Ectoparasites of Wild Rats (*Rattus* spp.) in Banyuwangi: Prevalance, Diversity, and Potential Risks

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ABSTRACT

This study aimed to determine the prevalence of ectoparasite infestation and all types of ectoparasites that infest wild rats (*Rattus* spp.) from three villages in Banyuwangi Subdistrict, namely Lateng Village, Kampung Mandar Village, and Kepatihan Village. A total of 100 wild rats of the species *Rattus norvegicus* and *Rattus tanezumi* were collected from Lateng Village, Kampung Mandar Village, and Kepatihan Village. Samples were anaesthetised based on the standard operational procedure of ethical testing and combed to obtain ectoparasites that predilect on the surface of the rat body. Ectoparasites were identified using the whole mount method natively with 10% KOH fixation, dehydration, and clearing to see the morphology of the ectoparasites.The results showed that the prevalence of ectoparasite infestation was 94% from three villages in Banyuwangi Subdistrict, consisting of 94 fleas, 38 lice, and 1,392 mites. The results of ectoparasite identification obtained five genus namely *Xenopsylla*, *Polyplax, Hoplopleura, Laelaps, Ornithonyssus*. Further research is needed to determine the prevalence of infestation and diversity in wild rats (*Rattus* spp.) in Indonesia.

Keywords: Banyuwangi, ectoparasite, neglacted disease, prevalence, wild rats

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INTRODUCTION

Banyuwangi sub-district has a tropical climate (Wulandari *et al.*, 2023). These circumstances favour the transmission of ectoparasites from wild rats (*Rattus* spp.) (Gunawan *et al.*, 2022). Environmental conditions that support the presence of wild rats with many waterways, slums, and lack of lighting, especially in Lateng Village, Kampung Mandar Village, and Kepatihan Village (Husni *et al.*, 2023) The presence of tourist attractions and traditional markets in the area, makes the presence of food scraps a supporting factor for the reproduction of wild rats. In addition, based on Regent Decree No. 188/482/Kep/429.011/2014, it has been stipulates that Kampung Mandar village, Lateng village, and Kepatihan village are included in slum areas. These villages are located on the coast and generally have poor living conditions and

many sewers, so they are potentially living conditions and many sewers, making them potential breeding grounds for rats (Assagaff, 2019). Habitat close to humans and high population causes rats to become a pest that is detrimental to humans from various aspects of life. Wild rats act as ectoparasitic hosts as well as reservoirs of pathogenic agents (Moravvej *et al.*, 2015; Tijjani *et al.*, 2020). Diseases transmitted by rats are zoonotic diseases that can be transmitted to humans through saliva, urine, faeces and ectoparasite bites. Ectoparasites are a group of insects found in rats that can act as vectors of disease (Priyotomo *et al.*, 2015).

Ectoparasites can be found in domestic and silvatic rodents (Manyullei *et al.*, 2019). In general, ectoparasites can predilect according to the manifestation of parasitism such as on the outer surface of the host's body, skin grooves, and ear areas (Rusman and Ainun, 2021). Ectoparasites have properties that do not settle only in one host, so they can move to other hosts (Mulyono *et al.*, 2017). Ectoparasites in rats include fleas, lice, ticks, mites that can be a source of disease transmission from rats to fellow animals and humans (Annashr *et al.*, 2011). Various types of ectoparasites are known to be vectors of zoonoses that can cause death to humans, for example the Hoplopleura pasifica tick which has the potential to spread Rickettsia disease (Ristiyanto *et al.,* 2014), the Laelaps echidninus has the potential to spread Scrub typhus and Q-Fever (Handayani, 2007), and the *Xenopsylla cheopis* flea has the potential to spread Bubonic Plague, Murine typhus and Trypanosomiasis (Ristiyanto *et al.*, 2014).

