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RESEARCH ARTICLE

Freshwater mollusks and occurrence of *Cercaria lutzi* (Trematoda) in *Pomacea canaliculata* (Gastropoda, Ampullariidae) at Aclimação Park, São Paulo, Brazil

Liliane R. Di Luca[1], Sylvio C. Rocco[1], Leyva Cecília V. de Melo[3], Luiz Fernando M. Gomes[2], Sarah Desirée B. Cavalcanti[2], Alessandro A. Giongola[2] & Dan Jessé G. da Mota[1]*

[1]Laboratório de Identificação e Pesquisa de Fauna Sinantrópica (LABFAUNA) - Divisão de Vigilância de Zoonoses, Secretaria Municipal da Saúde, Prefeitura de São Paulo, SP, Brazil.
[2]Unidade de Vigilância em Saúde Sé, Secretaria Municipal da Saúde, Prefeitura de São Paulo, SP, Brazil.
[3]Núcleo de Enteroparasitas, Centro de Parasitologia e Micologia, Instituto Adolfo Lutz, São Paulo, SP, Brazil.
*Corresponding author: djmota@prefeitura.sp.gov.br

ABSTRACT

This study aimed to characterize the freshwater mollusk assemblage of a lake and investigate the occurrence of helminth larvae, with emphasis on the morphological identification of emergent cercariae. Malacological surveys were conducted at several sampling points along a freshwater lake, totaling 98 limnic mollusks. Specimens were identified taxonomically based on morphological criteria. Parasitological examinations included light exposure to stimulate cercarial release and tissue digestion using a peptic solution following the modified Rugai technique, aiming to detect trematode and nematode larvae. Five mollusk species were recorded: *Pomacea canaliculata* (Lamarck, 1804), *Pseudosuccinea columella* (Say, 1817), *Stenophysa marmorata* (Guilding, 1828), *Melanoides tuberculata* (Müller, 1774), and *Omalonyx convexus* (Martens, 1868). *Pomacea canaliculata* was the most abundant and widely distributed species, absent only at one sampling site. Egg masses of *P. canaliculata* were observed along the entire lake margin, fixed above the waterline on vegetation and artificial substrates. A single specimen of *P. canaliculata* released *Cercaria lutzi* Ruiz, 1943 during two light exposure assays and after peptic digestion. The cercaria was identified as a xiphidiocercaria based on diagnostic morphological features, including a long central stylet, an elongated tail longer than the body, a ventral sucker smaller than the oral sucker, and a Y-shaped excretory vesicle. No larvae of Metastrongylidae were detected. The results confirm *Pomacea canaliculata* as an intermediate host of *Cercaria lutzi* in the studied environment and highlight the importance of integrated malacological and parasitological monitoring in freshwater ecosystems with potential sanitary relevance.

Keywords: Freshwater mollusks; cercariae; trematodes; xiphidiocercaria; intermediate host.

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INTRODUCTION

Urban and peri-urban parks play an essential role as areas for leisure, recreation, and health promotion, providing the population with spaces for social interaction and contact with natural environments. The presence of green areas and water bodies in these locations is associated with physical and psychosocial benefits, such as encouraging physical activity, improving well-being, and reducing stress (Londe & Mendes 2014, Oliveira et al. 2022). However, such environments may also act as favorable scenarios for the maintenance of biological cycles of organisms of sanitary importance, especially when associated with environmental changes, the introduction of exotic species, and the absence of systematic monitoring.

Among organisms of public health relevance, freshwater mollusks stand out, particularly limnic gastropods, which play a fundamental role as intermediate hosts of trematode helminths. Species of the genera *Biomphalaria* Preston, 1910 and *Lymnaea* Lamarck, 1799 are widely recognized for their participation in the transmission cycles of *Schistosoma mansoni* Sambon, 1907 and *Fasciola hepatica* Linnaeus, 1758, the etiological agents of intestinal schistosomiasis and fascioliasis, respectively (Malek 1980, Carvalho et al. 2014). These parasitic diseases are among the most important neglected tropical diseases, presenting high medical and epidemiological relevance, particularly in developing countries.

In Brazil, the distribution of schistosomiasis is strongly associated with the occurrence of vector mollusks in natural and artificial aquatic environments, including ornamental lakes, drainage channels, and water bodies located in recreational areas (Thiengo et al. 2004, Gomes et al. 2024).

