

Trap Success of House Rat (*Rattus Tanezumi Temminck*) Around The IPB Darmaga Campus, Bogor, West Java, Indonesia

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ABSTRACT

Trapping rats has become a practical and environmentally safe method of control as well as monitoring the presence of rats in a place. The study aims to determine the presence of house rats (*Rattus tanezumi* Temminck) and the trap success rate around the IPB Darmaga Campus, Bogor, Indonesia, using a single live trap. There were 10 traps installed incrementally over 3 consecutive nights at 10 locations both indoor and outdoor. The number of rats caught, the number of rat footprints, the size and sex of the rats, and the location of the trapped rats became an observed parameter. The results showed that house rats around the IPB Darmaga Campus caused damage to facilities, physical appearance, faeces, and urine odor. The trapping success around the IPB Darmaga Campus from 300 trappings reached 9%, which is 3.67% of trapped rats remained in traps and 5.33% rats escaped from traps. The trapping success was affected by trap shyness by 72.16%.

Keywords: Presence of rat, single live trap, trap shyness

INTRODUCTION

Background

Rats are wild animals that associate with and adapt to human life. Rats often move around residential areas to breed and obtain food (Widayani and Susilowati 2014). Rat species frequently found in residential areas are *Rattus rattus*, *Rattus norvegicus*, and *Mus musculus* (Suciananda 2016). Dirty, damp, and poorly lit areas are preferred habitats for rats (Yulianto and Candra 2019). The presence of rats often causes damage and loss to humans. Rats can transmit various diseases, such as plague, salmonellosis, leptospirosis, rickettsia, rat-bite fever, trichinosis, and hantavirus.

Rats can cause damage to homes due to their grinding incisors. This damage can include bite marks or holes in foundations, electrical wiring, windows, and household appliances (Pramestuti and Widiastuti 2015). Residential environmental conditions also influence rat numbers, such as the presence of garbage piles. Furthermore, rats can contaminate residential homes by defecating and urinating in frequently visited areas or nests. Rat droppings and urine can transmit diseases that are dangerous to humans. Furthermore, house rats can cause noise when they build nests in ceilings or roof tiles. Meanwhile, sewer rats often dig holes in the ground around homes, even penetrating the foundations. House rats are highly adaptable to a wide variety of environmental conditions. This adaptability is supported by various factors, including a very high reproductive rate and excellent climbing and gnawing abilities, which enable them to survive in a wide range of environmental conditions (Ikhsan 2017).

Common and frequently used rat control efforts include sanitation, physical, mechanical, chemical, and biological methods. Mechanical rat control can be achieved through the use of traps, including dead traps, live traps, and glue/sticky traps. Traps generally serve to monitor rat presence and are a method of controlling rat populations in an area. Meanwhile, chemical control typically involves the use of bait mixed with rodenticide. However, the use of poisoned bait can lead to rat resistance to rodenticides. Furthermore, the chemicals contained in rodenticides can pollute the environment. Excessive and uninformed use of rodenticides can lead to poisoning of non-target animals and users.

Live traps used for rat control include single live traps and multiple live traps. Single live traps have a wide-open door, allowing rats to easily enter. The trap door closes when a rat enters, preventing other rats from entering. This means that a single live trap can only be entered once (Ikhsan 2017). The advantage of this single live trap system is that rats can easily enter and cannot escape (Ivakt dalam 2014). Using traps to control rats in residential areas is a simple and easy-to-apply control method (Ikhsan 2017). Rat control using traps is also relatively safe and poses no risk to the environment or users. Selecting the right bait can help increase trapping success. Salted fish and roasted coconut are more attractive to house rats (Siregar 2017). The bait treatment aims to make the coconut and salted fish aromas more potent, thus attracting rats to the trap. Junianto and Siwiendryanti (2015) added that roasted coconut is the WHO standard bait used for rat trapping.

