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Types of Rats and Their Parasites That Potential to Transmit Disease in Tugu District, Semarang City

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Abstract. Rats are known as vectors and reservoirs for various types of ecto and endoparasites. The existence of rats as cosmopolitan animals allows for complex parasitic transmission due to the relationship between humans, animals, and the environment. This study aimed to provide informative data on the types of rat along with their ecto- and endoparasites. This research is a qualitative descriptive study. Data collection was carried out by random sampling survey with a point time approach. Data collection was carried out in 4 villages, namely Tugurejo, Mangkang Wetan, Mangunharjo, and Mangkang Kulon Villages, Tugu District, Semarang City. A total of 89 rats were obtained, the species obtained were *Rattus norvegicus*, *Rattus argentiventer*, *Rattus exulans*, *Rattus tiomanicus*, *Rattus surifer*, *Rattus tanezumi*, *Bandicota indica*, and *Suncus murinus*. Ectoparasite infestation was found in all types of rats except *Suncus murinus*. The ectoparasites found were *Xenopsylla cheopis* and *Laelaps echidninus* which were reported as the main vectors of murine typhus, epidemic typhus, bartonellosis as well as scrub typhus and Q-fever disease. Endoparasite infestation was found in the intestinal organs, namely *Diphyllobothrium* sp. and two species of worm eggs *Hymnoepis* sp. and *Trichuris trichiura* which were reported as the cause of Diphyllobothriasis as well as digestion, absorption, which can result in the loss of protein, carbohydrates, fats, and blood in large quantities. Diphyllobothriasis is not transmitted from person to person, more than one family member can be infected by sharing common meals and having similar eating habits. This study can be used as an early warning for community against the potential of infectious diseases from rats as vectors in Tugu District, Semarang related to rats density, endoparasites and their ectoparasites**.**

Key words: Ectoparasite, Endoparasite, Parasite, Rat

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INTRODUCTION

Rats are the order Rodentia which belongs to the group of small mammals that act as vital components in various ecosystems that play a role as prey or predators as well as carriers and reservoirs of disease. Rats are known as a source of disease due to the interactions of rats with pathogenic organisms and their physicochemical environment. They are also known to harbor a number of ecto- and endoparasites. Ectoparasites such as fleas, ticks, and mites can be pathogenic to humans and animals. Parasite eggs in rodents are also responsible for the spread of disease (Sharma et al., 2013). There are several reasons why humans can be involved in the cycle of disease transmission from rats, including humans by chance entering the area where the disease is transmitted, the migration of infective wild rats from outside the house (forest, gardens/fields, sewers) into the residential environment, and the contact between an infected human with healthy humans (Ristiyanto et al., 2014).

The presence of rats either inside or around the house has a statistical relationship with the incidence of zoonotic cases (Ahmad et al., 2014). Transmission of disease from rat can be caused by contact between humans and rats, either through feces, urine, or rat bites. The interaction between rats and humans either directly or indirectly is when there is an increase in population which results in a decrease in the proportion of land that was previously a habitat for wild animals to become residential areas (Hamidi et al., 2015). This is supported by the fact that rats are cosmopolitan animals with high adaptability that can live in all places. Rats also have a high breeding power and are known as omnivorous animals that eat all kinds of food, including all food eaten by humans (Chaudhary et al., 2017).

Urban areas can be a habitat for wild rats (Kusuma et al., 2021). This is related to the phenomenon of slum settlements that arise due to the increasing demand for land in urban areas along with an increase in the number of people living in cities (Hanifah & Widiyastuti, 2015). Slums with poor sanitation and large piles of garbage due to a lack of public awareness of cleanliness make it a place favored by rats (Dewi et al., 2020).

Tugu District is located at the western end of Semarang City which is growing rapidly as a potential area for industrial and trading and service activities. A

study on rats in Tugu District needs to be carried out to minimize the risk of disease transmission to humans, taking into account several aspects based on the Semarang City SPPIP including fairly dense settlements, a quite large amount of waste generated, an inadequate quantity of waste facilities, and the waste disposal system that is not yet complete and not well managed. This study aimed to provide informative data on the types of rats and ecto- and endoparasites found in the Tugu District, Semarang City.

