



FRESHWATER SNAIL AS INTERMEDIATE HOST OF *TREMATODE* IN WATER CHANNELS OF PALANGKA RAYA CITY

KEONG AIR TAWAR SEBAGAI INANG INTERMEDIET *TREMATODA* DI ALIRAN AIR KOTA PALANGKA RAYA

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Abstract

Most of the area of Palangka Raya City consists of peat swamp land that is flooded almost all year round and river flows area. Therefore, there are many species of snails that can be found in rivers and peat swamp water. The existence of snails in peat swamp ecosystems and river flows as an intermediary host for intestinal worms for mammals and humans is essential information for human-environmental health studies. Research on the capability of snails as hosts of *Trematodes* on peat swamp land and river flows in Palangka Raya City has never been done. Research methods include the collection and identification of snail's and identification *Trematode* larvae. We collected 557 snails, and the identification showed the identity of our samples were *Ampullariidae*: *Pila* sp., *Pomacea* sp., *Viviparidea*: *Bellamya* sp., and *Planorbidae*: *Indoplanorbis* sp. *Pila* sp. was 35.90%, the most common snail found at the study site compared to *Pomacea* sp., *Bellamya* sp., and *Indoplanorbis* sp.. The results of this study, snail observations confirmed the presence of *trematode* larvae, namely *cercariae* and *redia*. This study is the first information regarding the presence of *Trematodes* in the snail body at the research area.

Keywords: *Cercariae*, *Host*, *Redia*, *Snail*, *Water Channel*

Abstrak

Sebagian besar area di Kota Palangka Raya merupakan lahan rawa gambut yang tergenang sepanjang tahun dan daerah aliran sungai. Hal ini membuat potensi keragaman keong yang tinggi di kedua area tersebut. Selain itu, informasi mengenai keberadaan keong sebagai inang dari *Trematoda* di daerah lahan rawa gambut dan aliran sungai merupakan hal yang penting dalam studi kesehatan manusia dan lingkungan. Penelitian mengenai potensi keong sebagai inang dari *Trematoda* di lahan gambut dan aliran sungai Kota Palangka Raya belum pernah dilakukan sebelumnya. Metode penelitian meliputi koleksi dan identifikasi dari keong yang ditemukan, serta observasi fase hidup *Trematoda* dalam tubuh keong. Sebanyak 557 keong berhasil dikoleksi pada penelitian ini. Hasil identifikasi keong menunjukkan keberadaan dari *Ampullariidae*: *Pila* sp., *Pomacea* sp., *Viviparidea*; *Bellamya* sp., dan *Planorbidae*: *Indoplanorbis* sp. *Pila* sp. sebesar 35,90% merupakan keong yang paling banyak ditemukan di lokasi penelitian dibandingkan dengan *Pomacea* sp., *Bellamya* sp., dan *Indoplanorbis* sp. Hasil observasi keong mengkonfirmasi keberadaan larva *Trematoda*, yakni *cercariae* dan *redia*. Penelitian ini merupakan informasi pertama mengenai keberadaan *Trematoda* dalam tubuh keong di lokasi penelitian.

Kata kunci: *Aliran air*, *Cercariae*, *Inang*, *Keong*, *Redia*

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INTRODUCTION

Palangka Raya City is located at 113030'–114007' East Longitude and 1035'–2 024' South Latitude (Badan Pusat Statistik, 2018). The city of Palangka Raya consists of five sub-districts, namely Pahandut, Sabangau, Jekan Raya, Bukit Batu, and Rakumpit sub-districts. Most of the land in Palangka Raya City is a water area, and the canals are filled with water throughout the year. Apart from being a source of livelihood, the community uses this waterway for fishing, catching fish, planting kale, defecating, picking fern leaves (local name: kalakai), cutting water grass, and hunting for snails as a food source. There are many species of snails in water channels that can be observed. The presence of snails in water channels is an intermediary host for intestinal helminth on mammals and humans active in waterways.

