

## ASSOCIATED FACTORS TO RAT DENSITY: A SYSTEMATIC REVIEW

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### ABSTRACT

Rats can be a reservoir of several pathogens that cause disease in humans. Types of diseases that are transmitted by mice to humans are generally known as zoonotic diseases. These diseases can be fatal and lead to death. Rats often cause damage to residential buildings, schools, offices and the food industry, where the presence of rats can describe slum, dirty environmental conditions, and indicate poor environmental hygiene. The purpose of this systematic review is to examine articles that explain related factors factors related to rat density. The research method used is a systematic review using the PRISMA chart. The search results obtained 12 articles which were analyzed in this systematic review process. It was found that the presence of rats describes an environment that is not maintained, dirty, slum, damp, adequate amount of food, an indication of poor environmental hygiene management. The structure of residential buildings that are not dense with rats, the presence of vegetation or grass in the garden area that is not maintained, poorly maintained sanitation, the presence of sewers or rivers that serve as garbage dumps are factors that support the life of rats to nest and breed. The biotic and abiotic environmental factors will affect the dynamics of the rat population. Considering that rats are a type of rodent that breeds. It was concluded that this review made a major contribution in developing and providing new knowledge related to the problem of rat density.

**KEYWORDS:** Rat, Rat Density, Residential area.

### BACKGROUND

Rats belong to the order Rodensia. Rodensia comes from the word rodere which means rodent, so that rats are included as rodents with the characteristics of having two pairs of incisors that always grow throughout the life of a rat. Rats have similarities with humans in the reproductive system, nervous system, disease (cancer and diabetes), and anxiety. This happens because of the similarity of DNA organization and gene expression where 98% of human genes have genes comparable to mouse genes. Rats can live up to 3.5 years with a growth rate of 5 grams per day (Nur, 2020).

Rats are wild animals that are often associated with human life. The high population of rats can have an impact on losses in various human lives. In addition to being a threat to agricultural managers in crop cultivation, rats often cause damage to buildings, schools, offices and the food industry. The presence of rats describes a slum, dirty environment and indicates poor environmental hygiene (BPPK, 2016).

In health, rats can be a reservoir of several disease-causing pathogens in humans. Rat urine and saliva can cause leptospirosis. These animals cause Physical Hazards in the form of contamination of food ingredients due to contamination of hair, feces and urine. The bite of a flea on the body of a mouse can cause Bubonic Plaque. According to the Center for Disease Control and Prevention, rats can transmit about 35 types of diseases, including *Leptospirosis*, *Bubonic Plague*, *Hantavirus*, *Pulmonary Syndrome*, *Lymphocytic Choria Meningitis (LCM)*, *Murine Typhus*, *Salmonellosis*, *Rickettsialpox*, *Rabies*, and *Trichinosis* etc (Rani dan Martini, 2019).

Types of diseases that are transmitted by mice to humans, are generally known as zoonotic diseases. The disease can be fatal and lead to death. Rats are a type of animal whose development is very fast if the environmental conditions are favorable for their life, including the availability of food, drink and shelter (Farha, 2019).

There are many potential places to find rats in high

enough numbers, such as traditional and residential areas. In preventing diseases caused by rats, it is necessary to pay attention to the rat population and identify factors that affect their density. So that rat control can be done in order to minimize the impact of environmental risks around it. Based on the background that has been described, the researcher conducted this study with the aim of reviewing articles that explain the factors related to the density of rats.

## METHOD

### 1. Research Design

The design in this article is a systematic review. Systematic review is a research method carried out for the identification, evaluation and interpretation of all research results that are relevant to the research question.

### 2. Article Criteria

The articles selected in the preparation of a systematic review are limited based on the following search criteria: in Indonesian and in English, published on 2017-2022. It was available in full text, available in qualitative and quantitative studies, relevant to the research topic/title. After applying the search based on the established criteria, then the retrieved articles are evaluated. Articles are included in the research if: a) Discusses the factors related to the density of rats; b) Discusses the types of rats; c) There are health impacts caused by the high density of rats; d) research on instruments used in monitoring and measuring rat density.

### 3. Data Source

The scientific database used to obtain relevant sources related to the problem of factors related to rat density, namely Google Scholar, R & D e-journal, Proquest, SemanticScholar, EBSCO, JNIK.