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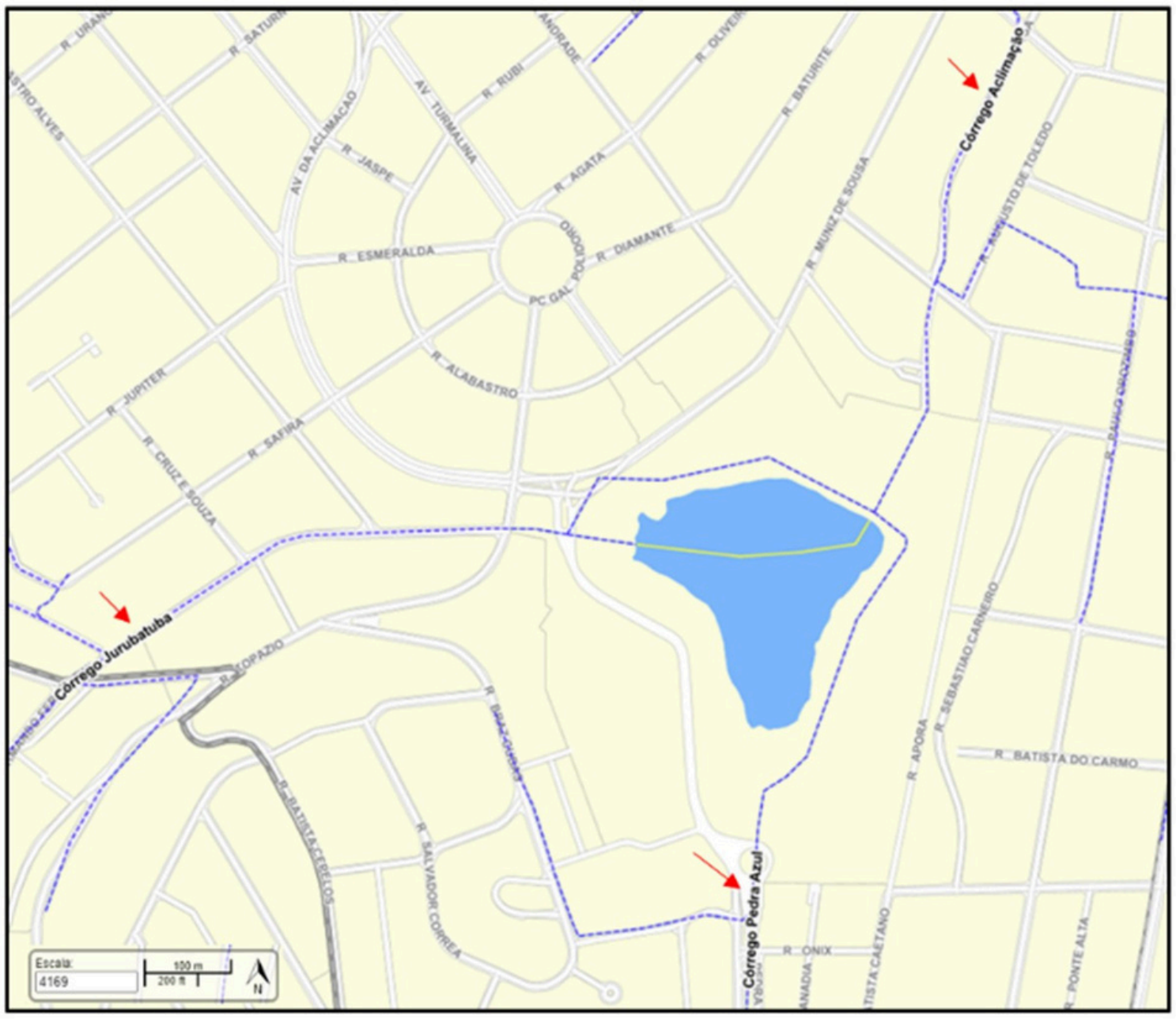

Figure 1. Hydrographic basin of the Aclimação stream. Red arrows indicate the Aclimação, Pedra Azul, and Jurubatuba streams (source: Geosampa, 2024).

The intensification of urbanization and the modification of natural environments favor the colonization of these ecosystems by freshwater mollusk species, thereby increasing the risk of human contact with infective cercariae during recreational activities in urban parks (Moreira et al. 2024).

Therefore, green areas containing water bodies accessible to the public may represent potential foci for the transmission of helminthiases, especially when frequented by vulnerable populations, such as children and park workers. Systematic malacological surveillance, combined with environmental management and health education actions, constitutes an essential strategy for the prevention of these diseases and for ensuring the safe use of parks as leisure environments (Calado & Machado 2012, Coelho et al. 2024).

In this context, studies that assess the composition of limnic malacofauna associated with urban parks and other recreational areas are fundamental for understanding local epidemiological risks.

The identification of the species present, as well as the evaluation of natural infection by helminth larvae, provides essential information to support integrated actions in public health, environmental conservation, and urban planning.

Thus, this study aimed to survey the limnic malacofauna present in the lake of Parque Municipal da Aclimação, São Paulo, SP, Brazil, and to evaluate the natural infection of mollusks by helminth larvae, with emphasis on the detection of cercariae, to assess the potential epidemiological risk associated with this recreational environment, as requested by the Secretaria Municipal do Verde e do Meio Ambiente de São Paulo.

MATERIALS & METHODS

Characteristics of the study area

Parque da Aclimação is a public urban park located in the central region of the city of São Paulo, state of São Paulo (SP), Brazil, in the Aclimação neighborhood, Liberdade administrative district (23°34′29″S, 46°37′44″W; Fig. 1) (PMSP 2024). The park was inaugurated on 16 September 1939 and has an area of 118,787 m^2. It is protected as a historical heritage site by CONDEPHAAT (Conselho de Defesa do Patrimônio Histórico, Artístico e Arquitetônico) and CONPRESP (Conselho Municipal de Preservação do Patrimônio Histórico Central e Ambiental da Cidade de São Paulo).

Figure 2. Map of the lake in Aclimação Park. Arrows indicate the sites where limnic mollusks were collected. (A) Lake margin closest to the lake's spillway. (B) Lake margin adjacent to the island. (C-G) Grassy and easily accessible lake margins often used by park visitors, which become flooded during high-water periods.

The park infrastructure includes facilities in good condition and areas suitable for activities for all age groups. The fauna comprises 111 species, including invertebrates, amphibians, reptiles, fishes, mammals and birds (PMSP 2024).

The flora consists mainly of planted woodlands dominated by eucalyptus (*Eucalyptus* spp.), occupying approximately 65,856 m^2, in addition to landscaped areas with native and exotic plant species, as well as aquatic and palustrine vegetation (PMSP 2024).

The park contains a lake with an area of 33,380 m^2 that supports resident and migratory aquatic bird species, including herons, cormorants, boat-billed herons, common gallinules, white-faced whistling ducks, and white-cheeked pintails. The fish fauna includes tilapias, ornamental carps, and mirror carps. Large portions of the lake margins are covered by aquatic and palustrine vegetation. The lake contributes to the drainage of the Pedra Azul and Jurubatuba stream basins (Fig. 1) and receives stormwater runoff from the surrounding urban area, being susceptible to pollution from clandestine domestic sewage discharges (PMSP 2024).

The Pedra Azul stream is fully canalized, with its source located near Rua Dona Avelina. Its waters flow through underground galleries until reaching Rua Pedra Azul, where a transition structure is located within Parque da Aclimação.