This study aims to determine the presence and measure the success rate of trapping rats using single live traps to control house rats around the IPB Darmaga Campus, Bogor. The benefit of this study is to obtain information on the presence and success of house rat trapping around the IPB Darmaga Campus, Bogor, so that appropriate management strategies can be formulated for house rat control.

METHOD

Time and Location

The research was conducted at ten locations inside and outside around the IPB Darmaga Campus in Bogor, West Java, Indonesia. Site selection was based on signs of rat presence following site exploration. Signs of house rat presence observed included rat tracks, food scraps, slits, droppings, runways, and information from respondents (Balitbangkes 2015). The research was conducted from November 2022 to January 2023.

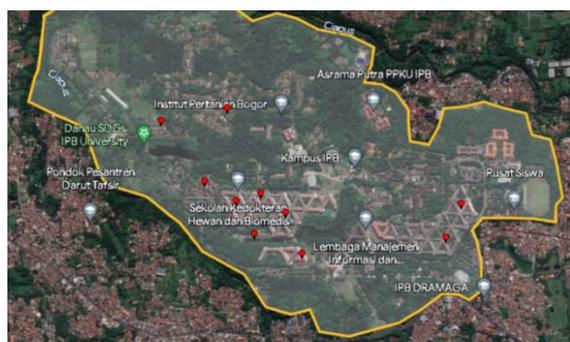


Figure 1. Satellite photo of the trapping location (Source: Google Earth)

Tools and Materials

The tools and materials used in the study include a single live trap, plastic, a digital scale, a ruler, a camera, cotton, roasted coconut, fried salted fish, flour, chloroform, and detergent.

Working Procedure

Field Observations

Field observations began with trap preparation. The traps used were single live traps baited with roasted coconut and fried salted fish. Flour was sprinkled around the traps to mark the footprints of rats that approached the traps but did not enter. Trapping uses the removal method (trapping without replacement). Prepared traps are placed at predetermined locations. Traps are placed in the afternoon, between 3:00 PM and 5:00 PM, as rats are most active at night. Traps are then checked the following morning between 6:00 AM and 8:00 AM. Ten traps are set at each location in stages over three consecutive nights, for a total of 30 trapping sessions at each location.

Trap inspection includes recording the number of rats trapped and the number of footfalls. Traps that successfully capture a rat are then thoroughly washed with water and detergent and dried to remove odors so they can be reused. Traps that fail to capture a rat are removed from their original location. Traps placed indoors are moved

at least 5 m from their original location or to another room. Traps placed outdoors are moved 5-10 m from their original location, forming a straight line or according to the characteristics of the trapping site for easy tracking (Balitbangkes 2015).

Rat Identification

Identification of captured rats was conducted in the Vertebrate Pest Laboratory, Department of Plant Protection, Fac. of Agriculture, Bogor Agricultural University (IPB Univ.). Rats were euthanized by placing them in a plastic bag filled with cotton soaked in chloroform and sealed until they ran out of breath. Then, the rats were identified based on their morphological characteristics, namely quantitative and qualitative characteristics (Priyambodo 2009). Rat identification based on quantitative characteristics included: Body weight (W), head and body length (HB), tail length (T), total length (TL), ear length (E), hind foot length (HF), incisor width (I), and the mammary formula (MF). Rat identification based on qualitative characteristics included hair color, nose shape, body shape, hair texture, and sex. Captured house rats were categorized as large if their body weight was > 70 g, while those weighing < 70 g were categorized as small.