### 4. Search Strategy

Article searches were conducted using keywords: Rats, Rat Density, Density of Rats. Keywords are entered in the search for each also using the BOOELAN operator, namely "OR" "AND", which is used to combine each keyword. Initial searches via Google Scholar, R&D e-journal, Proquest, Semantic Scholar, EBSCO, JNIK yielded 330,000 articles. The initial screening of titles to exclude irrelevant studies resulted in 18. After that, a quick screening through abstracts resulted in 12 articles that could be continued for analysis. The final stage obtained as many as 12 complete articles including full text that can be analyzed. The process of searching for articles relevant to the research question is described in the PRISMA chart in Figure 1.

### 5. Data Analysis

Research results are presented descriptively to answer research questions. In this study, the PRISMA diagram or selected reporting items for systematic review is used, this diagram is used to show the overall study selection process.

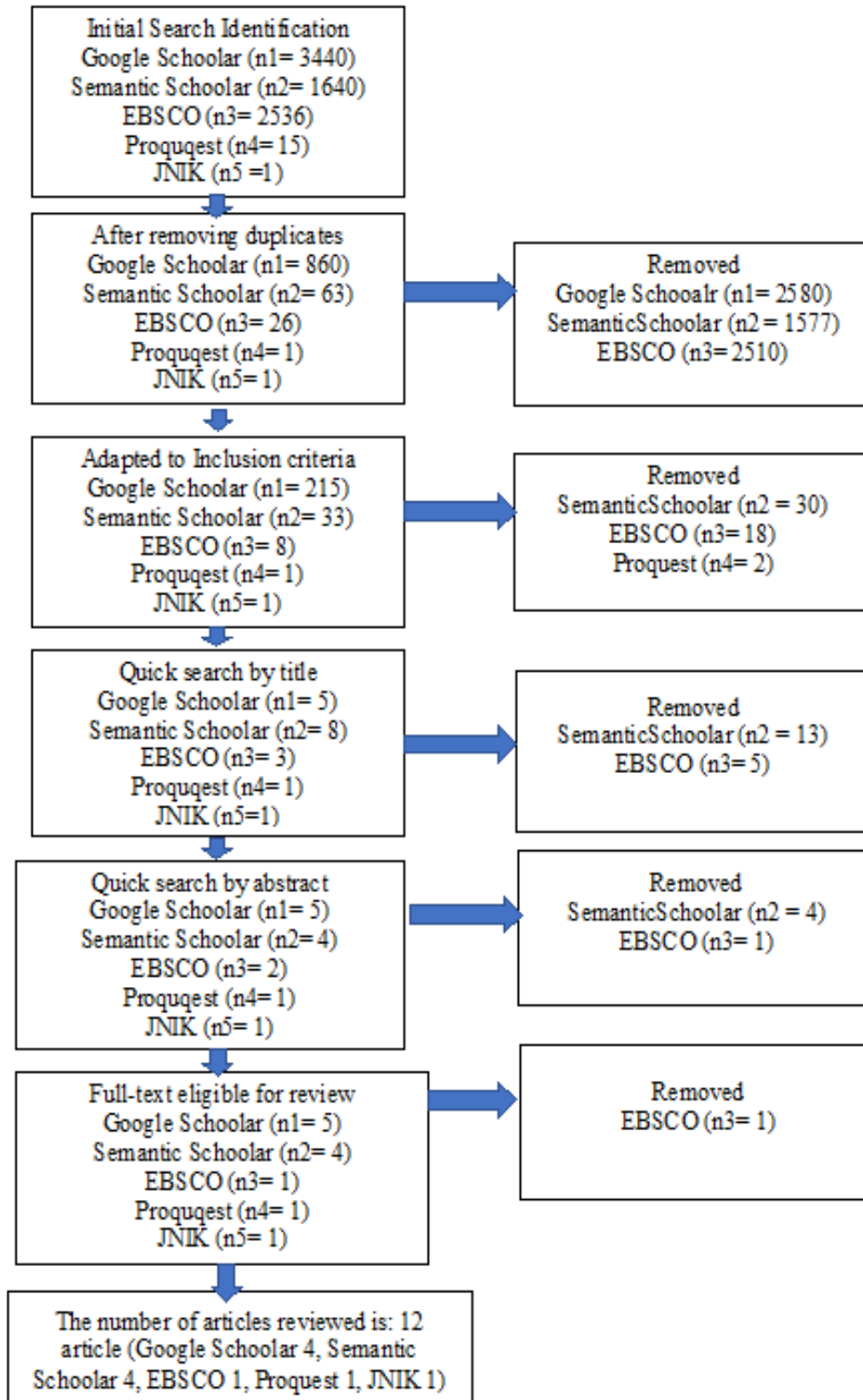


Figure 1: PRISMA Chart.