According to Malatji et al. (2020) family of *Lymnaeidae* snails act as intermediate hosts of *Trematode* in humans and mammals. The species of snails that can be intermediate hosts for *Trematode* include *Brotia* sp., *Bellamya* sp., *Melanoides* sp., *Indoplanorbis* sp., and *Lymnaea* sp. (Chontanarith & Wongsawad, 2013; Jabal et al., 2022). In addition, *Indoplanorbis* sp., *Gyraulus* sp., *Lymnaea* sp., *Bellamya* sp., *Pomacea* sp., *Melanoides* sp., and *Melanoides* sp. as another host for *Trematode* (Annida & Paisal, 2014). Recent works also pointed out that *Lymnaea* sp. and *Biomphalaria* sp. as *Trematode* hosts (Anucherngchai et al., 2016). *Helminth* that can infect snails belongs to the *Trematodes* class. This infection occurs through the medium of water.

According to Luka and Mbaya (2015), about 16 of the 1.700 snails were positive for *cercariae*. Ten of them are *Bulinus* sp with *cercariae*, six of which are species of *Lymnaea natalensis* with *Cercariae* of *Fasciola* sp. (Luka & Mbaya, 2015). *Trematodes* require water in their life cycle and need snails as the first intermediate host (Rondelaud et al., 2014). Humans and livestock can be infected by eating immature aquatic plants, not using hand and foot protection when active in the water and drinking water that contains *metacercariae*. To date, there was no information about the potential of snails as hosts for *Trematodes* in waterways in Palangka Raya City. The current study aimed to provide the initial information regarding the species of snails that can be an intermediate host for *Trematode* and observed larvae of the *Trematode* symbiont in Palangka Raya City.

MATERIALS AND METHODS

This study is a descriptive survey to determine the diversity of snails as *Trematode* hosts and the distribution of *Trematode* larvae in water channels in Palangka Raya City. The stages of this research are snail collection, laboratory examination, identification of snails, identification of *Trematode* larvae, and data analysis. The research was done from July to December 2021. Laboratory investigation was done at the Biomedical Laboratory, Faculty of Medicine University of Palangka Raya, Indonesia.

Data was collected by taking snails found in waterways using simple random sampling. The snail is put in a plastic bag according to the location. Next, determine the coordinates of the location of the snail using GPS. The snails were brought to the laboratory for examination. The snails were measured and identified by comparing the snail morphology. The snails are placed in a petri dish and crushed the snail shells slowly using a mortar. The snails were measured and identified by comparing the snail morphology. The snails are placed in a petri dish and crushed the snail shells slowly using a mortar. Then, drip distilled water on the crushed snail body and observe using a compound microscope for the presence of *Trematode* larvae (*sporocysts*, *redia*, and *cercariae*) in the body of snail. The data were analyzed descriptively about the species and distribution of snails and *Trematode* larvae. Identification of the types of snails and *Trematode* larvae refers to the identification guidelines and existing references (Chontanarith & Wongsawad, 2013; Anucherngchai et al., 2016).

RESULT

Snail collections were found in five locations of water channels across Palangka Raya City (Table 1). The classification of snails found was *Ampullariidae*: *Pila* sp., *Pomacea* sp., *Viviparidea*:

Bellamy sp., *Planorbidae*: *Indoplanorbis* sp. (Figure 1). The number of snails collected was 557 snails. The most common snail species found were *Pila* sp. with 35.90% occurrence frequency compared to *Bellamy* sp. was 30.52%, *Pomacea* sp. was 14.36%, *Indoplanorbis* sp. was 19.21%. Morphologically, *Pila* sp. found in the current study is closely related to *Pila ampullacea*. *Pila ampullacea* has a yellow-brown shell and enlarged underside, measuring 27–56 mm and 24–49 mm wide.

In our study, the morphological characteristics of *Bellamy* sp. were pyramidal in shell shape, shell towers with sticking out type, and rounded bottom of the shell. The color of the shell is brownish-green or yellowish green. The surface of the shell has slightly prominent strokes forming circular lines. At the top, there is a transverse line with the characteristics of a thick protrusion (keel). The periphery is slightly angular or has an obtusive line. In adult snails, the hook is more rounded. Shell was 6–7 cm in size. The thread is relatively deep, and the end of the shell is slightly pointed but is generally eroded. The umbilicus is open, not too wide. The mouth of the shell is rounded, the top is narrowed, and the bottom is rounded. The shell cover is rather complex (horn-shelled), the vortex is somewhat in the middle (subcentral), and the details are like a circular and centralized ring. The shell height was 34–40 mm, the width was 22–26 mm, and the shell mouth height was 16–17 mm. The *Pomacea* sp. has a globose shell with an oval to round aperture. The color of this snail was green to brown with no spiral bands on the shell. The *Indoplanorbis* sp. has an oval to round opening with a thin shell.