At this point, part of the flow is directed to the park's flotation station, part flows through a gallery bypassing the eastern side of the lake, and the excess discharge flows directly into the lake. The Jurubatuba stream originates near Praça Angel Ramirez and flows through a gallery beneath Armando Ferrentini Avenue until reaching the intersection of Topázio and Pedra Azul streets. From this point, the flow follows a gallery bypassing the western side of the lake, with excess discharge also directed into the lake. The Pedra Azul and Jurubatuba streams form the Aclimação stream basin, which covers an area of approximately 5.0 km^2 and is a tributary of the left bank of the Tamanduateí River, located between the Anhangabaú and Ipiranga basins (PMSP 2023).

Collection, identification, and parasitological examination of mollusks

The survey of limnic gastropods was conducted on 5 June 2024 at multiple sampling points distributed along the lake margins. Sampling locations were selected to cover areas readily accessible to park users and where human contact with the water was most likely to occur, following concerns raised by park managers regarding potential public health risks associated with freshwater mollusks. Therefore, the sampling design was intended to characterize the malacofauna of the lake and assess the occurrence of medically important species, rather than to support statistical comparisons among sampling points. Collections were carried out by technicians from Laboratório de Identificação e Pesquisa de Fauna Sinantrópica (LABFAUNA) and Divisão de Vigilância de Zoonoses (DVZ) with support from Unidade de Vigilância em Saúde Sé (UVIS Sé) (Fig. 2).

Sampling points were selected and characterized as follows:

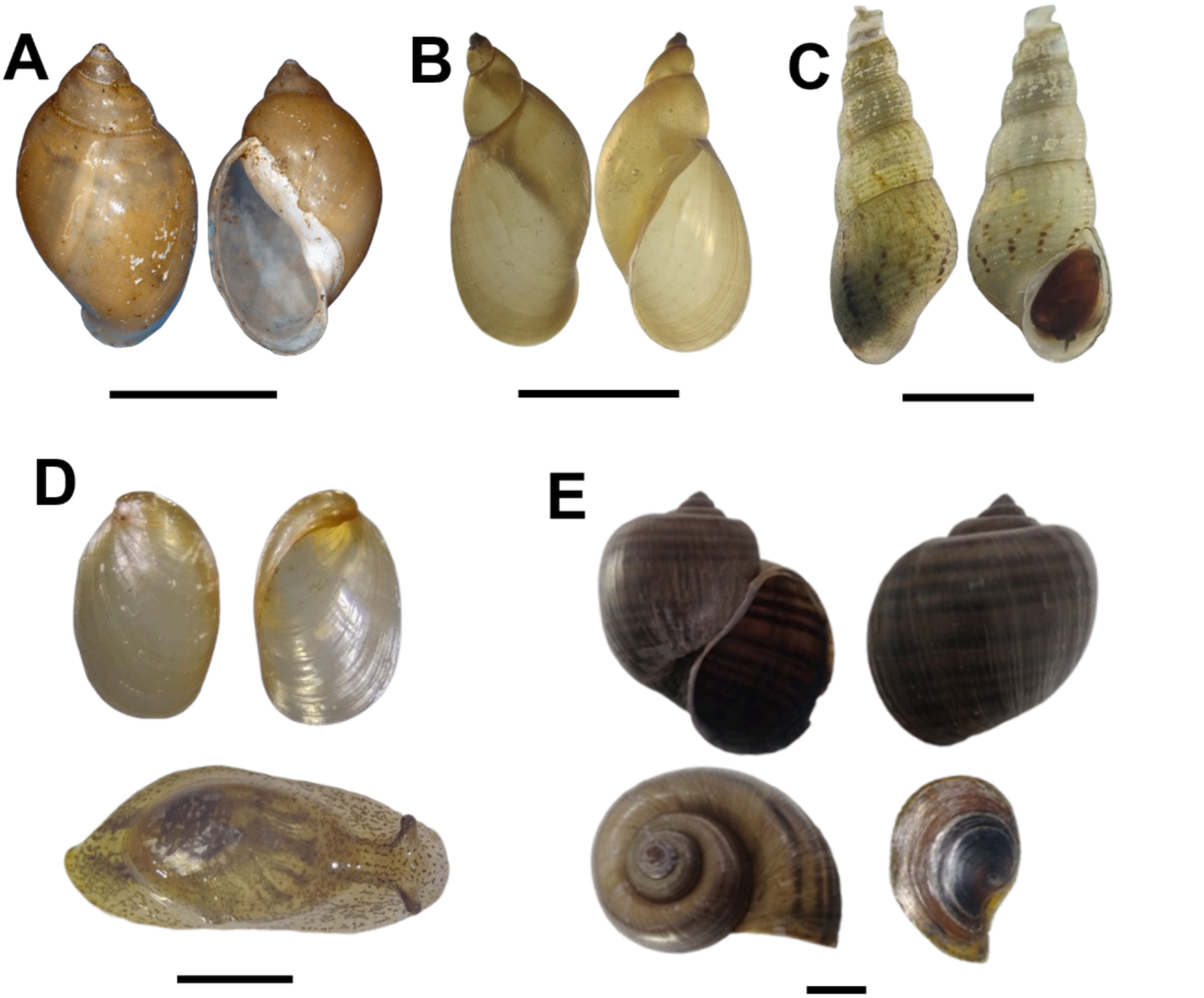

Figure 3. Representative freshwater mollusks collected from lake Aclimação Park, São Paulo, Brazil. (A) *Stenophysa marmorata*. (B) *Pseudosuccinea columella*. (C) *Melanoides tuberculata*. (D) *Omalonyx convexus*. (E) *Pomacea canaliculata*, illustrating shell morphology and operculum. Scale bars = 5 mm.