METHODS

This study was conducted at the Parasitology Laboratory of FIKKIA Universitas Airlangga in Banyuwangi with the research period in August - December 2023. The samples used were wild rats captured from three villages in Banyuwangi Subdistrict, namely Lateng Village, Kampung Mandar Village, and Kepatihan Village with a sample calculation using the calculating proportion formula. Wild rats were anaesthetised in accordance with the standard operational procedure for ethical testing, then combed to obtain ectoparasites that predilect on the surface of the rat's body. Ectoparasites obtained were then stored in sample pots containing 70% alcohol and identified using the whole mount method natively with 10% KOH fixation, dehydration, and clearing to see the morphology of the ectoparasites.

RESULT AND DISCUSSION

The result of wild rats captured from three village is 100 rats, with prevalence from Lateng Village was 38%, Mandar Village was 56%, and Kepatihan Village was 6%. The most common species of wild rat obtained from the three villages was *R. norvegicus* (63), while *R. tanezumi* (37). The catch of wild rats by species and sex is shown in Table 1.

The prevalence of ectoparasite infestation in wild rats (*Rattus* spp.) from three urban villages in Banyuwangi sub-district out of a total sample of 100 rats was 94.00%, making it a parasite infestation. Not all positive wild rats were infested with all types of ectoparasites, some were infested with only one type. The total number of ectoparasites found in wild rats was 1,524, consisting of 94 *X. cheopis*, 27 *P. spinulosa*, 11 *Hoplopleura* spp., 169 *L. echidninus*, 1218 *L. nuttali*, and 5 *Ornithonyssus* spp that shown in Table

2. Ectoparasites that were successfully identified in this study were 5 genus including *Xenopsylla*, *Polyplax*, *Hoplopleura*, *Laelaps*, and *Ornithonyssus.*

The species of flea found from wild rats was Xenopsylla cheopis with a length of 1,722 µm and a width of 1,459 µm as shown in Figure 1. The examination results showed microscopic morphology with a dark brown body, bilaterally flattened, and wingless. There is an ocular bristle in front of the eye area, and lacks genal combs and pronotol combs. It has three pairs of legs with the hindmost legs being longer than the front two pairs. Posteriorly on the female terminal segment there is a sperm sac called the spermateca, and on the male terminal segment there is a pincer device called the aedeagus (Wells and Elson, 2020).

Table 1. Results of wild rat captured by species and sex from three villages in Banyuwangi

Location	*R. norvegicus*		*R. tanezumi*		Total
	Male	Female	Male	Female	
Lateng	7	21	1	9	38
Kampung Mandar	9	22	14	11	56
Kepatihan	2	2	0	2	6
Total	18	45	15	22	100

Table 2. The prevalence of ectoparasite infestation in wild rats (*Rattus* spp.) from three neighbourhoods in Banyuwangi

Ectoparasite	Rat (n)	Infested Rat (n)	Prevalence (%)	Total Ectoparasite
Lice	100	10	10,00	38
Flea	100	53	53,00	94
Mite	100	84	84,00	1.392
Tick	100	-	-	-
Total	100	94	94,00	1.524

The results of this study found the lice species *Polyplax* spp. as Figure 2 with a length of 1,459 µm and a width of 569 µm which is brownish yellow in colour. It has a pair of antennae on the head with tapered tips. There is a sternal plate on the thorax in the shape of a tapered hexagon resembling a spina on the posterior part. Has three pairs of legs with different sizes for each pair and at the end of each leg there are nails like claws. The abdomen is convex and elongated with seven pairs of paratergal plates that are tapered like spines at the end (Wang et al., 2020).

Hoplopleura spp. found in this study is still in the nimph stage with a length of 646 µm and a width of 569 µm as shown in Figure 3. Head size is wider than long with a square-shaped anterior head shield and smooth edges and antennae. It has three pairs of legs with two pairs of hind legs that are larger than the front pair of legs. There is a pair of setae on the posterior dorsal head and a pair of setae on the dorsal thorax. Large rounded abdomen with a barrel-like shape (Kozina *et al.*, 2021).