The findings of the study are intended to aid Semarang Health Office in rat eradication efforts, which include both therapeutic and preventive measures. Curative activity in form of community socialization in order to maintain environmental health and prevent the spread of diseases caused by rats. To lower the number of rats in Semarang, particularly in Tugu District, preventive measures such as employing live traps, poison, and rat glue have been implemented.

METHODS

The type of this research is descriptive qualitative research. This study does not have a hypothesis, but only describes an object as it is systematically by emphasizing factual data. Data collection was carried out by random sampling survey with a point time approach. The data studied were data from samples of rats caught in Tugu District, Semarang City.

Sampling location

The study was conducted in July – August 2021. The rats were caught using a single live trap in four villages, namely Tugurejo, Mangkang Wetan, Mangunharjo, and Mangkang Kulon. The installation of rat traps using area sampling technique in one district, was only carried out in one area (Rukun Warga/RW) (Dewi et al., 2020). The bait used was grilled coconut or salted fish. As stated in Siswandeni (2020), the roasted coconut and salted chicken feather bait has no difference in the success of rat capture . So that the use of grilled coconut and salted fish was adjusted to the information obtained from the local community about the bait that is preferred by rats. Trap installation was carried out in the afternoon and then was taken on the next day starting at 06.00 Western Indonesian Time (WIB). In capturing the rats in houses, two traps used were placed in the warehouse, kitchen, or places that were thought to be frequented by the rats.

Animal identification

The captured rats were anesthetized with ketamine at a dose of 100 mg/KgBW (Musterman, 2016; Yang & Liang, 2015). Identification of rats was carried out by measuring body morphometry and physical observations. The measurements taken were the measurement of body weight, body length, tail length, ear length, and hind foot length. The process of identifying rats was carried out at the Laboratory of Animal Taxonomy, Department of Biology, State University of Semarang, referring to the “Rodent in Java” book (Suyanto, 2006)

Examination and identification of ectoparasites

Ectoparasites in rat were collected by combing the body hair with a brush in opposite directions. The inner ear was scraped with a cotton swab to collect mite larvae if present. The ectoparasites obtained were put in a vial containing 70% alcohol accompanied by an identity label. The ectoparasites were then observed with a stereo microscope to distinguish between soft-skinned ectoparasites such as ticks, mites, and ticks with hard-skinned ectoparasites such as fleas. Examination of ectoparasites was based on Ristiyanto method, the method of study was by wire trap and ectoparasite processing by combing the hair. Soft-skinned ectoparasites were immersed in 95% alcohol for 3 minutes, then the abdomen was pierced. The specimens were washed with distilled water for 2 repetitions and then immersed in 50%, 80%, 95%, and absolute alcohol for 10 minutes each. The specimen was placed on a microscope slide and carefully covered with a cover glass using a needle. Meanwhile, hard-skinned ectoparasites were immersed in 10% KOH solution for 24 hours. The specimens were then transferred to distilled water for 5 minutes, then placed in acetic acid solution for 30 minutes. Specimens were observed by placing them on a microscope slide with a binocular microscope. Identification of ectoparasites referred to the book titled “Rodentia Infectious Diseases” (Ristiyanto et al., 2013).

Examination and identification of endoparasites

Endoparasites were collected surgically by cutting along the stomach and then the liver, intestines, and stomach of the rats. They were then taken and put in a vial containing 70% alcohol and brought to the laboratory for further examination. Examination of adult endoparasites was carried out with a stereo microscope. The endoparasites found were put into 70% glycerin alcohol solution for 2 hours to dissolve the cuticle then transferred to Semichon's carmine dye solution for 20 minutes, then clarified in 70%, 80%, 90%, and absolute alcohol. The well-stained specimens were placed on a microscope slide to be observed under a binocular microscope (Ristiyanto et al., 2013; Mabarwati et al., 2011).

Examination of worm eggs was carried out by the floating method (Sheather's sugar solution) (Yang & Liang, 2015). Feces from the digestive tract were taken and then homogenized in a saturated sugar solution. The faecal solution was then filtered and poured into a test tube until it was full and formed a convex above it. The cover glass was affixed to the convex and waited for 10 minutes, then the cover glass was attached to the microscope slide so that the sample can be observed.