Table 1. Location and species of snail in Palangka Raya City

Location	Latitude/longitude	Species
G.Obos 14 (Menteng)	2°14'52.4"S 113°53'14.5"E	<i>Bellamy</i> sp. <i>Pila</i> sp.
Suka Damai (Tanjung Pinang)	2°12'56.2"S 113°56'24.2"E	<i>Bellamy</i> sp. <i>Pomacea</i> sp. <i>Pila</i> sp
B. Koetin (Palangka)	2°12'58.8"S 113°53'41.2"E	<i>Pomacea</i> sp.
G.Obos IX (Menteng)	2°13'45.5"S 113°53'16.2"E	<i>Pila</i> sp
Adonis Samad (Langkai)	2°14'57.9"S 113°55'34.1"E	<i>Pomacea</i> sp.
RTA Milono (Langkai)	2°15'47.4"S 113°55'10.2"E	<i>Pomacea</i> sp.
Mangku Raya (Kereng Bangkirai)	2°17'40.0"S 113°54'15.8"E	<i>Pila</i> sp.
Bukit Tunggal (Tangkiling)	1°58'50.5"S 113°44'50.1"E	<i>Indoplanorbis</i> sp.

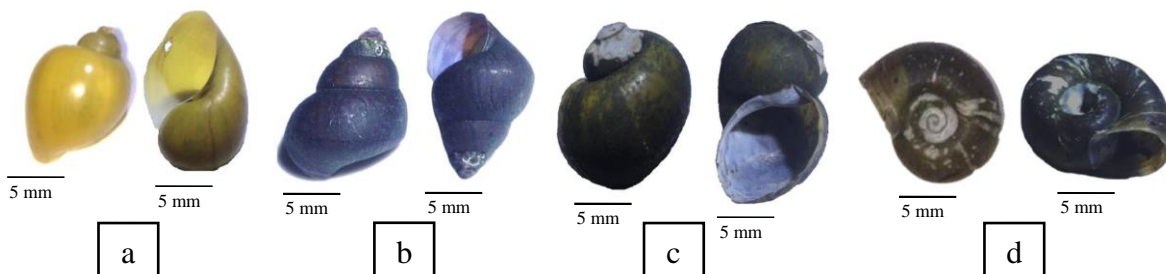


Figure 1. The morphological appearance of snails in the current study. *Pila* sp. (a), *Bellamy* sp. (b), *Pomacea* sp. (c), and *Indoplanorbis* sp. (d)

The habitat of *Pila* sp., *Pomacea* sp., and *Bellamy* sp. was in the swamp area of Menteng and irrigation canals in Tangkiling. The plants around the snail are water grass and water hyacinth. *Indoplanorbis* sp. was only found in the ditch of the Tangkiling with water grass around the Tangkiling water channels (Figure 2). The snail population was different in each habitat.

The investigation of the snail revealed the *Trematode* larvae's occurrence in the snail body, with the type of *redia* and *cercariae* (Figure 3). The number of *redia* found was 15 and *cercariae* was four (Table 2). The life cycle type of *cercariae* in the *Bellamy* sp. and *Pomacea* sp. is

megarulous with the characteristics of this type of elongated *cercariae* characterized by prominent granules.