**Table 1: Results of Data Extraction Articles Entered in the Analysis Stage.**

No	Title	Author	Objective	Design	Sampling	Result
1	Paparan Tikus di Lingkungan Pemukiman Sekitar Kasus Leptospirosis Desa Sumberejo , 2018 (Exposure to Rats in Settlement Surroundings for Leptospirosis Cases in Sumberejo Village, 2018)	Okky Listyana Indraswari	To find out the factors that affect the density of rats and rat species found around leptospirosis cases	Cross sectional	Rats in 75 houses by cluster sampling	The density of rats in Kembangarum and Sumberejo villages was still high at 6.67 more than the rat density index (> 5%), the types of rat species found included <i>Rattus tanezumi</i> (40%), <i>Rattus exulans</i> (26%), <i>Rattus norvegicus</i> (20%), <i>Bandicota indica</i> (7%), <i>Bandicota bengalensis</i> (7%). There is no relationship between the availability of food sources, physical condition of the ditch, the frequency of trapping, the presence of feces and piles of used goods and the presence of rats, there is a relationship between the condition of the ditch, the presence of garbage, the presence of predators and the presence of rats.
2	Observasi Tingkat Kepadatan tikus Di Lingkungan Buffer dan Parimeter Pelabuhan Soekarno Hatta Makassar, 2019 (Observation of Rat Density Levels in the Buffer and Parimeter Environments of Soekarno Hatta Port, Makassar, 2019)	Sulasm, Sri Hastuti	Assessment of rat catch results (rat density) in the buffer area and perimeter	Observation	Rats found in the buffer area and perimeter of Soekarno Hatta harbor	The presence of rats describes an environment that is unkempt, dirty, slum, damp, an adequate amount of food, an indication of poor port environmental hygiene management. Given that rats are a type of rodent that reproduces very quickly. Rats can live between 3 to 4 years. Generally, the age of 1.5 to 5 months, mice are ready to mate. A female rat can give birth between 6 to 8 tails and the live can be 5 6 tails. The gestation period of rats ranges from $\pm$ 21 days and in 1 year it can give birth up to 4 times
3	Studi Kepadatan Tikus dan Ektoparasit di Pelabuhan Laut Soekarno Hatta Tahun 2019 (Study on Rat Density and Ectoparasites at Soekarno Hatta Seaport in 2019)	Syamsuar Manyullei, Agus Bintara Birawida, Izmi Fhadillla Suleman	To determine the density of rats, types of rats, success traps in catching rats, description of types of ectoparasite rats	Descriptive Observation	Rats caught in Soekarno Hatta Seaport.	Based on the results of the research that has been carried out, it shows that the density of rats for 4 days of installation there are 12 rats. And the type of rat caught is the rat species, namely <i>Rattus Tanezumi</i> (75.00%), <i>Rattus Norvegicus</i> (25.00%). These rats are rats that live in the habitat of houses, yards, warehouses and sewers. The measurement results for the total success trap indicator are 0.03 (3%) while the success trap per day is 0 to 0.1. There were 7 ectoparasites of the flea <i>Xenopsylla xeoipis</i> , 2 mites, and 1 lice.
4	Jenis dan kepadatan Tikus Di Pantl Asuhan "X" Kota Semarang (Types and Density of Rats at the "X"	Rani Kristina Putriosa Saraguh, martini, Udi Tarwatjo	To find out and analyze the determinants, types and density of rats at the "X"	Descriptive Observation with cross-sectional approach	All rats that were caught during the study were then	Environmental conditions that contain a lot of garbage, as well as the environment of residents who do not maintain cleanliness are the nests most favored by this rat species. They are a type of rat that carries out its life activities, especially looking for food, shelter, nesting, and breeding in the house. Activities that often litter is also the cause of this population to breed well because it has nests and food.