RESULTS AND DISCUSSION

A total of 89 rats caught in this study were from 7 species of rats and 1 species of shrew. The species identified were including *Rattus norvegicus*, *Bandicota indica*, *Rattus argentiventer*, *Rattus exulans*, *Rattus tiomanicus*, *Rattus surifer*, *Rattus tanezumi*, and *Suncus murinus*. The most commonly found species was *Rattus norvegicus* or known as the sewer rat because it is often found in drains / sewers in urban residential areas and markets (Ristiyanto et al., 2014).

Based on the location of the trap, more rats were trapped in the trap outside the house. Even though the condition of the houses at the research site was dense and close to each other, the facts show that the existing houses are in moderate condition. The condition of the feasibility of the building is said to be moderate when the roof is made of tile, the house has cement floors, walls, the division of space in the house is quite clear, and the lighting is relatively moderate – good (Hanifah & Widiyastuti, 2015). The physical condition of the building is quite good as evidenced by the small number of *Rattus tanezumi* species caught. In several similar studies *Rattus tanezumi* was found more than the other species. This species is known as the house mouse which is often found on roofs, rooms, and warehouses. The poor and dense housing conditions greatly facilitate the mobilization of these rats (Juhairiyah et al., 2021).

Another cause of the presence of rats is the lack of public awareness of the cleanliness of the surrounding environment, causing a lot of piles of garbage such as along roadsides and in the corners of bush areas. This condition is getting worse due to the waste system that is not managed properly. Garbage that accumulates can cause clogged drains. The resulting damp and dirty conditions can be used as a habitat for wild rats.

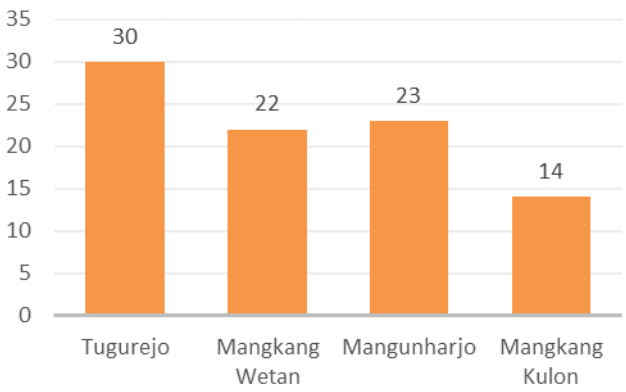


Figure 1. Number of rats caught in 4 villages

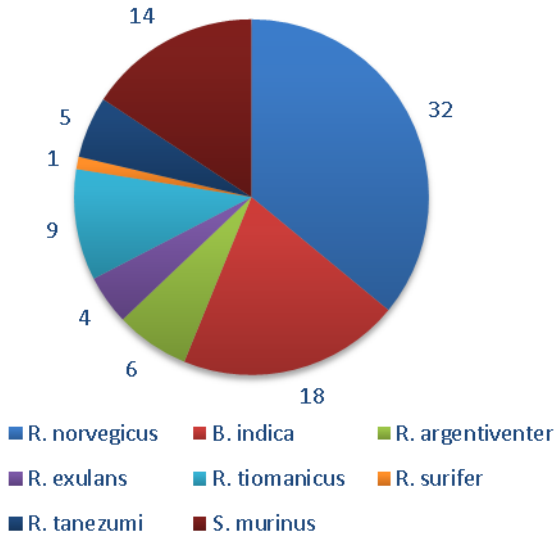


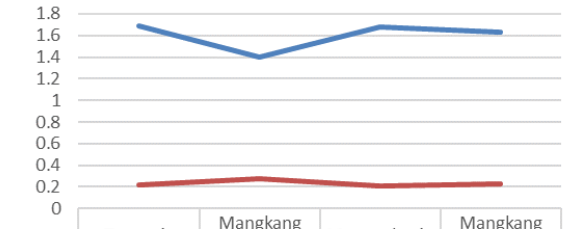
Figure 2. Total species of rats caught in 4 villages.