Based on the results of this study, the *Laelaps nuttali* mite species was found to be 819 µm long and 461 µm wide with an oval shape as shown in Figure 4. The anal opening is located on the anal plate which has three flanking setae on the right, left, and bottom sides. Anterior to the anal plate is the genital

plate that extends posteriorly to the base of the hindmost leg and there are four pairs of setae surrounding the genital plate. The anal plate is separated from the genital plate and the anterior part is straight with the anterior lateral (Yang *et al.*, 2022).

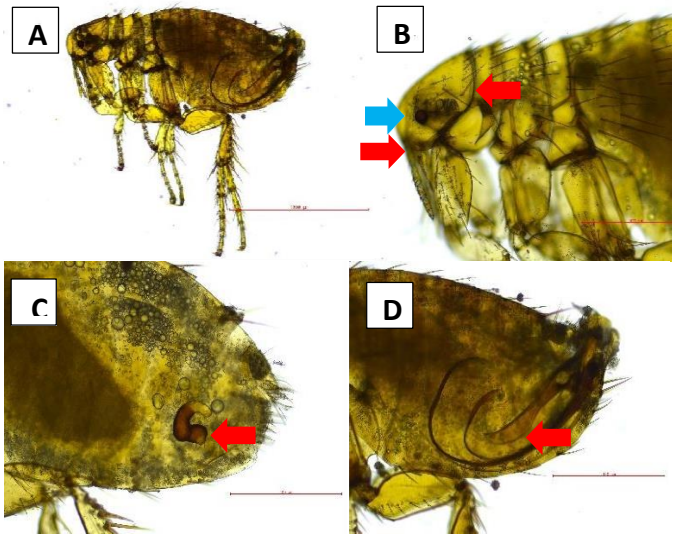

Figure 1. *Xenopsylla cheopis*. A. Lateral view of body (40x magnification), B. No combs (red arrow) and has ocular bristle (blue arrow) (100x magnification), C. Female terminal segment, spermatheca (100x magnification), D. Male terminal segment, aedeagus (100x magnification).

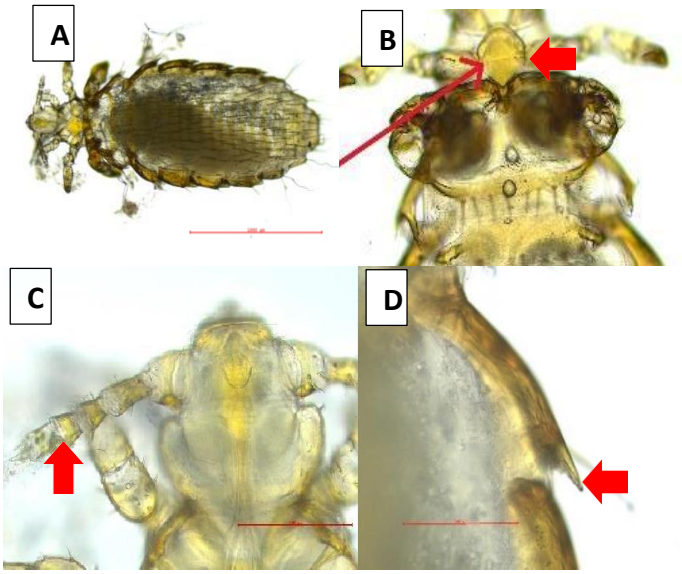

Figure 2. *Polyplax* spp. A. Dorsal view of body (40x magnification), B. Sternal plate (100x magnification), C. Antena (400x magnification), D. Parategral plate (400x magnification).

