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## Distribution of rats and endoparasites zoonoses risk in Tandang village, Tembalang District, Semarang City

Ning Setiati and Laily Fatmawati \*

Department of Biology, Faculty of Mathematics and Sciences, Universitas Negeri Semarang, Jl. Raya Sekaran, Gunungpati, Semarang 50229, Indonesia.

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### Abstract

Rats are rodents that coexist with humans because of the abundant easily available food sources, and aggravated due to the lack of public awareness with environmental hygiene. Apart from being troublesome, rats are also intermediaries for the cause of zoonoses. Initial observations, in Tandang village, there are densely populated areas, many rats of various types were found, including *Rattus norvegicus*, *Rattus tanezumi* and possibly other types that cause zoonoses. This study aims to examine the distribution of rats and their endoparasites in the Tandang village. The research method is analytical descriptive research. Traps were set at several points around dense settlements and markets. Data obtained by conducting random sampling. From the results of detainment, 104 rats were obtained, consisting of 5 species namely *Rattus norvegicus*, *Rattus tanezumi*, *Rattus exulans*, *Bandicota indica*, *Mus musculus*. Endoparasites found in intestinal organs in the form of the tapeworm *Hymenolepis* sp., *Trichuris trichiura* worm eggs, *Hymenolepis* sp. The distribution of rats was found in dense residential areas, with 27 rats (22.21%) *Rattus norvegicus*, and 21 rats (20.19%) compared to their distribution in the market. The eggs of these parasitic worms are known to cause infection to humans through objects that encountered with soil, sewage, etc. and are eventually swallowed. Symptoms experienced when infected include diarrhea, abdominal pain, constipation, and anorexia.

**Keywords:** Distribution; Endoparasites; Parasites; Rats; Zoonoses

### 1 Introduction

The development of industrial world in Indonesia accompanied by climate change has the possibility to trigger an increase rodent-borne disease case, through the transmission of diseases by rodents to humans or better known as Zoonoses [1].

The distribution of rats is usually found in densely populated settlements, markets where there are trash cans and sewers which allow them to utilize it as shelters and a sufficient source of food for rat habitat [2].

Direct transmission is a disease that is transmitted throughout the air by infectious agents in feces or wounds when bitten by rats [3]. Rat also acts as host amplifiers, for cases of disease whose transmission is not directly through vector bites, for example through aerosols in the air when a person is in a polluted environment. Apart from having an impact on health, rodent-borne disease is currently also a social and economic problem [4].

Infectious diseases are caused by various disease agents from the group of bacteria, rickettsiae, viruses, and parasites (Paramasvaran *et al.*, 2009). Parasites are organisms that live on other organisms both inside (endoparasites) and

\* Corresponding author: Laily Fatmawati

outside the body (ectoparasites) which aim to take food from these organisms [6]. The existence of endoparasites in the rat body is one of the potentials for endoparasite transmission from rats to humans [7].

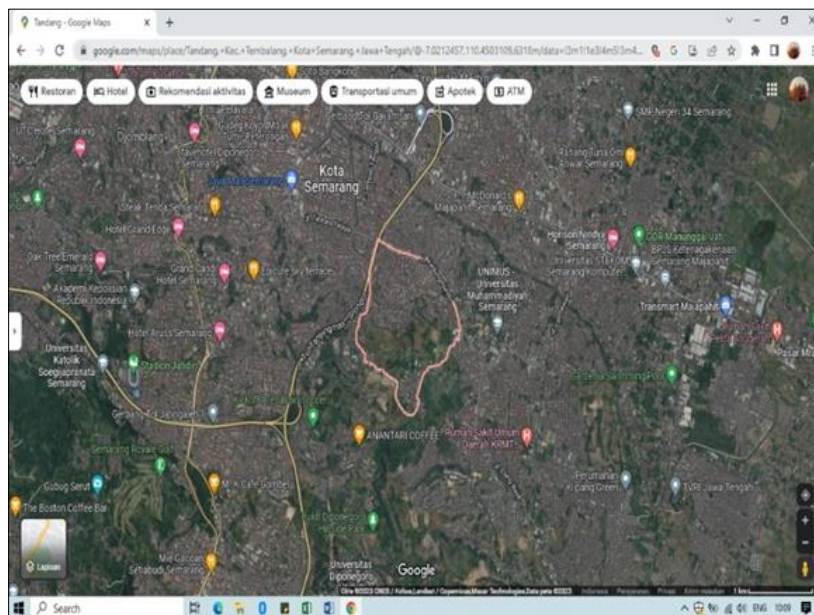
Based on the preliminary study, several reasons for taking samples in Tandang village are the emergence of various problems related to dense settlements, garbage problems, high building density, dense population, unfavorable road conditions that cause puddles on the roads, inadequate housing conditions, poor sanitation and drainage as well as low environmental hygiene [8].