Research Parameters

Data on the number of mice successfully trapped, both those that remained inside and those that escaped, were used to calculate the trap success rate. Data analysis from field observations was conducted using the Microsoft Excel 365 application program. Trap success was calculated using the following formula:

Trapping success (Yuliadi *et al.* 2016) = Number of rats trapped divided by (number of traps x duration of trapping) x 100%

Rats footprints = Number of rat footprints divided by (number of traps x duration of trapping) x 100%

Expected trapping success = (Number of rat footprints + number of rats caught + number of rats escaping) divided by (number of traps x duration of trapping) x 100%

Trap shyness/deterrent = 100% - (Number of rats caught + number of rats escaping) divided by number of rats footprints x 100%

RESULTS AND DISCUSSION

General Conditions of Trapping Sites

Bogor Agricultural University (IPB Univ.) is located primarily in Darmaga District, Bogor Regency, West Java. Geographically, IPB Darmaga is located at 6°33'16" South Latitude and 106°43'18" East Longitude. Traps were mostly placed inside buildings, such as warehouses, kitchens, and work spaces, while others were located outside, around buildings that showed signs of rat passage (Figure 2).

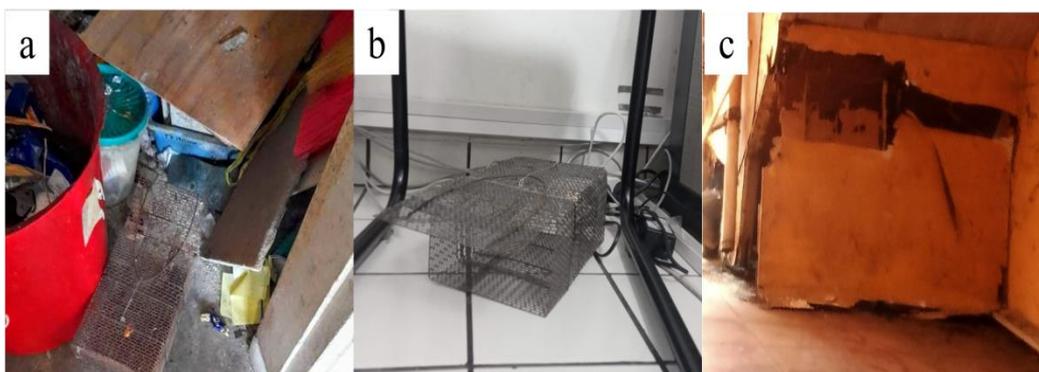


Figure 2. Trapping locations: (a) Warehouse; (b) Workroom; (c) Outdoors

The warehouse serves as a hiding place for rats, while the kitchen provides food for them (Siregar 2017). Rats forage in areas containing household waste, such as the kitchen and trash can. The proximity of the kitchen and workroom makes the workroom a pathway for rats to travel from the warehouse to the kitchen and vice versa. The disorganized arrangement of items in these spaces creates gaps or small cavities that serve as hiding places for rats. Rats have a habit of gnawing on hard objects to prevent their incisor teeth from growing (Arrasit and Wahyuni 2022). This causes damage to the facilities in the room where the trap is set (Figure 3).

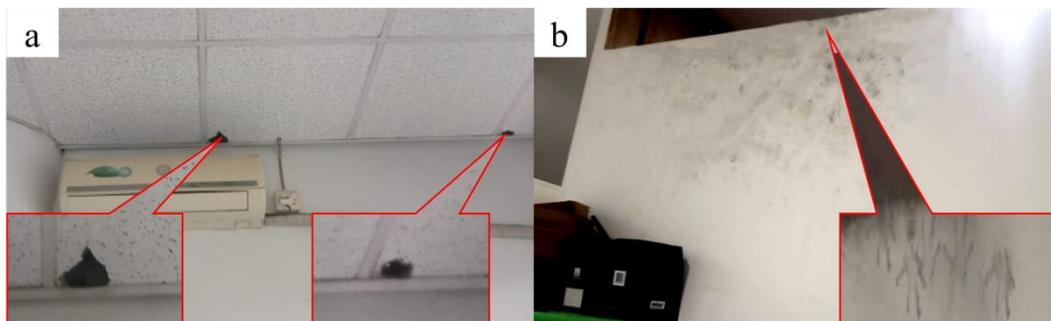


Figure 3. Signs of the presence of house rats: (a) Holes in the ceiling; (b) Footprints on the wall