No	Title	Author	Objective	Design	Sampling	Result
	Orphanage in Semarang City)		Orphanage in Semarang City		identified the type of rat.	
5	Studi Kepadatan Tikus Dan Ektoparasit Di Pasar Gudang Arang Kelurahan Benteng Kecamatan Nusaniwe Kota Ambon (Study of Rat Density and Ectoparasites in the Charcoal Warehouse Market, Benteng Village, Nusaniwe District, Ambon City)	Farha Assagaff	Identifying rats and ectoparasites in rats at the Gudang Charcoal Market, Benteng Village, Nusaniwe District, Ambon City	Descriptive research	All rats caught during the study	Mice mobility aims to find food, mates and area orientation. The number of male rats caught indicates that the rat has high mobility.
6	Pengaruh Pendidikan Kesehatan Terhadap Peningkatan Pengetahuan dan Penurunan Kepadatan Tikus di Sumurboto, Semarang, 2019 (The Effect of Health Education on Increasing Knowledge and Decreasing Rat Density in Sumurboto, Semarang, 2019)	Sri Yuliaati, Retno Hestingsih, Martini, dkk.	To evaluate the effect of health education intervention on increasing knowledge and its implications for reducing rat density	Field experiment research with pre and post test design	All rats caught during the study	The knowledge scores before and after the intervention were 80.87 and 88.83, respectively. The rat population calculated based on the trap success method decreased from 8% to 6% after the intervention.
7	Analisis Faktor Lingkungan Terhadap Distribusi Jenis Tikus Yang Terkonfirmasi Sebagai Reservoir	Yanelza Supranelfy, Nungki Hapsari S, Reni Oktarina	To determine environmental factors related to the distribution of confirmed rat	Analytical descriptive research with cross sectional approach	All rats caught during the study	The presence of rats is also due to the presence of rats. The presence of rats is also caused by good and poor lighting because rats like dark places

No	Title	Author	Objective	Design	Sampling	Result
	Leptospirosis Di Tiga Kabupaten Di Provinsi Sumatera Selatan (Analysis of Environmental Factors on the Distribution of Rat Species Confirmed as Leptospirosis Reservoirs in Three Regencies in South Sumatra Province)		species as reservoirs of leptospirosis in three districts (Lahat, Banyuasin and Ogan Komering Ilir (OKI)) in South Sumatra Province.			
8	Domestikasi Tikus: Kajian Perilaku Tikus dalam Mencari Sumber Pangan dan Membuat Sarang (Mice Domestication: A Study of Rat Behavior in Searching for Food Sources and Making Nests)	Dwi Priyanto, Jarohman Raharjo dan Rahmawati	To find out the domestication of rats related to their foraging and nest-building behavior	Survey descriptive research	All rats caught during the study	The potential for rat domestication is relatively small in <i>R. exulans</i> and <i>R. tiomanicus</i> , these two species adapt well to food sources derived from human food by making nests in settlements so that this species is classified as a domestic rat.
9	Survey Kepadatan Tikus di Kelurahan Tandang, Kecamatan Tembalang Kota Semarang (Rat Density Survey in Tandang Village, Tembalang District, Semarang City)	Rery Afianto, Retno Hestningsih, Nissa Kusariana, dan Dwi Sutningsih	To calculate the density of the rat population from the success of the traps carried out and to identify the types of rats caught in Tandang Village, Semarang City	Analytical descriptive research with cross sectional approach	All rats caught in RW 03	Two types of rats and insectivores were found in the village of Tandang, namely <i>Rattus Norvegicus</i> and <i>Rattus tanezumi</i> . The results showed that <i>Rattus tanezumi</i> was the most common rat found in the village of Tandang as many as 10 rats (55.6%). The existence of <i>Rattus tanezumi</i> in the Tandang Village is probably due to the location of the Kedungmundu market close to the housing of the residents of the Tandang village. <i>Rattus tanezumi</i> 's original habitat is at home because the rat is a domestic rat whose life activities such as foraging, sheltering, nesting and breeding in the house. Mice can move from one place to another when there is a lack of food
10	Keanekaragaman, Deteksi dan Peranan Tikus terhadap Penularan	Tri Wijayanti dan Dewi Marbawati	To measure the success of catching, identify the	Descriptive research	The rat survey was carried out using the	Several factors that influence the breeding of rats are the type of food, the arrangement of goods, temperature and humidity. Rats tend to eat foods that are liked by humans such as carbohydrates, proteins, fats and make nests that are not far from food sources. An irregular arrangement of items will make it easier for mice to make nests. The existence of cats as natural predators of rats has been widely known, such as research in Kulon Progo, people agree

