range of diet, bandicoot rat can be a considerable threat paddy farmer and calls for effective means of controlling the species. Communal efforts of actual hunting by flushing out from their burrows or mechanical trapping requires huge labour deployment and cost. These traditional means of tackling rats are still practice in the Indian subcontinent with varied results.

Conventional methods of control by the application of anticoagulant rodenticides such as warfarin (Hussain and Prescott, 2003), brodifacoum, difenacoum, diphacinone, coumatetralyl (Brooks, et al. 1980) and acute rodenticide such as; zinc phosphide (Parshad and Kochar,1995) has been used. After decades and long-term application of anticoagulant rodenticides, there was an urgent need for a competitive and more efficient rodenticide to overcome massive rodent problem in India. In 2015, Singla and her team discovers a synergistic effect between bromadiolone and cholecalciferol as a rodenticide towards *B. bengalensis.* These were based on testing formulations of various combinations of varying doses of anticoagulant rodenticides and cholecalciferol on their respective degrees of efficacies.

The applications of cocktails of active ingredients in producing new line of rodenticide seems like a breakthrough. However, they possess clear and present imminent danger of emergence of resistant generations of bandicoot rats or other rodent species. This has been demonstrated by the Brown rat (*Rattus norvengicus*) which have developed resistance to a second-generation anticoagulant in Denmark by Lund (1984). Highly potent rodenticide will cause a severe secondary poisoning effects on non-target species such as the barn owls (Fisher, et al., 2003; Salim, et al, 2014), domestic poultry and canaries (Eason, et al. 2000) and the black kites, *Milvus migrans* (Hong, et al; 2018). Therefore, it is impertinent to explore safer options or rely on potential biological control, hence with ensuring safety in our food production.

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