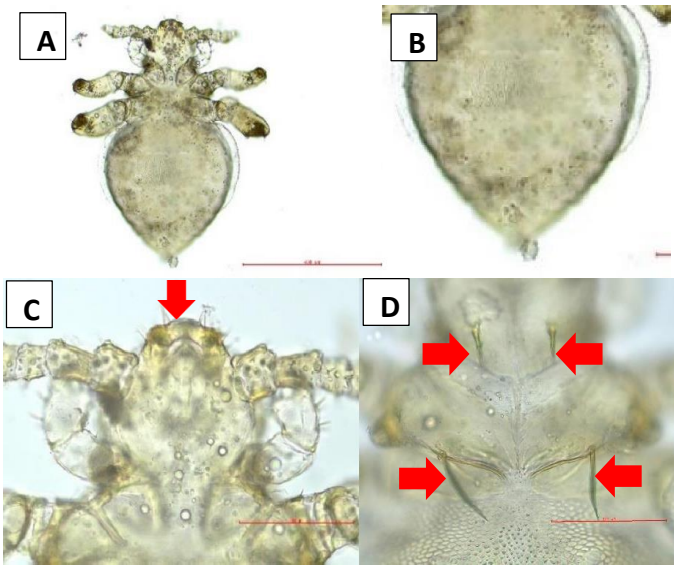

Figure 3. *Hoplopleura* spp. A. Ventral view of body (100x magnification), B. Abdomen (100x magnification), C. Head shield (400x magnification), D. Seta on thorax (400x magnification).

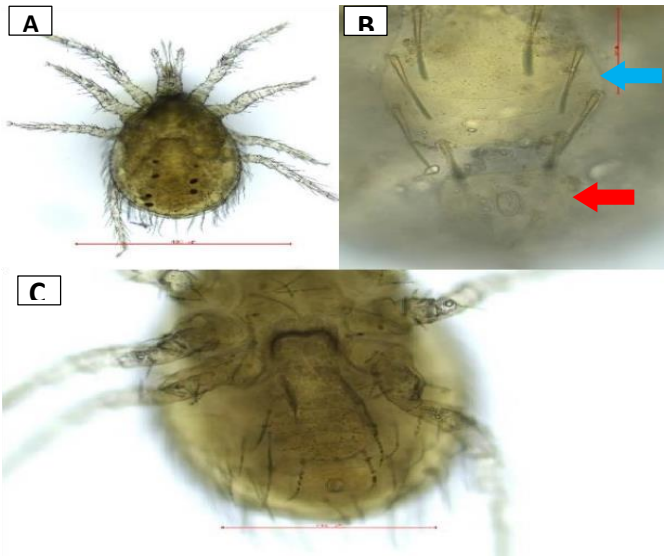

Figure 4. *Laelaps nuttali*. A. Dorsal view of body (100x magnification), B. Genital plate (blue arrow) and anal plate (red arrow) (100x magnification), C. Ventral viewo of body (400x magnification).

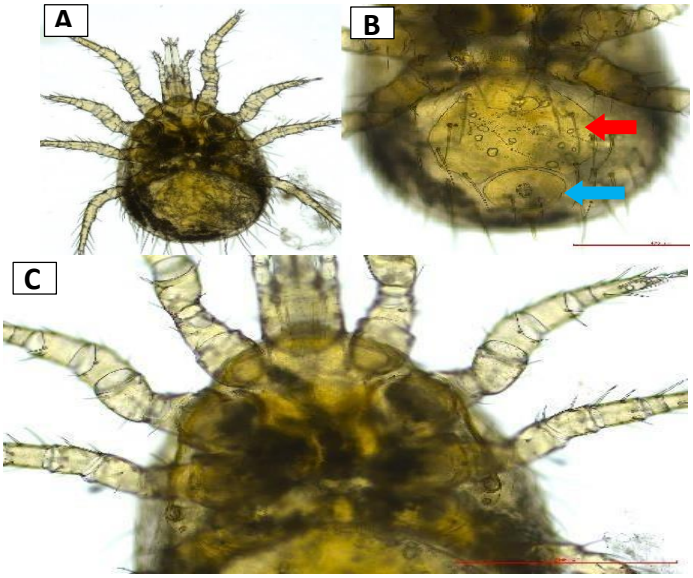

Figure 5. *Laelaps echidninus*. A. Dorsal view of body (100x magnification), B. Genital plate (blue arrow) and anal plate (red arrow) (100x magnification), C. *Spiracel* (400x magnification).