No	Title	Author	Objective	Design	Sampling	Result
	Toksoplasmosis di Kabupaten Banjarnegara (Diversity, Detection and Role of Rats in Toxoplasmosis Transmission in Banjarnegara Regency)		species of rats caught, measure the index of diversity, dominance, analyze toxoplasmosis in rats, density factor and its role in toxoplasmosis transmission in Banjarnegara Regency.		single live trap method in the main market, public hospital and shopping complex, Semampir Village	that the form of controlling rats is by keeping cats on the grounds that they do not kill rats with their own hands directly.
11	Analisis Spasial Kepadatan Tikus di Pasar Simongan dan Pemukiman Sekitarnya Kota Semarang, 2021 (Spatial Analysis of Rat Density in the Simongan Market and Surrounding Settlements in Semarang City, 2021)	Sabrina Daniswara, Martini, dkk.	To assess the density of rats and ectoparasites in Simongan traditional market and settlements around Simongan Market	Analytical descriptive research with cross sectional approach	Rats caught in Simongan traditional market and settlements around Simongan Market	Based on the results of the calculation of the density of rats, Simongan Market and its surrounding settlements are considered not too crowded but still need to be aware of the possibility of spreading infectious diseases by rodents and vectors. Research shows that 2 out of 3 houses for leptospirosis sufferers are located far from Simongan Market, which is a public facility where rats are more likely to be found. Meanwhile, the number of rats found in the settlements around the Simongan market was far less than the houses that were further away from the Simongan market. It is possible that there are other factors that affect the case of Leptospirosis and also the density of the rats.
12	Identifikasi Endoparasit Pada Tikus Di Tiga Area Pemandokan Mahasiswa Perguruan Tinggi Negeri Kota Makassar, 2021 (Identification of Endoparasites in Rats in Three Student Housing Areas of Makassar City State Universities, 2021)	Syamsuar Manyullei, Makmur Selomo, MS, Ardalif Lulhaq Musbir, Mochammad Al Anugerah Agus	Identifying parasites in rats caught in the student housing area of Unhas, UIN, and UNM	Descriptive Observation	Rats were caught in three locations, namely the student housing area of Unhas, UIN, and UNM.	The results of this study are: a. The endoparasites found included 5 <i>T. taeniaeformis</i> , 10 <i>H. diminuta</i> , 10 <i>H. nana</i> , 3 <i>N. brasiliensis</i> and 3 <i>Moniliformis</i> spp. b. The condition of the wall that did not meet the requirements and was positive for rats was 21.7% while those who did not meet the requirements and were negative for rats were 78.3%. c. Environmental conditions, namely the presence of a rat path to the roof and positive rats were 23.3% while those without a path and rat negative were 80.3%. d. Environmental conditions related to piles of goods and positive rats were 21.8% while those without piles of goods were negative for rats was 78.9%



## RESULT AND DISCUSSION

Okky L Indraswari (2018) made observations on 75 houses in the Village of Kembangarum Sumberjo RT 1 and RT 2 with the results of a rat density of 6.67% which indicates that the density of rats in that place is still high (> 5%). The types of rats found included *Rattus tanezumi*, *Rattus Exulans*, *Rattus Norvegicus*, *Bandicota Indica* and *Bandicota Bengalensis*. In this study, the presence of 17.3% of feed and the absence of 2.7% of feed sources explained that the feed source did not affect the density of rats because of the diet and household waste in that place. Household waste, including the state of the house where there was no trash, found 1.3% of rats, while the house with open waste, especially in the house, invited rats to gather to look for food with a total of 18.7%. Another factor is related to biological control where there are cats as predators. There were 4% of rats in the house that had predators, while 16% of those without predators in the house were found. In this study revealed that the factors that affect the density of rats include the condition of the gutter, the presence of garbage and the more dominant is the presence of rat predators in this case the cat.