Rats not only gnaw to prevent their incisor teeth from growing but also create pathways to facilitate access to food sources. Some rooms have holes in certain areas that serve as passageways for rats. Rats also leave tracks on the walls of the rooms. Rats' movements in search of food, mates, and their territorial orientation tend to be regular or follow a similar trajectory. Rats' range of movement is influenced by the distance between food sources and nests or hiding places. Rats' range of movement is no more than 50 m if sufficient food and shelter are available, and can reach 700 m if food sources are insufficient (Syamsuddin 2007).

Trap Success

The rat species trapped was the house rats (*Rattus tanezumi*). Most of the trapped rats were caught in traps placed inside buildings, while others were caught outside. This finding is similar to the research by Priyanto *et al.* (2020) that found *R. tanezumi* caught in traps placed both inside and outside buildings. The habitat of *R. tanezumi* is residential areas, and its distribution follows the presence of residential areas, which is related to food sources. The success of trapping house rats depends on several factors, one of which is the rat population level. The results showed that far more rats approached the traps than were successfully trapped. This can be seen from the large number of rat foot prints detected (Table 1).

Table 1. Trap success and rat foot prints at each trapping location

Location	Total trap	Total rat trapped	Trap Success reality (%)	Number of rat escaped ^A	Rat escaped (%)	Total rat foot print ^B	Rat foot print (%)
A	30	0	0	0	0	9	30
B	30	2	6.67	1	3.33	10	33.33
C	30	3	10	2	6.67	12	40
D	30	1	3.33	3	10	18	60
E	30	1	3.33	1	3.33	10	33.33
F	30	0	0	4	13.33	6	20

G	30	1	3.33	1	3.33	4	13.33
H	30	0	0	1	3.33	7	23.33
I	30	1	3.33	0	0	12	40
J	30	2	6.67	3	10	9	30
Total	300	11	3.67	16	5.33	97	32.33

Note:

^A Based on the number of traps showing signs of rats escaping (closed trap door, missing bait, scattered flour in front of the trap door).

^B Footprint count based on the number of traps containing rat footprints, but no rats trapped.

Trapping success is determined by several factors, including trap placement, bait selection, and trap duration (Armando 2016). The type of bait used also influences trapping success (Astuti 2013). The actual trapping success rate for house rats was only 3.67%, while the number of rat footprints reached 32.33%. This indicates that rats were attracted to the bait inside the traps, but were not successfully trapped. Syamsuddin (2007) explained that rats have highly developed brains. Using the same type of trap throughout a trapping session allows rats to learn from previous experiences, allowing them to approach the traps but avoid them.

Trapping success is influenced by the trap's deterrent properties. Daily trapping results (Table 2) showed that rats tended to be rarely caught on the first day, then increased on the second day, and then decreased again on the third day. The same was true for escaped rats. This is inconsistent with trap shyness/deterrent (Table 3), a situation where rats are easily caught at the start of a trap, but difficult to catch on subsequent traps (Priyambodo 2006).

Table 2. Results of rat trapped, escaped, and footprint per day at indoor and outdoor locations

Location	Total rat trapped (head)			Total rat escaped (head)			Total rat footprint		
	Day-1	Day-2	Day-3	Day-1	Day-2	Day-3	Day-1	Day-2	Day-3
A (I)	0	0	0	0	0	0	2	5	2
B (I)	0	2	0	0	0	1	3	4	3
C (I)	1	1	1	1	0	1	6	4	2
D (I)	0	0	1	0	3	0	7	5	6
E (I)	1	0	0	1	0	0	4	3	3
F (I)	0	0	0	2	1	0	4	0	2
Total (Indoor)	2	3	2	4	4	2	26	21	18
G (O)	0	1	0	0	1	1	3	1	0
H (O)	0	0	0	0	1	0	2	3	2