Point A: Located at 23°34′27.59″S, 46°37′40.84″W. The surveyed area extended from the pier to the region known as the "teiú area," inhabited by reptiles. The site is easily accessible and features introduced trees and shrubs along the lake margin. The lake exhibits dense aquatic and palustrine vegetation, predominantly *Colocasia* sp. (taro), *Salvinia auriculata* Aubl., (Salviniaceae), and grasses (*Brachiaria* sp., Poaceae). Aquatic birds such as the great egret, *Ardea alba* Linnaeus, 1758, and the common gallinule, *Gallinula galeata* (Lichtenstein, 1818), were observed.

Point B: Located at 23°34′29.07″S, 46°37′41.38″W. This point corresponds to the margin closest to the island used by aquatic birds as shelter. Species observed included the cocoi heron, *Ardea cocoi* Linnaeus, 1766, the Neotropic cormorant, *Nannopterum brasilianum* (Gmelin, 1789), the black-crowned night heron, *Nycticorax nyctcorax* (Linnaeus, 1758), and the common gallinule (*G. galeata*). The margin is covered by introduced trees and grasses, while dense stands of *Typha domingensis* Pers., *Eichhornia crassipes* (Mart.) Solms, and *Colocasia* sp. limited mollusk samplings.

Point C: Located at 23°34′30.14″S, 46°37′44.19″W. The external margin is covered by grasses (Poaceae) and is accessible during dry periods when the water level is low. During heavy rainfall, this area becomes flooded. The internal margin is covered by dense aquatic and palustrine vegetation, including *T. domingensis*, *Colocasia* sp., and Poaceae species.

Points D and F: Located respectively at 23°34′29.98″S, 46°37′44.41″W and 23°34′28.70″S, 46°37′45.40″W. Environmental characteristics are similar to those of Point C, with grassy external margins and extensive palustrine vegetation on the internal margins, including Poaceae, *Ludwigia* sp., *Mikania micrantha* Kunth, and *Commelina* sp.

Point E: Located at 23°34′29.88″S, 46°37′45.02″W. A small flooded area near Point D, surrounded by grasses.

Point G: Located at 23°34′26.92″S, 46°37′47.29″W. Situated near concrete channels that discharge stormwater into the lake. The margin has sparse vegetation, with Colocasia sp. clusters at the edges. The water was dark and emitted a strong odor of decomposing organic matter.

Figure 4. Egg clutch of *Pomacea canaliculata* observed in the lake of Aclimação Park, adhered to different surfaces. (A) on grass stems (Poaceae). (B) on a masonry wall. (C, D, E,) on swamp taro (*Colocasia* sp.) stems.

Nile tilapia, *Oreochromis niloticus* (Linnaeus, 1758), the muscovy duck, *Cairina moschata* (Linnaeus, 1758), and the domestic pigeon *Columba livia* Gmelin,1789, were observed.

The collection of limnic gastropods consisted of carefully scraping submerged vegetation, margins, and the lake bottom using a mollusk scooper, following established guidelines (Brasil 2014). Collected material was examined for mollusks, which were manually removed with forceps and placed in plastic containers without water but with moist plant material. Specimens were transported in insulated containers to LABFAUNA, along with a capture form sheet, containing date, place of collection, and identification of the collectors. In the laboratory, gastropods were maintained alive in aquaria with dechlorinated and filtered water and fed fresh lettuce leaves (Mota et al. 2012, Brasil 2014). For species identification, the mollusks were relaxed in an anesthetic solution of menthol crystals for 8 hours and subsequently sacrificed in water at 70°C.

The soft parts were removed from the shells, fixed in Railliet–Henry solution, and dissected according to the methodologies of Deslandes (1951) and Paraense (1966) using a Carl Zeiss CL600 stereomicroscope. Species identification was based on conchological and anatomical characters, including features of the shell, pallial cavity, and reproductive system. Diagnostic characters were analyzed under a stereomicroscope and compared with specialized taxonomic literature for each group (Paraense 1982, 1983, 1986, Facon et al. 2003, Simone 2006, Arruda & Thomé 2008, Coelho et al. 2018, Vidigal et al. 2018).

Specimens of *Pomacea* sp. were identified using an integrative morphological approach, following diagnostic criteria proposed for Neotropical Ampullariidae by Thiengo (1987), Thiengo et al. (1993), Simone (2006), Hayes et al. (2009, 2012a), and Letelier et al. (2016). Identification considered shell morphology and dimensions, operculum morphology, male copulatory anatomy, egg mass morphology, clutch size, and egg size. To complement the identification of *Pomacea canaliculata* (Lamarck, 1804), we

consulted the literature and examined specimens from the Mollusk Collection of the Oswaldo Cruz Institute (Fiocruz/CMIOC). Representative specimens and shells of each species were deposited as voucher material in the synanthropic animal collection of LABFAUNA (voucher numbers 46540-1 to 46540-4).

Live specimens of all collected species were subjected to parasitological techniques for cercarial shedding and nematode larval extraction. Cercarial shedding was investigated using the light exposure technique (Brasil 2014), with each mollusk placed individually in culture plates or beakers containing filtered water and exposed to incandescent light (60 W) for four hours. Two light exposure assays were conducted with a 15-day interval. Water from each container was examined under a stereomicroscope for the presence of trematodes. Recovered cercariae were maintained in aqueous solution and examined alive between slides and coverslips under light microscopy. Identification was based on morphological features as well as swimming and resting behavior (Schell 1970, Naruto 1984). Larvae were examined in vivo and fixed in 5% formalin. Some specimens were stained with Lugol's iodine, 0.05% neutral red, or Nile blue sulfate (Brasil 2014) using a Carl Zeiss Axiolab 5 microscope and an Axiocam 208 color camera. After cercarial shedding evaluation, collected mollusks were subjected to nematode extraction using the modified Rugai technique (Rugai et al. 1954, Mota et al. 2020).