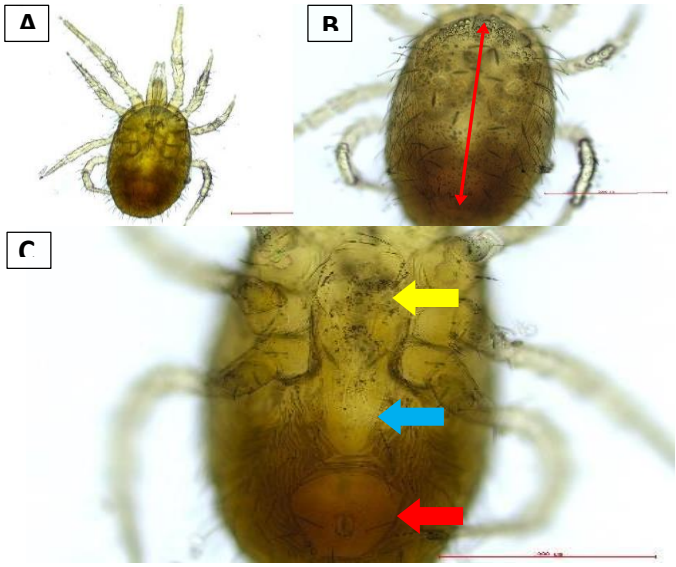

Figure 6. *Ornithonyssus* spp. A. Dorsal view of body (100x magnification), B. Dorsal plate (blue arrow) and anal plate (red arrow) (100x magnification), C. *Sternal plate* (yellow arrow), *genital plate* (blue arrow), *Anal plate* (red arrow) (400x magnification).

Laelaps echidninus mites were also found with a length of 1,490 µm and a width of 779 µm as shown in Figure 5. The morphology of *L. echidninus* is almost the same as *L. nuttali*, but has differences in body size and the shape of the anal plate with the genital plate. *L. echidninus* has an anal plate connected to the genital plate, so that the anterior anal plate is rounded and the posterior genito-ventral plate is concave (Yang *et al.*, 2022).

Ornithonyssus spp. has an oval shape with a length of 1,254 µm and a width of 936 µm as shown in Figure 6. The morphology of the mite is that it has a broad dorsal plate which is increasingly tapered towards the posterior end. The sternal plate is wide, and the genital plate is long and tapered posteriorly. The anus is located in the centre of the anterior anal plate which is in the ventral part of the body (Xu *et al.*, 2023).

Based on the result above there are potential for disease transmission from rats to humans through ectoparasitic vectors to humans through ectoparasitic vectors, there is a need for public awareness related to control of wild rats. Control can be done by providing counseling with related parties about rats and the diseases they can spread as well as controlling rats by paying attention to environmental sanitation (Daniswara *et al.*, 2021), Sanitation and hygiene of the environment by minimizing rat nests such as minimizing rat nests such as bushes, eliminating water sources, cleaning and disposing of garbage in a tight place (Wati and Mitoriana, 2020). Physical rat control needs to support for success in controlling wild rats by installation of rat traps in the pathways that are thought to be often passed by rats (Irawati *et al.*, 2015) Chemical rat control by using poison if physical control does not provide optimal results (Juhairiyah *et al.*, 2021).

CONCLUSION

The prevalence of ectoparasite infestation in wild rats (*Rattus* spp.) from three urban villages in Banyuwangi Subdistrict was 94% or 94 positive rats from a total sample of 100 rats. The types of ectoparasites that infest wild rats (*Rattus* spp.) from three villages in Banyuwangi Subdistrict consist of 5 genus namely *Xenopsylla, Polyplax, Hoplopleura, Laelaps, and Ornithonyssus*.

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Author Contribution

All authors participated to all aspects of this work, including preparation, research, data collecting and analysis, manuscript drafting, and publication approval.

Competing Interest

None.

Ethical Approval

The present study was approved by the Ethics Committee of Faculty of Veterinary Medicine, Gajah Mada University, with reference number 055/EC-FKH/Eks./2023.

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