Various efforts to eradicate rats have been carried out by the Semarang City Health Office through two actions, which consist of curative and preventive. Curative action is in the form of outreach to the community to always maintain environmental health and prevent transmission of diseases that can be caused by rats. Preventive measures include catching rats using live traps, poison and rat glue to reduce the number of rats in the city of Semarang [9]. With the increase in cases of zoonotic diseases from year to year, a method is needed, that is carrying out prevention by studying the distribution of rats and their endoparasites [10].

## 2 Material and methods

The method used in this research is descriptive analytic. Data collection used a survey method with a cross sectional approach. In this study, the population used was all rats and endoparasites contained in the bodies of rats in the city of Semarang. The samples applied were all types of rats caught and endoparasites in rats in Tandang village, Tembalang district, Semarang City. The number of samples is the number of rats caught.

This research was conducted from December 2021 to January 2022. The location for research was the result of an area study of Semarang City area which was determined with the criteria of a location with lots of food sources, fouled up sanitation and there are sewers such as in Tandang village, Tembalang district, Semarang City, The general picture is as shown in Figure 1.



**Figure 1** Map of sampling locations

The rats that were caught were then given intra-thoracic overdose anesthesia, which putting the rats into a closed container containing chloroform [11]. Identification of rats was carried out by physical observation and morphometry on the rat's body. Measurements include body weight, body length, tail length, leg length, and ear length, referring to the rat identification method [12]. Discovery of endoparasites using the flotation method by centrifugation, namely intestinal samples from rats were weighed 3-grams for everyone, then stored in plastic labeled with information. Furthermore, making saturated NaCl can be done by adding 600 ml of distilled water to NaCl continuously until the NaCl precipitates and stops dissolving.

Endoparasites found in faecal samples were recognized as parasite types using parasitology and helminthology atlases. Identification was carried out up to the species level and photomicrographs were made with a digital camera to facilitate identification by following the procedure [6].

### 3 Results and discussion

#### 3.1 Overview of Research Locations



**Figure 2** The Condition of Tandang Village Environment RT 9 RW 11

Research was conducted in Tandang village, to be precise, in RT 09 RW 11, Tembalang district, Semarang City has a large area of approximately 375,734 ha, and oversees 14 RWs with a population of 18,138 people [9]. Tandang village territory is a hilly area, so the access road is uneven and goes up and down, there is a stream that is not well maintained. Dense settlements and lack of attention to good hygiene, such as waste problems, high building density, dense population, poor road conditions that cause standing water on the roads, inadequate housing conditions, poor sanitation and drainage, also low environmental health [14].

Apart from being around residential areas, the market is also used for sampling. Rats that live in residential areas can contaminate stored food ingredients, so consuming them directly can be a source of disease reinfestation for people living in the surrounding area (Kusuma et al., 2021).

**Table 1** Types of caught rats

Caught Rats Species	Trap Installation Locations					
	Settlement		Market		Total	
	Head	%	Head	%	Head	%
<i>Rattus norvegicus</i>	23	22.12	4	3.84	27	25.96
<i>Rattus tanezumi</i>	21	20.19	7	6.73	28	26.92
<i>Rattus exulans</i>	8	7.69	0	0	8	7.69
<i>Bandicota indica</i>	15	14.42	4	3.85	19	18.27
<i>Mus musculus</i>	17	16.35	0	0	17	16.35
<i>Suncus murinus</i>	5	4.81	0	0	5	4.81
Total (head)	89	85.58	15	14.42	104	100



a: *Mus musculus*; b: *Bandicota indica*; c: *Rattus exulans*; d: *Rattus tanezumi*; e: *Rattus norvegicus*

**Figure 3** Types of caught rats

Based on the identification results, 104 mice were obtained which belonged to six species including mice with different types (Table 1). The six species caught are *Mus musculus*, *Bandicota indica*, *Rattus exulans*, *rattus tanezumi*, and *Rattus norvegicus*. *Rattus norvegicus* and *Rattus tanezumi* are the most widely caught species (Figure 3).