I (O)	0	1	0	0	0	0	4	3	5
J (O)	0	1	1	1	0	2	3	4	2
Total (Out door)	0	3	1	1	2	3	12	11	9
Total (I and O)	2	6	3	5	6	5	38	32	27
	11			16			97		

Note: I = Indoor; O = Outdoor, D-1, D-2, D-3 = Day-1, 2, 3

The total number of rats caught, the number of rats that managed to escape, and the number of rats tracks around the traps showed that indoor rats were consistently higher than outdoor rats on all three observation days. This indicates that house/roof rat activity was consistently higher indoors than outdoors. This is consistent with the behavior and ecological conditions or habitat of the species of rat. Single live traps performed poorly both indoors and outdoors due to the trap door closing process when the bait was touched by a rat and the spring strength of the trap door to keep it closed. In contrast to the number of rats entering the trap, the number of rat footprints was high on the first day and tended to decrease from then on until the third day. This is consistent with the trap's deterrent properties. Trap deterrence can occur because rats are highly cautious with new objects, including traps (Ikhsan 2017) and have adapted to the trap (Khoirunnisa and Siwiendrayanti 2020). Furthermore, rats have highly developed senses of taste, touch, hearing, and smell. This is used by rats to pick up danger signals from trapped rats so that rats in the environment will not enter the trap. Efforts to overcome the deterrence of rat traps are by changing the location of the trap to another place and washing the trap that has successfully trapped rats.

Table 3 Comparison of expected, reality trap success, and trap shyness in each location

Location	Expected Trap Success ^A (%)	Reality Trap Success ^B (%)	Trap Shyness/ Deterrent (%)
A	30	0	100
B	43.33	10	70
C	56.67	16.67	58.33
D	73.33	13.33	77.78
E	40	6.66	80
F	33.33	13.33	33.33
G	20	6.66	50
H	26.67	3.33	85.71
I	43.33	3.33	91.67
J	46.67	16.67	44.44
Total	41.33	9.00	72.16

^A Calculated from the number of rats that enter the trap and the number of rats footprints seen around the installed trap.

^B Calculated from the number of rats entering the trap, both those that remained inside and those that managed to escape.

Locations A and I showed the highest levels of trap shyness (100% and 91%), this depended on the success of trapping rats and the activity of rats around/outside the installed traps, that indicated their suspicion to the new object (trap). In addition to the trap's deterrent effect, the low actual trap success rate was also due to rats escaping from the trap. This was evident from the disappearance of the bait in the trap and the closed trap door (Figure 4). The number of rats that allegedly escaped from the trap reached 5.33%. The rats' ability to escape from the trap was thought to be due to their large size, which allowed them to push the trap door open. Furthermore, the traps used were standard factory traps, with some traps not closing tightly because the door leaf did not reach the bottom of the trap, creating gaps. Rats exploited these gaps to escape. If the door retaining springs were not strong enough, trapped, large rats would push the door open and escape (Mulyana 2017).

To prevent rats from escaping, modifying the trap, such as replacing the trap door springs with stronger ones, can be done. In addition, to attract more rats to approach the trap and enter it, we can apply a more attractive type of lure for rats such as fried fish bones or chicken, with cooking oil used to fry ingredients that attract rats such as shrimp paste or salted fish. The type of trap that can hold the captured rats so they can not escape is by using a sticky trap, plus a more attractive bait for house rats. Sticky traps can only be used once, then immediately burned or buried, while single live traps can be used multiple times as long as they are washed thoroughly with soap or detergent, immediately after successfully catching a rat, to eliminate suspicion of the next rats caught.



Figure 4. Trapping process conditions: (a) Rat successfully trapped; (b) Trap marks; (c) Signs of rat escaping.