RESULTS

A total of 98 mollusks belonging to five species were collected. *Pomacea canaliculata* accounted for 38.78% of the sample and was recorded at all sampling points except point G. *Pseudosuccinea columella* (Say, 1817) represented 23.47% of the sample and was found at sampling points C and D, followed by *Stenophysa marmorata* (Guilding, 1828), also collected at points C and D, which represented 16.33% of the specimens. *Melanoides tuberculata* (Müller, 1774) accounted for 13.26% of the sample and was collected at point A, while *Omalonyx convexus* (Martens, 1868) was recorded at point F and represented 8.16% of the mollusks collected in the lake (Table 1; Fig. 3). No mollusks were found at point G. Egg masses of *P. canaliculata* were observed throughout the entire length of the lake, primarily attached to stems of taro (*Colocasia* sp.), grasses (Poaceae), and the masonry wall of the spillway. The egg masses were located above the waterline and presented a clustered arrangement, with numerous eggs adhered to one another. Their coloration ranged from bright red to pale pink (Fig. 4). Figure 5 shows the avifauna most frequently observed at the mollusk sampling sites in Aclimação Park lake.

The examined specimens of *P. canaliculata* exhibited globose shells with a low spire, deeply impressed sutures, and a brownish-olive periostracum bearing dark spiral bands. Shell length ranged from 46 to 56 mm. The operculum was corneous, relatively thin, and marked by concentric growth lines. In addition, mating behavior was observed under laboratory conditions, and the male copulatory organ was photographed and examined as an auxiliary diagnostic character before parasitological analyses. Egg masses produced in the laboratory and observed in the field were bright pink, compact, and contained approximately 90 to 120 eggs per clutch. Individual eggs measured approximately 3 mm in diameter. These reproductive characteristics are consistent with the diagnostic features of *P. canaliculata* described by Hayes et al. (2012a), who reported that this species typically produces eggs measuring approximately 3 mm in diameter and relatively small egg clutches. In contrast, *P. maculata* is characterized by smaller eggs (< 2 mm in diameter) and substantially larger egg masses. Taken together, the shell morphology, reproductive traits, and morphology of the male copulatory organ corroborate the identification of the examined specimens as *P. canaliculata*.

During the examination of limnic mollusks, a specimen of *P. canaliculata* released *Cercaria lutzi* Ruiz, 1943 during both light exposure assays and after tissue digestion with a peptic solution using the modified Rugai technique. *C. lutzi* was identified as a xiphidiocercaria based on the following morphological characteristics: a simple, tapered tail longer than the body, containing numerous cells along its entire length; a well-developed oral sucker bearing a long, centrally positioned stylet; a muscular pharynx; an acetabulum (ventral sucker) smaller than the oral sucker; and a Y-shaped excretory vesicle, with lateral branches reaching the acetabular region (Fig. 6). The cercariae exhibited crawling movements and rhythmic vibrations of the body and tail. The body assumed various shapes, becoming wide, elongated, or flattened, while the tail exhibited whip-like movements oriented toward the body (Suppl.1). Parasitological examinations for nematode extraction were negative for larvae of Metastrongylidae in all mollusk species analyzed (Table 1).

DISCUSSION

Urban parks and green areas provide numerous benefits to the population of large cities, with positive impacts on health and well-being (Kuo 2015). However, these environments may expose people to risks of parasitic infections such as neuroangiostrongyliasis, hepatic fascioliasis, schistosomiasis, and other helminthiases transmitted by freshwater mollusks (Carvalho et al. 2014, Coelho et al. 2024).

Freshwater mollusks are fundamental components of continental aquatic ecosystems and present high ecological, sanitary, and epidemiological relevance, mainly because they act as intermediate hosts of helminths of medical and veterinary importance (Lutz 1919, Ruiz 1952, Thiengo et al. 2004).