Distribution of *Rattus norvegicus* or sewer rats caught from culverts or ditches (25.96). *Rattus tanezumi* can be found (7.69%) in residential houses, such as in warehouses, rooms, kitchens, and roofs of houses, so they are called house rats. The condition of the residents' houses seemed to be poorly sustained or not maintaining cleanliness, quite dense so that they were very suitable for the rat's preferred habitat [15].

The least number of rat species caught is *Rattus exulans*, which is found in trees around river streams near settlements, because the habitat of *Rattus exulans* is in gardens and is often referred to as garden rats, but sometimes it can be found at home. The population of *Rattus exulans* increases when entering the rainy season [10].

Another species caught, namely *Bandicota indica*, was found in kitchens and warehouses inside the house, while *Mus musculus* was trapped around landfills, and even then, this indicated that this *Mus musculus* was looking for food from humans, same thing goes with *Rattus tanezumi*.

Under normal circumstances, mice occupy the habitat according to their natural habits. But the need to get a food source makes rats leave their natural habitat towards more food supplies. This happened because of the domestication of rats, due to several things, such as food sources for rats that were increasingly difficult to obtain; natural habitats are becoming increasingly scarce due to deforestation and fragmentation. The human environment tends to provide food so that rats will get closer to this area to maintain their survival.

Based on the location of rat traps in the settlement, more rats were found in the house. Physically, the condition of the building can be said to be shabby, because most of the walls of the house are made of wood, cement floors and roofs are made of tiles, and lighting is inadequate at night (Wardani et al., 2021).

Rats exist simultaneously with humans because of the abundance of easily available food sources. In addition, it is also caused by a lack of public awareness regarding an unclean environment, hence the garbage is piled up on the side of the road or on the riverbank, and there is no proper waste management. Garbage buildup causes blockage of water flow and creates humid conditions so that it is used as a rat habitat (Rothenburger et al., 2014).

### 3.2 Rats Caught Based on Gender

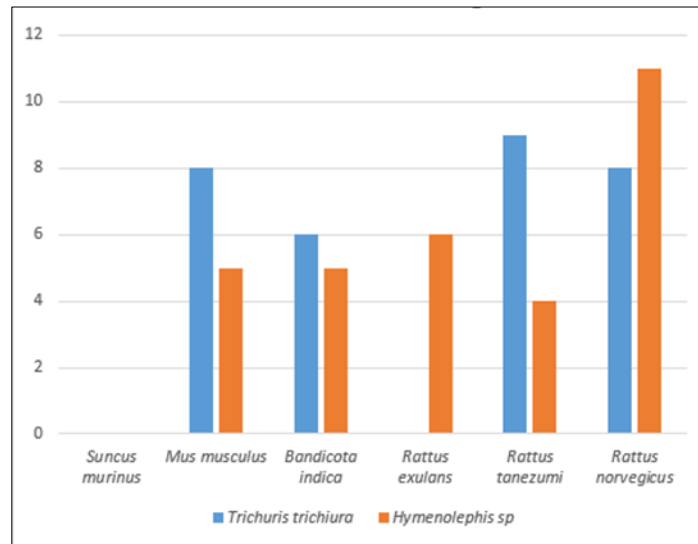
From 104 rats caught in this study, 40% of the rats were male, while 60% of the rats were female. Catching female rats is easier than male rats, this might happen because female rats are more likely to leave their nests especially during pregnancy or lactation to get food. Therefore, female rats are easier to seize than male rats [17].



The influence of the endocrine glands on the hypothalamus which produces sex hormones, as well as the influence of the pituitary hormone, allows the instinct of female rats to nurture and care for these young rats. Meanwhile, as nest guards and fights are carried out by male rats [18].