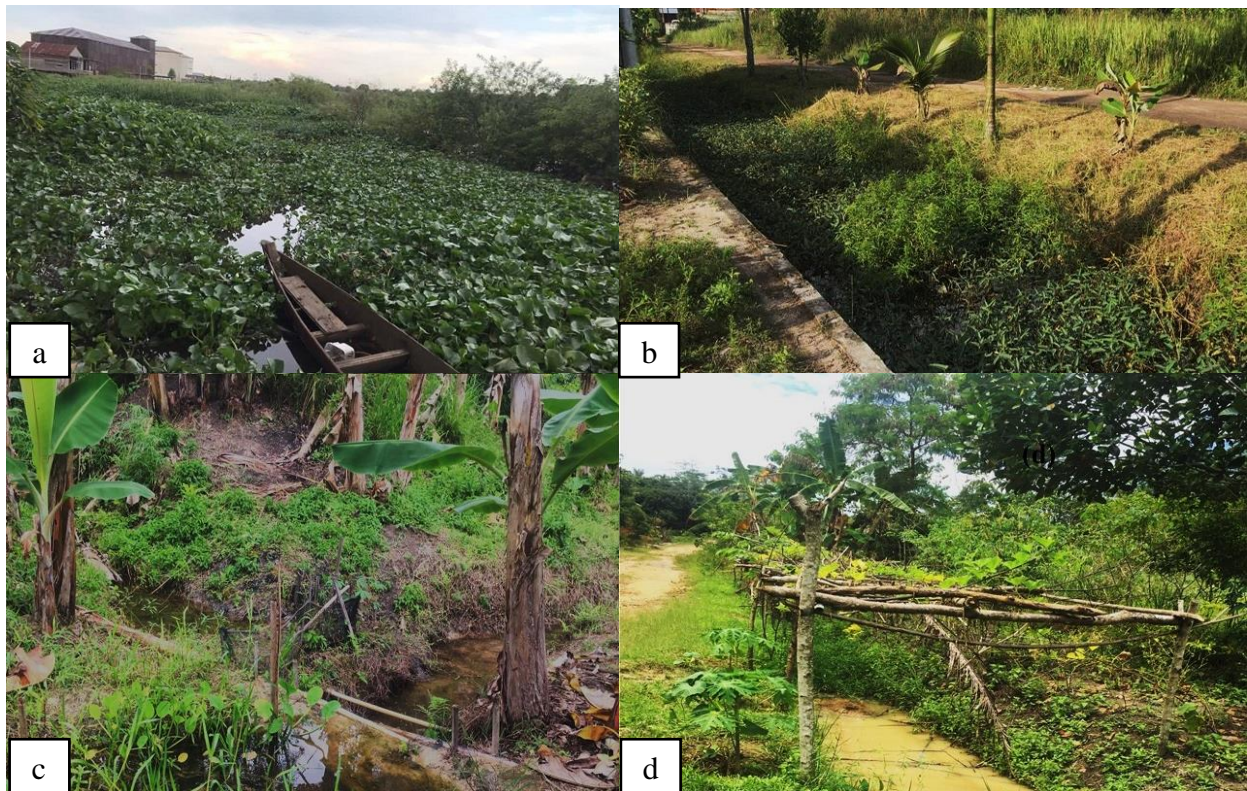


Figure 2. Habitat of snails in research site: (a, b, c) habitat of *Pila* sp., *Pomacea* sp., and *Bellamya* sp., and *Indoplanorbis* sp. (d)

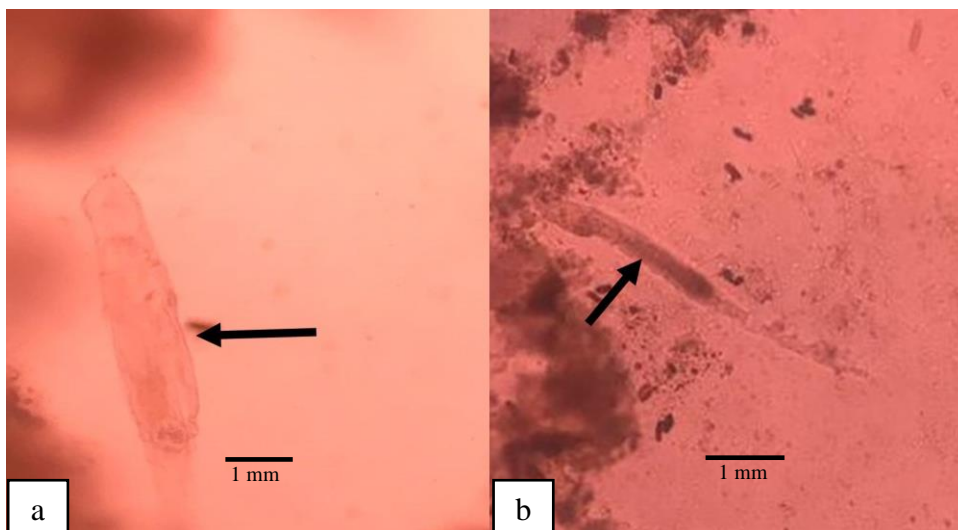


Figure 3. The *Trematode* larvae's *redia* (a) and *cercariae megarulous* (b). The magnification of the microscope 400x