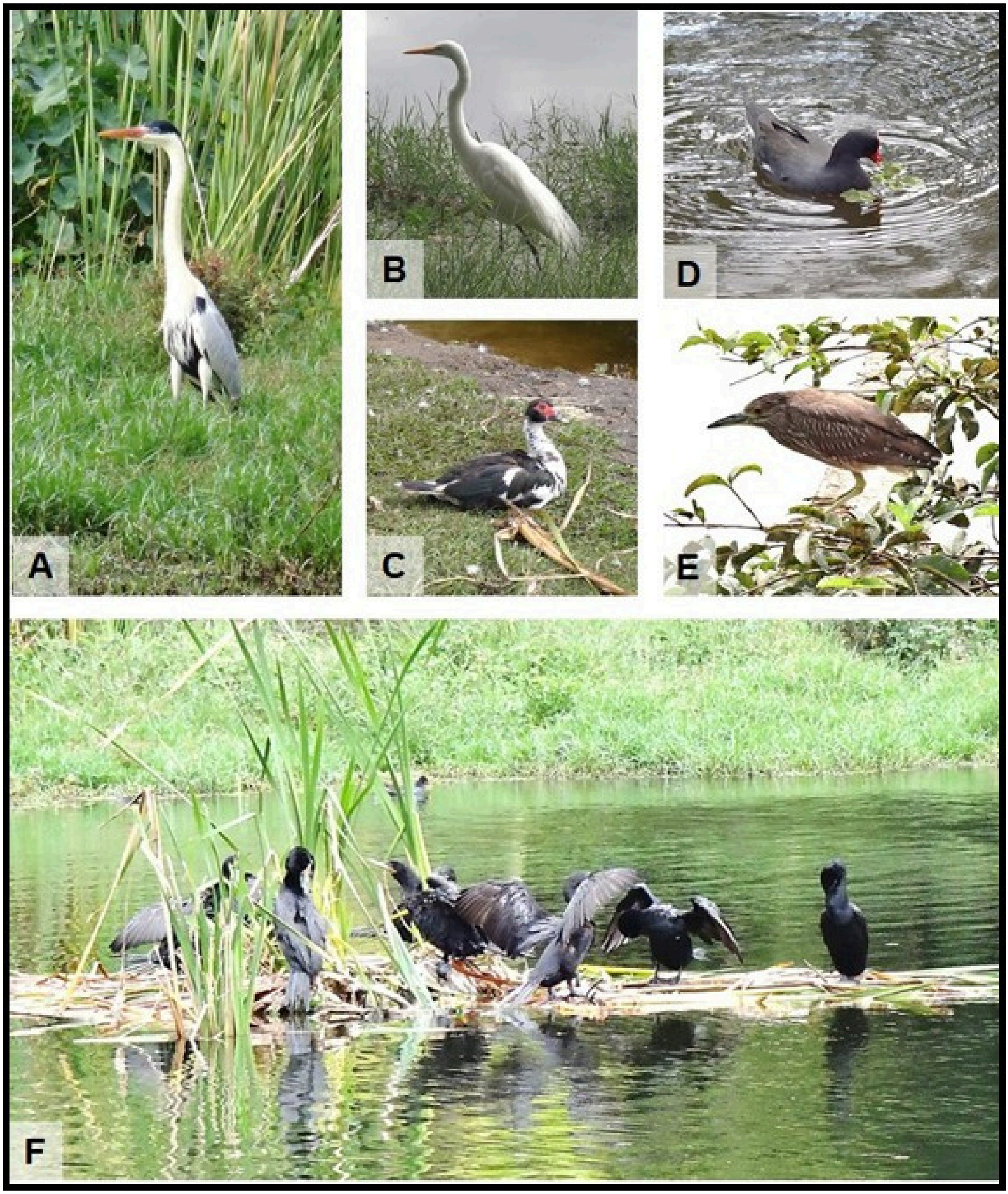

Figure 5. Avifauna observed in relation to freshwater mollusks at the sampling points of Aclimação Park. (A) *Ardea cocoi*. (B) *Ardea alba*. (C) *Cairina moschata*. (D) *Gallinula galeata*. (E) *Nycticorax nycticorax*. (F) *Nannopterum brasilianum*.

The malacological composition recorded in the lake of Parque da Aclimação reflects a recurrent pattern observed in Brazilian urban environments, characterized by the coexistence of native and exotic species well adapted to anthropized water bodies. Among the five mollusk species collected in the lake, *P. canaliculata*, *P. columella*, *S. marmorata*, and *M. tuberculata* are recognized as intermediate hosts of helminths of medical importance.

The dominance of *P. canaliculata* observed in this study corroborates previous records that indicate this species as frequent in urban lentic environments, both in Brazil and in other South American countries (Thiengo et al. 2004, França et al. 2007, Seuffert & Martín 2024). In addition to its high ecological plasticity, *P. canaliculata* exhibits efficient reproductive strategies, such as aerial oviposition on natural and artificial substrates, a behavior widely observed in the present study and previously described in the literature (Hayes et al. 2012b).