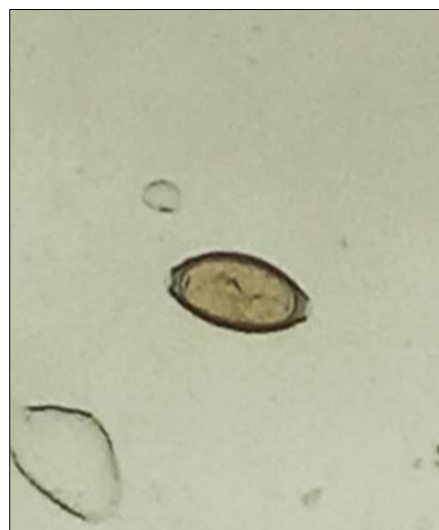
### 3.3 Endoparasites Found in Rat Intestine

In this study, two types of worm eggs were found, namely from the nematode group *Trichuris muris*, and from the cestode group, is *Hymenolepis* sp. These two types of worms have also been reported to infect *Rattus tanezumi* in Pasar Rasamala, Sambiroto village and Sendangmulyo village. This indicates that rats can transmit Soil Transmitted Helminths infection to humans through their faeces or urine. Therefore, the presence of rats has a great impact on the epidemiology of disease transmission. Besides acting as a host, rats also act as a reservoir for diseases that are considered lethal, such as leptospirosis and the plague [19].



**Figure 4** Graph of the distribution of worm eggs based on caught rats in Tandang village

In the nematode group, *Trichuris trichiura*, is a worm that lives in the rectum, cecum, and large intestine. Whip worm is another name for *Trichuris trichiura*. The shape of the egg is round or elongated and there is an operculum at both ends. The outside is golden yellow and clear on the inside. The disease caused by this parasite is trichocephaliasis or trichuriasis. In severe infections, it can cause nausea, vomiting, severe anemia, dysentery [20].



**Figure 5** *Trichuris trichiura* Worm Egg

Based on examination, *Hymenolepis* sp. was found in Cestoda group. Most of the rats caught were infected by this cestode. Apart from infecting rats, this parasitic worm, *Hymenolepis* sp., can also infect humans through soil contaminated with rat feces and accidentally ingested, causing Hymenolepiasis [21] & [24].



**Figure 6** *Hymenolepis* sp. Worm Egg

Infections caused by parasitic worms usually do not cause chronic disease or a large number of patients, therefore this disease is often regarded as something normal, but in fact this infection can cause great detrimental effects [13]. Contamination by rat feces is usually caused by personal hygiene factors or community groups, especially settlements with dense population levels. Because the eggs of this parasite can infect humans through objects that are exposed to soil, water disposal, etc. and are eventually swallowed. Symptoms experienced when infected include diarrhea, abdominal pain, constipation and anorexia, which include mild symptoms [22].

*Hymenolepis* sp. can also infect humans through soil contaminated with rat feces and accidentally ingested, resulting in hymenolepiasis (Gholipoury et al., 2016). Illness caused by *Trichuris trichiura*, which are trichocephaliosis or trichuriasis, in severe infections, can cause nausea, vomiting, severe anemia, dysentery [23].

The benefits of research results are expected to help efforts to eradicate rats carried out by Semarang City Health Office throughout two actions, those are curative and preventive. Curative action is in the form of outreach to the community to always maintain environmental health and prevent transmission of diseases that can be caused by rats. Preventive measures in the form of catching rats using live traps, poison, and rat glue to reduce the number of rats in Semarang City, especially in the Tandang village area.

The number of endoparasites identified based on caught rats types has the potential for the emergence of zoonotic diseases in the Tandang village. The surrounding community must try to reduce the rat population by catching rats regularly by setting mouse traps every day in places rats have the potential to settle.

Besides that, waste management and maintaining environmental cleanliness are important for every household and in the community.

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#### 4 Conclusion

In this study, types of rats caught in Tandang village were *Rattus Norvegicus*, *Rattus tanezumi*, *Rattus exulans*, *Bandicota indica*, and *Mus musculus*. Endoparasites found in the intestinal organs are small tapeworms *Hymenolepis* sp which are intestinal inhabitants with a ribbon-like shape. The distribution of rats was found more in settlements than in markets, while the distribution of endoparasites was found in eggs from the worm *Trichuris trichiura* and *Hymenolepis* sp. Intestines.

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#### Compliance with ethical standards

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### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

### *Statement of ethical approval*

The author has carried out experimental animals in this study according to the rules and codes of ethics for using animals.

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