Table 2. The distribution of *redia* and *cercariae* on snails in this study

Snails	(n)	(m ²)	Larvae <i>Trematode</i>		
			<i>Sporocyst</i>	<i>Redia</i>	<i>Cercariae</i>
<i>Bellamya</i> sp.	170	1.5	0	9	2
<i>Pila</i> sp.	200	2.2	0	1	0
<i>Pomacea</i> sp.	80	3.4	0	5	2
<i>Indoplanorbis</i> sp.	107	1.4	0	0	0
Total	557		0	15	4

DISCUSSION

Indonesia is a tropical country with health problems such as parasitic infections that cause helminthiasis. One of the common parasites is *Trematode*. Several diseases are caused by *Trematodes*, such as paragonimiasis, schistosomiasis, fascioliasis, and fasciolopsiasis (Poerwanto et al., 2020). Based on the habitat and definitive host, *Trematodes* parasitic to humans are divided into six groups, namely blood flukes, liver flukes, pancreatic flukes, lung flukes, throat flukes, and intestinal flukes.

The *Trematode* larval stage usually infects the snail's liver (Chen et al., 2013). *Pila* sp. is the most dominant snail in this study and was collected from reservoirs near water hyacinth plants. This finding was contrary to previous reports, which stated that this snail was obtained from the swamps around the residence area (Budiati, 2016; Jabal et al., 2022). *Pila* sp. belongs to the family *Ampullariidae*. Previously, the occurrence of this snail was reported from Makassar (South Sulawesi) and Papuyu River (South Kalimantan). Our specimen was identical to *Pila ampullacea*, which has a yellow-brown shell and enlarged underside, measuring 27–56 mm and 24–49 mm wide (Yendri et al., 2013). *Pilla* sp. can live even in dry habitat conditions for a long time and are usually found in ponds and swamps (Marwoto & Isnainingsih, 2014).

The following snail in our study was *Bellamya* sp. the Habitats of this snail are swamps, ponds, and rice fields (Budiati, 2016). Characteristics this snail has such as a round shell shape and yellow to dark brown. This snail is difficult to control in the environment. This snail has strong adaptability to the habitat environment (Isnainingsih & Marwoto, 2011). We also noted the *Pomacea* sp., collected from rice fields, irrigation canals, and ponds. In line with *Pilla* sp., we also obtained *Pomacea* sp. from the resident's irrigation area.

The genus *Indoplanorbis* is taxonomically derived from the family *Planorbidae*, Order *Basommatophora*, Subclassis *Pulmonata*, Classis *Gastropod*, and Phylum *Mollusca*. and is widely distributed in South Asia and Southeast Asia, from India, Philippines, Japan, Indonesia, Thailand (Anorital & Annida, 2011; Mcdermott et al., 2014). This snail plays a significant role because it has the potential to be an intermediary for intestinal *Trematodes* and cercarial dermatitis. This snail is the first and second intermediate host of *Echinostoma* spp., and these worms can cause intestinal damage in humans, other mammals, and birds. Cercarial dermatitis is itching and rash on the skin due to exposure to *cercariae* from *Trematode* (Anorital & Annida, 2011; Mcdermott et al., 2014).

The current study is the first report of *cercariae* and *redia* in freshwater snails in Palangka Raya. This study found the *cercaria megalourus* type in *Bellamya* sp. and *Pomacea* sp. The characteristic of *megalourus cercaria* is elongated granules along the *Trematode* body. The oral sucker is positioned at the anterior terminal next to the pharynx. A ventral sucker is placed in the middle of the body. A ventral sucker was found in the middle of the body. The bifurcate esophagus was found between the ventral sucker and the pharynx. Prior reports describe that a unique type of this cercarial is the presence of many adhesive gland cells sited at the tip of its tail (Anucherngchai et al., 2016).