Sulasmi & Sri Hartuti (2017) divides 2 areas in terms of looking at the level of control of rat density in the research area, namely 1) Perimeter area, namely the entire area within the port including the pier to the Soekarno port fence area, 2) the buffer area is an area outside the port with a radius of 400 m from the harbor fence area. Based on the results of this study, the number of trapped rats was 9 with a density of 1 rat. Where the most caught species were 56% *Mus musculus*, 22% *Rattus novergicus* and 22% *Rattus diardi* in the perimeter area. Meanwhile in the Buffer area where the most caught species were 40% *Rattus Novergicus*, 40% *Mus musculus* and 20% *Rattus diardi*. Factors that influence the presence of rats even though the density level of the rats is still low, namely in the perimeter area of 1 tail and buffer area of 1 tail, it is influenced by community awareness factors as well as factors of humid, dark and poorly maintained area conditions, locations such as storage of containers, toilets and trash bins and there are still piles of used goods that have the potential as breeding places for rats that support the high level of rat density in the perimeter and port buffer areas.

Syamsuar Manyullei, et al (2019), found that the density of rats in the Harbor area was about 4 days and 12 rats were caught. The type of rat caught was the rat species, namely *Rattus Tanezumi* (75.00%), *Rattus Norvegicus* (25.00%). These rats are rats that live in the habitat of houses, yards, warehouses and sewers. The measurement results for the total success trap indicator are 0.03 (3%) while the success trap per day is 0 to 0.1. There were 7 ectoparasites of the flea *Xenopsylla xeopis*, 2 mites, and 1 lice. Meanwhile, in terms of gender, 10 male rats were caught (83.33%) compared to 1 female (8.33%) and 1 juvenile (8.33%). Mice mobility aims to find food, mates and area orientation. The number of male rats caught

indicates that the rat has high mobility. One of the factors that determine the movement and development of rats, among others, is a source of food, water, and hiding places for the rats themselves. Areas or places that ensure the availability of food, water, hiding places that remain throughout the year. The success rate of catching is influenced by several factors, namely good trap quality, proper bait and relatively high density of rats.

Rani, et al (2019) found that the calculation of the success trap inside the orphanage building was 3%, while outside the orphanage it was 5%. A good success trap is inside the house by 7% and outside the house by 2%. 48.49 The success of catching rats inside the orphanage is more outside the orphanage, this can happen because the conditions between outside and inside the orphanage have many differences. The conditions outside the Orphanage are more disorganized, there are many ditches and trash cans, causing the rats to breed faster and more rats to roam. The breeding rat population can be supported by environmental factors and people who do not maintain the cleanliness of the environment around the Orphanage. The existence of rats is not always limited to residential areas, this is because one type of rat can inhabit several kinds of habitats or one type of habitat can be inhabited by several types of rats. The environmental condition of the orphanage which contains a lot of garbage, as well as the environment of the residents who do not keep it clean are the nests most favored by this rat species. They are a type of mouse that carry out their life activities, especially looking for food, shelter, nesting, and breeding in the house. Residents in housing around the orphanage who often throw garbage carelessly are also the cause of this population breeding well because they have nests and food.

Farha Assagaf (2019) conducted a study on the presence of rats in the Gudang Charcoal market with a success trap of 8.33% in the Gudang Charcoal Market. Rat catch 7%, it means that the density of rats in that location is high. The high success trap is related to environmental conditions that are not kept clean. Environmental conditions such as the structure of the stalls that are not close to rats, poorly maintained sanitation, the presence of sewers or rivers that serve as landfills are factors that support the life of rats to nest and breed.

Sri Yuliawati, et al (2019) evaluated the effect of Health Education intervention on rat density. This is certainly interconnected, considering how social behavior can affect the presence of mice. The results show that the density of rats measured before the intervention and after the intervention resulted in a decrease in the density of rats from 7 (8% trap success) to 3 captured mice (3% trap success). The density before the intervention was high and decreased after the intervention. This can show how the presence of rats is influenced by humans themselves in carrying out sanitation efforts and maintaining environmental conditions. Responsibilities



in terms of environmental sanitation such as waste management, the state of standing water around the house is not only the responsibility of the individual but all the local residents. Community service and knowledge are needed in order to know the potential breeding sites for rats so that they can carry out control interventions quickly and accurately.

Yanelza Supranelfi, et al (2019) conducted a study in three districts of South Sumatra, namely Lahat, Banyuasin and Ogan Komering, showing that altitude and temperature have a significant relationship with the presence of rats, especially those that are positive for leptospirosis. The altitude of the place is related to the distribution of the rat species. Leptospirosis positive mice can be found both at altitudes <100 masl and more than 100 masl. Altitudes below 47 meters above sea level have a great potential for flooding, causing puddles of water. Areas with such conditions become obstacles in managing rainwater or household waste water. Unhealthy environmental conditions are also an influence, such as house components that do not meet the requirements can become a nesting place for rats. This also happens because of the absence of proper waste management and the lack of lighting around locations that are densely populated with rats.