Figure 3. (a) Conditions around the house that have a lot of garbage piles (b) Flooded gutters and traces of rat droppings.

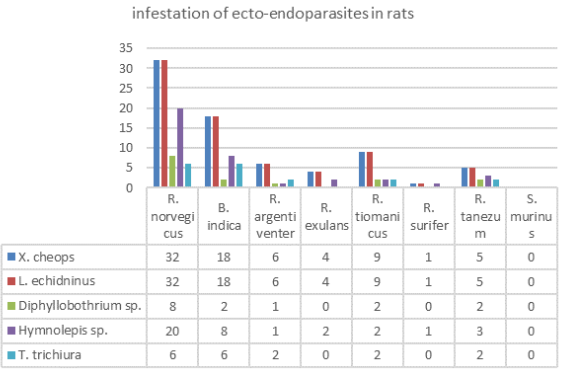
The results of the calculation of the Shannon-Wiener diversity index showed that the value of $1 \leq H' \leq 3$ is moderate diversity. Based on this interpretation, it can be seen that the diversity of rats caught in Tugu District, Semarang City is moderate, with the highest value was obtained from Tugurejo Village while the lowest value was from Mangkang Wetan Village. The results of the calculation of the evenness index showed that there is no significant

difference in the four villages. This result show that the evenness index value of the species is quite stable.

The diversity of rat species is strongly influenced by habitat characteristics, such as vegetation cover, the availability of food and safe shelter, and the level of human intervention. Based on several previous studies, rat caught in the area tends to have a low - medium diversity index value with a stable evenness value. Rat can adapt to the human environment because of the abundant and easily available food source (Chaudhary et al., 2017).



	Tugurejo	Mangkang Wetan	Mangunharjo	Mangkang Kulon
H'	1.684077	1.400662	1.68095	1.630799
E	0.222222	0.27686	0.20983	0.22449



	R. norvegicus	B. indica	R. argenti venter	R. exulans	R. tiomani cus	R. surifer	R. tanezu m	S. murinu s
X. cheops	32	18	6	4	9	1	5	0
L. echidninus	32	18	6	4	9	1	5	0
Diphyllobothrium sp.	8	2	1	0	2	0	2	0
Hymnolepis sp.	20	8	1	2	2	1	3	0
T. trichiura	6	6	2	0	2	0	2	0

Figure 4. (a) Diversity index and evenness index of rats in Tugu District, Semarang City (b) Infestation of ecto- and endoparasites in rats.

Two species of ectoparasites found were fleas (*Xenopsylla cheopis*) and rat mites (*Laelaps echidninus*). Ectoparasite infestation was found in all types of rats caught except *Suncus murinus*. Rats differ from shrews based on the shape of the snout, body size, and tooth structure (Prasetio & Setiati, 2016). The hair structure of shrews is shorter, finer, and quite dense compared to rat, which is the cause of the absence of ectoparasites in shrews (Dewi et al., 2020).

Fleas are holometabolous insects that go through 4 stages in their life development, i.e. egg-larva-pupa-adult. It has a body size of 2-10 mm and is not winged. Fleas can jump using their powerful hind legs up to 150 times their body length (Waugh et al., 2006).

The relationship between rat and fleas is classified as an obligate (temporary) ectoparasite interaction (Ristiyanto et al., 2014), where the adult fleas always live attached to the surface of the host's body, while the immature stage lives independently from the host. Fleas like mammals living in nests, holes, or caves and away from direct sunlight. So it is very possible for rat to become the host of fleas.

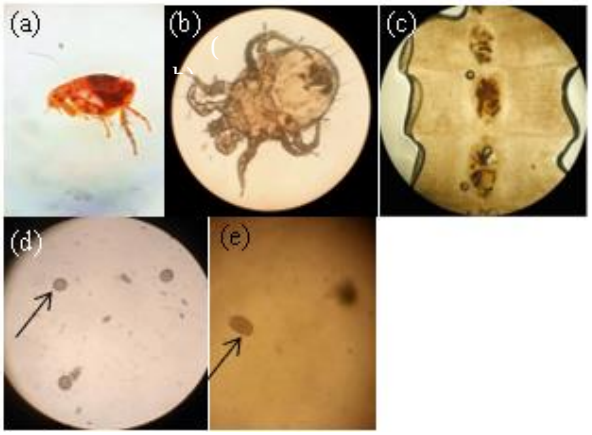


Figure 5. Ectoparasites and endoparasites found (a) *Xenopsylla cheopis* (b) *Laelaps echidninus* (c) *Diphyllobothrium* sp. (d) *Hymenolepis* sp. (e) *Trichuris trichiura*.