Freshwater snails were found from various locations in several areas in Palangka Raya. *Pila* sp. was the most dominant species in various locations in this study. *Pila* sp. is mainly found in Palangka Raya City due to the snail's ability to adapt to the different habitats and the abundance of food sources for this genus in various areas in Palangka Raya City. *Pila* sp. was the most common snail collected in Suka Damai, Tanjung Pinang, compared to other areas. This snail can survive even though the habitat conditions are dry for quite a long time. *Pila* sp. can be found in ponds and swamps (Marwoto & Isnainingsih, 2014). The habitat of *Pila* sp. is in the reservoir, and there are water hyacinth plants and swamps around people's homes (Budiati, 2016; Jabal et al., 2022).

The *redia* and *cercariae* are essential features in the *Trematode* life cycle. The *redia* is elongated and cylindrical, with a pointed anterior end with a blunt posterior end. The oral funnel resembles a sucker, and the pharynx is visible anteriorly. In *redia*, there are several anterior parts, and in the posterior part, there is a locomotor appendage that functions as a foot or a means of supporting *redia* motility (Stunkard, 2014). *Trematodes* have two *redia* development patterns, the

first *redia* are often called mother *redia*, and the second *redia* are called daughter *redia*. The mother *redia* phase contains germ cells and the following *redia* candidates, while the daughter *redia* is *redia* containing the *cercariae* candidates that are ready to be released (Phalee et al., 2015).

Cercariae are equipped with tails for active swimming in search of a definitive host and the next suitable intermediate host. *Cercariae* have a body shape similar to other *cercariae*; therefore, it is recommended to use molecular analysis (Bogitsh et al., 2019). *Cercariae* have two body parts that compose it: the body and tail. *Cercarial* organs include suckers, the digestive tract, and excretory systems. The *cercariae* have specific organs in their bodies. The specialized organs are penetrating glandular cells, cystogenous glands, and mucoid glands. In addition, *cercariae* also have a stylet or spear mouth for penetration. Primordial genitalia in *cercariae* develops into male and female reproductive systems. The organ is located close to the sucker on the ventral sucker (Bogitsh et al., 2019).

In this study, we did not find any *sporocyst* cells in the snail. Generally, the *sporocysts* have a round body shape, while the adult *sporocysts* are elongated like pouches. The edges of the body are plain flat and have no indentations. Mature *sporocysts* resemble *redia* but do not yet have specific internal organs. Inside the adult *sporocyst*, there are granules. Granules are germ cells. Germ cells then develop into gonads *redia*. In general, the young *sporocysts* have a round body shape, while the adult *sporocysts* are elongated like pouches (Phalee et al., 2015).

Indonesia has various diseases caused by *Trematode* infections, such as paragonimiasis, schistosomiasis, fascioliasis, and fasciolopsiasis. It is crucial to disseminate the information about snail-bearing *Trematode* to the Indonesian people. Those mentioned diseases are commonly fostered by people's habits such as consuming freshwater, raw food, field activities, irrigation canals activities, or fishing in freshwaters without wearing boots. The manifestations that arise from infection with *Trematode* are different, depending on the localization of the *Trematode*'s habitat on the body part of the definitive host and the toxins released by the *Trematode*. *Trematode* species such as *Clonorchis* spp., *Opisthorchis* spp., and *Fasciola* spp. are parasites that live in the bile ducts of the liver and will cause jaundice due to inflammation and blockage of the bile ducts it can be accompanied by hepatomegaly (Ghaffar, 2015).

CONCLUSION

The current study is the first information on *cercariae* and *redia* on the snails in Palangka Raya. The result confirmed that there were four snails, namely *Pila* sp., *Pomacea* sp., *Bellamya* sp., in Menteng, Tanjung Pinang, Kereng Bangkirai, Langkai, Tangkiling, and Palangka. *Indoplanorbis* sp. found in Tangkiling. The number of *redia* phases was higher than *cercariae*, and no *sporocyst* was found. In addition, the *cercariae* type was megarulous type which infects *Pomacea* sp., and *Bellamya* sp. Periodical monitoring should be done to collect more ecological and taxonomical information on snails and *Trematode* larva in the future studies.

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