Trapping success is also determined by the location of the trap. Traps placed inside buildings showed higher trapping success rates than those placed outside. Similarly, rat footprints were detected (Table 4). This was also found in research of Siregar (2017), which found that trapping success rates for rats in domestic habitats were higher than those outside. *R. tanezumi* is often found indoors, such as in ceilings, kitchens, and storage areas (Kusumajaya *et al.* 2020). Environmental variables also have a significant influence on the success of trapping rats in this habitat, namely: Availability of food/feed for rats in the form of human food scraps inside and outside the building, human activities around the placement of rat traps, as well as seasonal factors such as temperature, relative humidity, rain, and wind.

Table 4. Trapping success and rat footprints based on trap location

Location	Total trap	Total rat trapped	Trap Success (%)	Total rat escaped	Rat escaped (%)	Total foot print	Foot print (%)
Indoor	172 (57.33%)	7	4.07 or 2.33 per 300	16	9.30 or 5.33 per 300	65	37.79 or 21.66 per 300

Outdoor	128 (42.67%)	4	3.12 or 1.33 per 300	0	0	32	25 or 10.66 per 300
Total	300	11	3.66	16	5.33	97	32.33

Trap success for indoor use was 4.07% per 172 traps installed, or 2.33% per 300 traps. Meanwhile, trap success for outdoor use was 3.12% per 128 traps installed, or 1.33% per 300 traps. Similarly, the number of rats that managed to escape from the traps was 9.30% or 5.33% per total traps. The percentage of rats' footprints was 37.79% (indoor) and 25% (outdoor) per traps installed, and 21.66% (indoor) and 10.66% (outdoor) per total (300) traps. Trapping success reflects the relative rat population in a given area (Supriyati and Ustiawan 2013). The higher the trapping success rate, the higher the rat population (Siregar 2017). Trapping success is considered high if it exceeds 7% for indoors and above 2% for outdoors (Saragih *et al.* 2019).

Rat Identification

Rat identification was performed on 11 trapped rats based on their quantitative and qualitative characteristics. All trapped rats were of the *Rattus tanezumi* species or house/ roof rat. House/roof rats are arboreal creature, it adept at climbing. This is characterized by a tail length that is longer than the size of their head and body length (Table 5).

Table 5. Identification of house rats based on quantitative characteristics

Location	Sex	W (g)	HB (mm)	T (mm)	TL (mm)	HF (mm)	E (mm)	I (mm)	MF (pair)
B	Female	150.58	189	215	404	35	15	3	2+3
B	Female	115.15	172	175	347	35	15	3	2+3
C	Female	87.0	120	160	280	35	17	2	2+3
C	Male	42.0	120	145	265	33	15	2	-
C	Female	24.73	105	115	220	29	15	3	2+3
D	Female	138.42	171	204	375	35	16	3	2+3
E	Female	145.04	174	207	381	35	17	3	2+3
G	Female	132.32	170	200	370	35	19	3	2+3
I	Female	145.3	170	200	370	38	16	3	2+3
J	Male	121.0	170	183	353	35	16	3	-
J	Female	137.68	170	200	370	35	17	3	2+3

Note: W= body weight, HB= head and body length, T= tail length, TL= total length, HF= hind foot length, E= ear length, I= incisor width, MF= mammary formula

The results of qualitative character identification showed that house rats have a rather coarse, short hair texture, a slightly truncated cone, a cylindrical body shape, dorsal and ventral colors tending to be grayish brown (GB), and a tail color tending to be blackish brown (BB) (Table 6). The color of the body of *R. tanezumi* tends to be

grayish brown due to genetic diversity in each individual. A total of two house rats were identified to have grayish black on the ventral part of their bodies (Figure 5).