Several studies in the health sector reveal that not all fleas have an important role in transmitting disease to humans. The flea species *Xenopsylla cheopis* has been reported as the main vector of *Murine typhus*, epidemic typhus, and bartonellosis. *Xenopsylla cheopis* is also the most commonly found species as a vector in the world, including Indonesia (Manyullei et al., 2020). *Murine typhus* is transmitted from flea feces containing *R. typhi* bacteria through breathing or entering through bite wounds (Joharina et al., 2016).

Rat mites are cosmopolitan so it is possible for all types of rat to be infested with mites. Mites in rat are most often found swarming between the hairs, especially on the posterior back and thighs (Nugroho et al., 2016). *Laelaps echidninus* acts as a vector for *murine typhus* and a potential reservoir of other rickettsial diseases such as scrub typhus and Q-fever disease (Annashr et al., 2011).

The species of endoparasites (adult worms) found from intestinal organs were *Diphyllobothrium* sp. and two species of endoparasites found in faecal samples including *Hymnolepis* sp. and *Trichuris trichiura* based on the 2019 Atlas of Medical Parasitology (Surja & Wijaya, 2019). *Diphyllobothrium* sp. belongs to the Cestoda class which can cause Diphyllobothriasis. Rats can be infected with this type of worm by eating fish or crustaceans that have been infected with *Diphyllobothrium* sp. so that later it will

grow up in the intestines of rat. Several studies have shown that this worm can be found in other animals such as fish (Gustinelli et al., 2016) and cats (Yudhana & Praja, 2017).

The tapeworm that is often found in rats is the small tapeworm *Hymenolepis* sp. This parasitic worm is an inhabitant of the intestine with a ribbon shaped and transverse stripes (Kusuma et al., 2021). Mature proglottids will break down in the intestine and free eggs, then come out with feces which when swallowed by a new host, the oncosphere will grow into cysticercoid larvae and adhere to the mucosa, then grow into adult worms (Widiastuti, et al., 2016). These worms can cause internal autoinfection, i.e. eggs that are free in the intestine can hatch and become worms in the same host (Sharma et al., 2013).

Trichuris trichiura is a nematode also known as whipworm that lives in the cecum, large intestine, and rectum. The eggs are elongated or spherical in shape with an operculum at both ends, and are highly resistant to environmental conditions (Waugh et al. 2006). His worm infection in humans, especially children affects digestion, absorption, and food metabolism which can result in the loss of large amounts of protein, carbohydrates, fat, and blood (Siregar, 2016).

This study showed that the presence of rats in the house environment indicates a close relationship between rats and humans, so that there is a potential for disease transmission through rats to humans. Although previously there were no reports of disease transmission to humans, the facts show that some local people are sometimes bitten by rats. Although it does not show significant symptoms, there is a need for further studies on parasites in rats in urban areas. The number of ectoparasites and endoparasites detected based on rats type seized in Tugu sub-district has potential to cause zoonotic diseases. The surrounding community must work to reduce rat population by trapping rats on regular basis and placing rat traps in areas where rats are likely to congregate.

CONCLUSION

The rat species caught in this study were *R. norvegicus*, *R. argentiventer*, *R. exulans*, *R. tiomanicus*, *R. surifer*, *R. tanezumi*, *B. indica*, and *S. murinus*. Ectoparasite (*Xenopsylla cheopis* and *Laelaps echidninus*) infestation was found in all types of rats except *S. murinus*. Endoparasite (*Diphyllobothrium* sp., *Hymnolepis* sp., and *Trichuris trichiura*) infestation was found in rats' intestinal organs.

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