Dwi Priyanto, et al (2020) show that there is a domestication of rat species where there is overlapping of habitats in certain types of rats. The survey in Petambakan Village showed different results, 15 *R. tiomanicus* were caught from rice fields and riverbanks where these areas are peridomestic habitats. The two survey results above show that *R. tiomanicus* tends to occupy silvatic habitats, but to meet its food needs this species is also able to adapt in areas closer to humans, namely peridomestic habitats. Under normal circumstances, mice occupy the habitat according to their natural habits. However, the need to obtain food sources makes rats leave their natural habitat for more food sources. The potential for rat domestication is relatively small in *R. exulans* and *R. tiomanicus*, both species are well adapted to food sources derived from human food. *Rattus Norvegicus* has long adapted to food sources and the human environment by making nests in settlements so that this species is classified as a domestic rat.

Rery Afianto, et al (2021) found that the relative density of rats (success trap) in the village of Tandang was 28.1%. The most caught rat species in Tandang Village was *Rattus tanezumi* and the least caught rat species was *Rattus Norvegicus*. 10 male rats (55.6%) were caught more than females. Rats have thigmotaxis properties, which means that mice have the same trajectory from foraging to getting to the nest. Two types of rats and insectivores were found in the village of Tandang, namely *Rattus Norvegicus* and *Rattus tanezumi* because the location of the Kedungmundu market is close to the housing of the residents of the Tandang village. *Rattus tanezumi*'s original habitat is at home because the rat is a

domestic rat whose life activities such as foraging, sheltering, nesting and breeding in the house. Mice can move from one place to another if there is a lack of food.

Tri Wijayanti and Dewi Marbawati (2018) measured the diversity, dominance and presence of rats in Banjarnegara district. The success of catching rats is an illustration of the relative density of the rat population in that location. The success of catching rats >7% indicates a high rat density. High rat population in an area is one of the risk factors for zoonotic disease transmission. The average success rate of catching rats in public places in Banjarnegara Regency is included in the high category. The highest success rate for catching mice in the home market indicates that the relative density of mice in the home market is high. Several factors that influence the breeding of rats are the type of food, the arrangement of goods, temperature and humidity. Rats tend to eat foods that are liked by humans such as carbohydrates, proteins, fats and make nests that are not far from food sources. An irregular arrangement of items will make it easier for mice to make nests. Market conditions with various food commodities such as cereals (rice, corn, soybeans); fish; meat, dark atmosphere, unorganized arrangement of goods and buildings not dense with rats, are very supportive of being a nesting and breeding place for rats. Rodentia are instinctively active at night, although house mice can be active both day and night. Rat control in the market is also not carried out so that the rat population is higher than the hospital and shopping complex in Semampir Village. The existence of cats as natural predators of mice has been widely known.

Sabrina Daniswara, et al (2021) conducted an analysis of the density of rats in the Simongan Market. There were 3 types of mice caught in this study and insectivores, namely *Rattus Norvegicus*, *Rattus tanezumi*, *Mus musculus*, and *Suncus murinus*. The results showed that the most common rat found in Simongan Market was *Rattus Norvegicus* (71.4%), in the settlements around Simongan Market was *Rattus tanezumi* (53.3%). The largest rat found besides *Rattus Norvegicus* was *Rattus tanezumi*. The discovery of this rat in addition to being at home was also found in Simongan Market because the market is close to the surrounding settlements. *Rattus tanezumi* has a natural habitat at home because the rat is a domestic rat. Rats have a clever nature. In addition, the behavior of rats that appear during the day even though there are humans. This condition shows that the level of rat population in the area is high because rats have limited mobility. Rats never pass through open areas especially during the day unless the condition is urgent because the rat instinct is more active at night. Based on observations at the Simongan Market and surrounding settlements, it was seen that rats roamed freely while conducting research during the day. This can be a factor indicating that the density of rats in the Simongan Market and market settlements is high. The market produces a lot of leftover food from sales which can be a source of food for rats, humid market conditions, open

sewers around houses that support rats to carry out their activities.