Table 6. Identification of house/roof rats based on qualitative characteristics

Loca- tion	Sex	Colour				Nose shape (snout)	Body shape	Hair	
		Dorsal		Ventral				Texture	Size
		Body	Tail	Body	Tail				
B	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
B	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
C	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
C	Male	BB	BB	BG	BB	slightly truncated cone	cylindrical	rather coarse	short
C	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
D	Female	BB	BB	BG	BB	slightly truncated cone	cylindrical	rather coarse	short
E	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
G	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
I	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
J	Male	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short
J	Female	GB	BB	GB	BB	slightly truncated cone	cylindrical	rather coarse	short

Note: GB = greyish brown, BB = black brown, BG = black grey



Figure 5. Differences in ventral hair color: (a) Grayish black; (b) Grayish brown

The trapped house rats consisted of both male (two heads) and female (nine heads) rats. Based on their body weight, several of the trapped rats were classified as small or sub-adult rats, weighing < 70 g (Table 7). The identified sub-adult rats had a total length of 220-265 mm, while the trapped large rats reached a total length of 404 mm (Figure 6).

Table 7 Results of trapping house rats based on sex/gender and body size

Variable observed	Number of rats (head)
Sex	
Male	2
Female	9
Body Size	
Big (> 70 g)	9
Small (< 70 g)	2

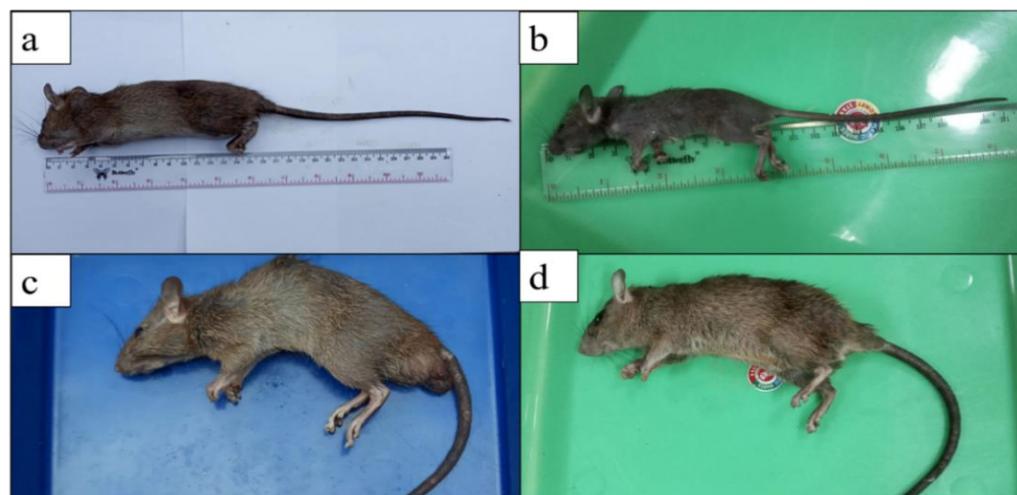


Figure 6. Caught house/roof rats: (a) Large size; (b) Small size; (c) Male; (d) Female

Female house rats are more frequently caught than male rats. Yuliadi *et al.* (2016) suggest that within a rat group, females are the foragers for their young, while males act as nest or territorial managers. Large house rats are more frequently caught than small rats. This is because mother rats frequently leave their nests to forage for their young (Priyambodo 2009). Therefore, adult and female rats have a greater chance of being caught than male and sub-adult rats.

CONCLUSION AND SUGGESTION

Conclusion

The presence of house rats (*Rattus tanezumi* Temminck) on the IPB Darmaga campus causes damage to property and facilities, such as damaged wiring, holes in ceilings and cabinets, and footprints on walls. The success rate for trapping house rats on the IPB Darmaga campus, out of 300 traps using single live traps, reached 9%. Of these, 3.67% of rats were successfully trapped and remained in the traps, while 5.33% of rats escaped. This success rate was influenced by trap shyness, which reached 72.16%.

Suggestion

Further research is needed to investigate the potential for increasing the success rate of trapping house rats using attractants and comparing this with pest control services agencies.

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