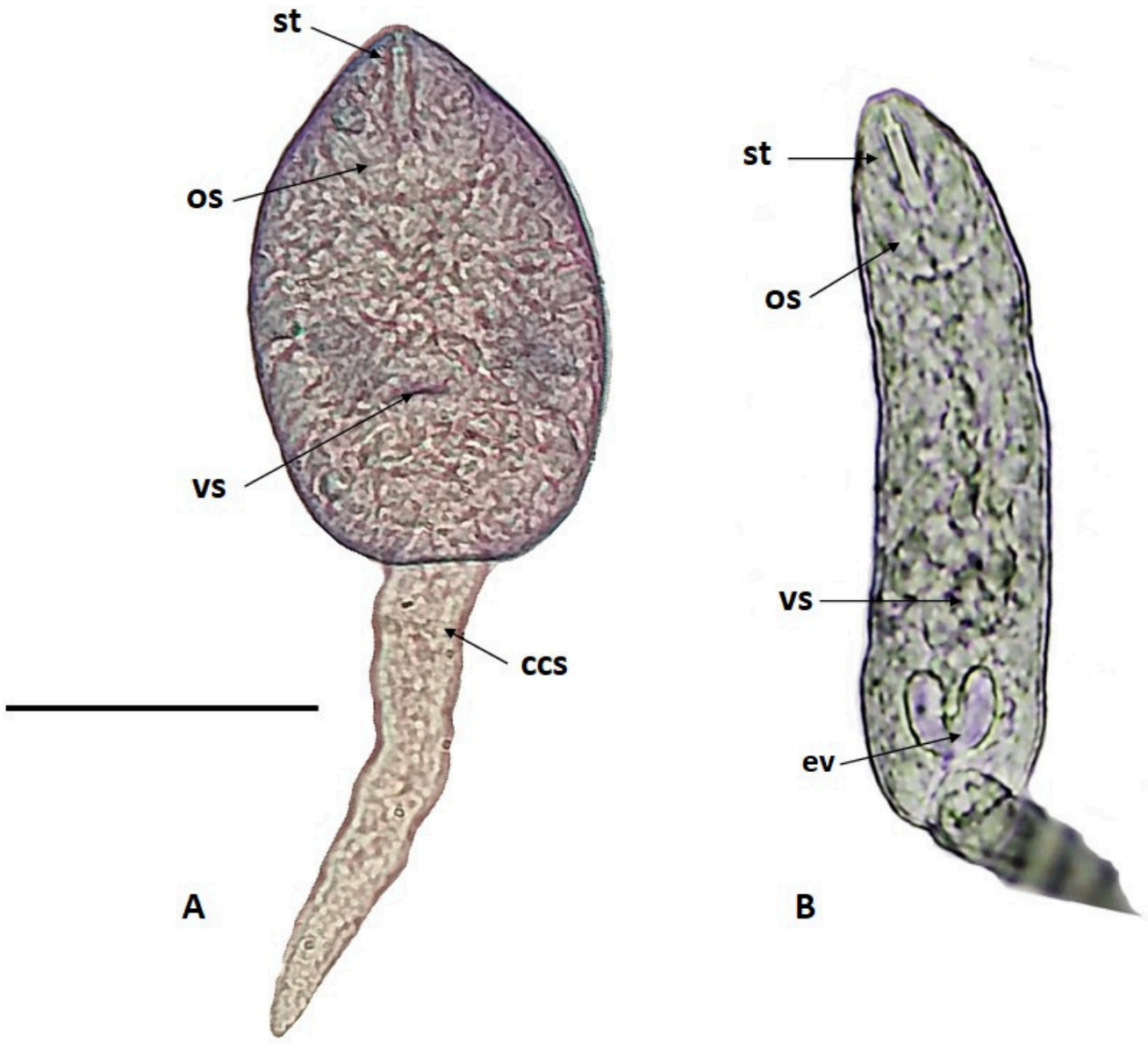

Figure 6. *Cercaria lutzi* obtained from *P. canaliculata*. (A) Fixed specimen stained with Neutral Red, showing the oval body, anterior stylet (st), oral sucker (os), ventral sucker (vs), and cercarial tail stem (ccs). (B) Live specimen in ventral view showing the relative position of the stylet (st), oral sucker (os), ventral sucker (vs), and excretory vesicle (ev). Scale bar = 20 µm.

On a global scale, this species has gained prominence as an invasive species, particularly in Asia, where it is associated with significant economic and ecological impacts (Cowie et al. 2017).

This species is an intermediate host of the helminth *Angiostrongylus cantonensis* Chen (1935), which causes neuroangiostrongyliasis in humans and other animals (Nishimura et al. 1986, Yang et al. 2013, Kim et al. 2014). The disease has an emerging character and is difficult to diagnose, as its symptoms are similar to those of common meningitis. Cases of neuroangiostrongyliasis have been recorded in humans in several countries and in multiple Brazilian states (Melo et al. 2002, Caldeira et al. 2007, Ohlweiler et al. 2010, Thiengo et al. 2010, Andrade et al. 2018, Barbosa et al. 2020). *Pomacea canaliculata* has been found naturally infected with *A. cantonensis* in Thailand, China, and the United States (Hawaii), where human cases have also been reported (Yang et al. 2013, Kim et al. 2014). In Brazil, *Pomacea lineata* (Spix, 1827) in Pernambuco and *Pomacea maculata* G. Perry, 1810 in Rio de Janeiro were found infected with *A. cantonensis* and were associated with cases of neuroangiostrongyliasis (Thiengo et al. 2010).

Pomacea canaliculata may also transmit echinostomiasis to humans, a parasitic disease common in Asian countries, caused by trematodes of the genus *Echinostoma*. Infection is usually asymptomatic; however, high parasite burdens may result in intestinal colic and diarrhea (Graczyk & Fried 1998).

The occurrence of *P. columella* at sampling points C and D is particularly relevant from an epidemiological perspective. This species is recognized as the main intermediate host of *Fasciola hepatica* in Brazil and presents wide distribution in the southern and southeastern regions of the country (Bennema et al. 2014, Carvalho et al. 2014), a trematode that parasitizes the bile ducts of herbivorous animals, dogs, and humans (Ohlweiler et al. 2010, Brasil 2014). Although no trematode larvae were detected in this species in the present study, its presence in an urban environment reinforces the potential establishment of fascioliasis transmission cycles in non rural areas, as demonstrated in other national studies (Medeiros et al. 2014). Human fascioliasis is endemic in regions of Asia, Africa, Europe, and South America (Mas-Coma et al. 2022, Valero & Bargues 2022). In Brazil, 66 cases of human fascioliasis were recorded in 20 municipalities in 10 Brazilian states between the years 1958 and 2022. The cases were distributed in the states of Mato Grosso do Sul (2 cases), Rio Grande do Sul (1 case), Santa Catarina (1 case), Rio de Janeiro (4 cases), Bahia (9 cases), Ceará (1 case), São Paulo (8 cases), Amazonas (19 cases) and Paraná (20 cases) (Maciel et al. 2023).

Table 1. Gastropods collected at various points in Aclimação Park lake were subjected to parasitological tests.

Species	**Gastropods (nº)**			**Collection points**	**Parasitological tests**	
	Live	**Shells**	**TOTAL**		**Cercariae of helminths**	**Metastrongylid larvae**
Pomacea canaliculata	35	3	38	A*,B,C,D,E,F	***Cercaria lutzi****	Negative
Pseudosuccinea columella	22	1	23	C e D	Negative	Negative
Stenophysa marmorata	16	0	16	C e D	Negative	Negative
Melanoides tuberculata	13	0	13	A e B	Negative	Negative
Omalonyx convexus	8	0	8	F	Negative	Negative
TOTAL	**94**	**4**	**98**			

Stenophysa marmorata is also frequently associated with altered environments and has been recorded as a host of different morphological types of cercariae in Brazil, including xiphidiocercariae (Veitenheimer Mendes 1981, Boaventura et al. 2002). The concomitant occurrence of this species with *P. columella* indicates environmental conditions favorable to the development of larval trematodes, even though infections were not detected during the sampling period.

Omalonyx convexus is a terrestrial snail with a reduced, flattened, nail-like shell that can adapt to both preserved and polluted freshwater environments (Arruda & Thomé 2011). There are no records of *Omalonyx* species naturally infected by helminths, except in experimental studies. *Omalonyx matheroni* (Potiez & Michaud, 1838) was experimentally infected with the nematode *Angiostrongylus vasorum*, a parasite of wild and domestic canids, and showed high susceptibility to infection (Mozzer et al. 2011).

The exotic freshwater snail *Melanoides tuberculata* has been widely distributed in Brazil since its introduction in the 1960s, with initial records in São Paulo State followed by rapid dispersal across multiple hydrographic basins (Vaz et al. 1986). Its high reproductive capacity, often through parthenogenesis, combined with remarkable ecological plasticity and tolerance to diverse environmental conditions, has enabled its successful establishment in both lentic and lotic systems, including urban and anthropogenically impacted habitats. Consequently, *M. tuberculata* is currently regarded as one of the most successful invasive freshwater species in the country (Machado et al. 2026).