Syamsuar M., et al (2021) identified parasites in rats caught in three locations, specifically in the boarding house area of Hasanuddin University, Makassar State University and Alauddin State Islamic University Makassar. Each area is divided into several points with 2-3 traps. The results showed that 29 rats were found in the three lodging areas of the Makassar City State University. There were 20 *R. norvegicus* (69.0%), 5 *R. tanezumi* (17.2%), 1 *R. exulans* (3.4%), and 3 *R. argentiventer* (10.3%). The lodging area with the most rats caught was the UIN lodging area, which was 15 individuals. The results obtained showed that from 29 rats, there were 32 endoparasites found in the rat's body. There were five types of endoparasites, including *T. taeniaeformis*, *H. diminuta*, *H. nana*, *N. brasiliensis* and *moniliformis* sp. The highest total endoparasites obtained at UIN were 14 endoparasites, while the lowest was obtained at Unhas, namely 6 endoparasites. The endoparasites at Unhas were dominated by *H. diminuta* and *H. nana*, each representing 33.3% of the total endoparasites in the lodging area. Endoparasites at UIN were dominated by *H. diminuta* with a percentage of 35.7% of the total endoparasites in the lodging area. The endoparasites at UNM were dominated by *H. nana* with a percentage of 33.3% of the total endoparasites in the lodging area. Based on observations, there are several environmental factors that can support the density of rats, including the condition of the walls that do not meet the requirements, the existence of a path to the roof of the cottage that can be passed by rats and the accumulation of goods around the cottage. With environmental conditions like this, of course, it can be a gap for mice to nest or hide.

Rats are animals that are able to filter out inedible foods such as those that can make them choke on food or foreign objects. Mice are very quick to adapt to the surrounding environment. Basically, rats are synonymous with environments with poor sanitation and dirty, shabby, dark and humid surroundings (Syamsuar M., et al. 2022). These animals include nocturnal animals or animals that sleep throughout the day and are active at night. However, because of the demands for more food needs, the rats can carry out their activities during the day even freely. The types of rats are basically different and have their respective habitats, it can be seen in table 2.

**Table 2: Rat Species and Their Habitat.**

Species	Habitat
<i>R. Tiomanicus</i>	Silvatic
<i>R. Argentiventer</i>	Peridomestic
<i>R. Exulans</i>	Silvatic
<i>R. Norvegicus</i>	Domestic
<i>Sundamys Mulleri</i>	Silvatic
<i>Bandicota Indica</i>	Peridomestic

Sumber: BPPK, 2016

Domestic rats carry out life activities (foraging, sheltering, nesting, and breeding) that are highly dependent on human activities. This species is also known as synanthropic or living in human settlements. Types of peridomestic Rat activities are mostly carried out outside the home. Found in agricultural land, plantations, rice fields and house yards, for example the field mouse *R. exulans*, the field mouse *R. argentiventer*, the wirok *Bandicota indica* rat, and the rice field mouse *M. caroli*. Domestic and peridomestic rats are also called commensal rodents (commensal rodents) because of their frequent contact and contact with humans. Sylvatic species (sylvatic species) This type of rat lives far from the human environment, eats wild plants, nests in forests and rarely comes into contact with humans.

**CONCLUSION**

Like other living things, the density of rats is strongly influenced by the environment in which they live. The environment can consist of biotic and abiotic environments and food sources:

1. Biotic environment  
Environmental conditions in the form of shrubs, grass and predators are factors that affect the density of rats. The presence of rat predators can naturally control the population and density of rats. Rat predators in nature are cats, owls, snakes, and some pathogenic bacteria.
2. Abiotic environment  
Rat abiotic environmental factors are physical and chemical environments including temperature, lighting, and the presence of rat nests that affect the rat population in the surrounding environment
3. Availability of food and environment  
The availability of food and drink for rats, both inside and outside the home, greatly affects the life cycle of rats. The availability of food and drink in the surrounding environment affects the number of rat populations. Female rats can repeatedly leave the nest during pregnancy and lactation. This is because the female rat acts as a food seeker while the male rat acts as a guard for the nest or territory from predators

**RECOMMENDATION**

Suggestion to minimize the breeding of rats, a comprehensive control can be done. With this kind of control can involve all aspects that affect the presence or place that is usually occupied by the rat. So far, the control that we are familiar with is control with pesticides which sometimes also creates new problems, namely the occurrence of resistance and poses a potential for human health and threatens other animal species. 3 activities that can be carried out are improving environmental sanitation, physical control (installing traps inside, outside the house and in the fields) and chemical control.

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