From an ecological perspective, this species can alter benthic community structure by competing with native mollusks and, in some cases, reducing populations of planorbid snails involved in the transmission of *Schistosoma mansoni* (Thiengo et al. 2004). However, this potential sanitary benefit is outweighed by its role as an intermediate host for a wide range of trematodes of medical and veterinary importance (Bogéa et al. 2005, Pinto & Melo 2011). Thus, its introduction has not only affected biodiversity but has also contributed to the establishment and expansion of new parasitic transmission cycles in freshwater ecosystems.

Among the associated parasites, *Centrocestus formosanus* (Nishigori, 1924) (Heterophyidae) stands out due to its wide distribution and frequent association with *M. tuberculata* (Pinto & Melo 2011, Tolley-Jordan et al. 2022). In Brazil, this snail has been confirmed as its natural first intermediate host, with records from Minas Gerais, the Federal District, Rio de Janeiro, and southern regions (Pinto & Melo 2010, Paula-Andrade et al. 2012, Ximenes et al. 2016; Ciccheto et al. 2021).

The detection of larval stages in snails and metacercariae in fish indicates that the life cycle of this trematode is well established in both natural and urban aquatic systems. In addition to *C. formosanus*, *M. tuberculata* has been reported as a host for other parasites of relevance, including *Clonorchis sinensis* (Looss, 1907), *Paragonimus westermani* Kerbert, 1878, and *A. cantonensis* (Chen, 1935) (Bogéa et al. 2005, Ibrahim 2007), highlighting its role as a suitable component in diverse parasite transmission networks. Although some of these parasites may have medical importance, the ecological role of *M. tuberculata* as a contributor to the maintenance and dispersion of parasite assemblages in freshwater environments appears to be more prominent (Ben-Ami & Heller 2001, Durán-Rodrigues et al. 2024).

Furthermore, infections in fish hosts may impair respiration and survival, potentially influencing community structure and aquaculture systems (Tolley-Jordan et al. 2022). These aspects underscore the importance of monitoring *M. tuberculata* populations, particularly in urban and peri-urban environments, in view of their ecological interactions and contribution to parasite life cycles.

The record of *Cercaria lutzi* Ruiz, 1943 in *Pomacea canaliculata* represents one of the main findings of this study. *Cercaria lutzi*, a xiphidiocercaria, was originally described by Ruiz (1943) from freshwater mollusks in the state of São Paulo and has been sporadically recorded in malacological surveys since then. Classical and contemporary studies indicate that this type of cercaria is common in environments with high vertebrate diversity, especially amphibians and fishes, which act as definitive or paratenic hosts of the associated trematodes (Ruiz 1952, Pinto & Melo 2013).

In Brazil, *C. lutzi* has been reported mainly in *Biomphalaria tenagophila* (d'Orbigny, 1835) and other planorbid gastropods (Machado et al. 1987, Moraes et al. 2009, Ohlweiler et al. 2013), being less frequent in ampullariids. The present record expands the range of hosts associated with this species and reinforces the importance of *P. canaliculata* in the maintenance of parasitic cycles in urban environments. Internationally, similar xiphidiocercariae have been reported in ampullariids and other gastropods in different regions of South America and the Caribbean, although many remain without definitive association with adult forms (Facon et al. 2005, Pinto & Melo 2011).

In addition to *P. canaliculata*, there are records of *Cercaria lutzi* infecting other freshwater gastropods in Brazil, including species of *Biomphalaria* and *Physodine*, albeit sporadically. These infections reflect the low specificity of some xiphidiocercarian trematodes regarding intermediate hosts, a phenomenon discussed in the literature as an adaptive strategy in environments subject to environmental and anthropogenic variation (Thiengo et al. 2004, Moraes et al. 2009).

At the international level, cercariae morphologically similar to *C. lutzi* have been described in species of Ampullariidae and Thiaridae in South America, the Caribbean, and Southeast Asia. (Sanil & Janardanan 2016, Moreira et al.2024, El-Sayed et al. 2025, Martínez et al. 2026). Although not always identified nominally as *C. lutzi*, these larvae share diagnostic characteristics, such as the presence of a stylet, a well-developed oral sucker, and a Y-shaped excretory vesicle, suggesting phylogenetic and functional affinities (Cort et al. 1960, Facon et al. 2005). In environments where *P. canaliculata* has been introduced as an invasive species, such as in Asian countries, evidence suggests that this species may incorporate local trematodes into its life cycles, increasing its importance as a potential intermediate host (Hayes et al. 2012a).

CONCLUSIONS

The malacological survey conducted in the lake of Parque da Aclimação, São Paulo, Brazil, revealed a diverse assemblage of native and exotic freshwater mollusks, highlighting the role of urban environments in maintaining limnic biodiversity. The predominance of *P. canaliculata*, together with other species of epidemiological importance, reinforces the ecological and sanitary relevance of this community.

The detection of *Cercaria lutzi* in *P. canaliculata* expands knowledge of its distribution and host range, demonstrating that urban aquatic systems can sustain complex trematode life cycles. Although not directly harmful to humans, its presence indicates active parasite circulation.

Overall, these findings emphasize the importance of systematic malacological surveillance in urban environments, such as the lake of Parque da Aclimação, for assessing epidemiological risks and supporting environmental health and conservation strategies.

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AUTHORS' CONTRIBUTIONS

LRDL - Conceptualization; methodology; investigation; data curation, formal analysis; writing (original draft; review & editing).
SCR – Conceptualisation; methodology; investigation; data curation, formal analysis; writing (original draft; review & editing).
LCVM – Investigation; data curation; formal analysis; writing (original draft).
LFMG – Investigation; data curation; formal analysis.
SDBC – Investigation; data curation; formal analysis.
AAG – Investigation; data curation; formal analysis.
DJGM – Conceptualization; methodology; investigation; data curation, formal analysis; writing (original draft; review & editing).

CONFLICTS OF INTEREST

None declared.

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