

**PARASITES OF FRESHWATER SNAIL *Pilaovata* (GASTROPODA:
sAMPULLARIDAE) FROM OVIA RIVER AT IGUORIAKHI**

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**A PROJECT SUBMITTED TO THE DEPARTMENT OF ANIMAL AND
ENVIRONMENTAL BIOLOGY, UNIVERSITY OF BENIN.**

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ENVIRONMENTAL BIOLOGY.**

NOVEMBER, 2022

CERTIFICATION

This is to certify that this research project was carried out by Odume Jessica Ndidiamaka with matriculation number LSC1704958 in the Department of Animal and Environmental Biology, Faculty of Life Science, University of Benin, Benin City, Nigeria.

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(HEAD OF DEPARTMENT)

EXTERNAL EXAMINER

DATE

DEDICATION

This project is dedicated to Almighty God for His infinite love, grace, fortitude and mercy throughout my academic pursuit.

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My heartfelt thanks goes to my project supervisor Prof. (Mrs.) A.O. Awharitoma for her professional guide throughout the duration of this project, who in the midst of her tight schedule created enough time to scrutinize this work, made necessary corrections to ensure that the best become the outcome of this work.

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ABSTRACT

The study was carried out to investigate the parasite of the freshwater snail *Pilaovata*. A total of 30 samples were collected from Ovia River at Iguoriakhifor a period of 4 months from October to January. The snails were transported to the Parasitology Laboratory, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria for examination. Of the 30 snail samples collected, 4 were naturally infected giving a prevalence of 13.3% only. The observation in this study is that the parasites found in the snails were the trematode larval stages (sporocysts). A total of 8 parasites (sporocysts) were recovered from 3 specimens of *Pilaovata* which were observed in the month of October 2021 giving a mean intensity of 2.7 ± 1.5 and 3 parasites (sporocysts) were recovered from 1 infected snail giving a mean intensity of 3 ± 0.00 in the month of November. However, no infection was recorded in the months of December and January. The sporocysts were mostly found in the intestine, muscle and mantle regions of *pilaovata*. It can be concluded that *Pilaovata* serves as an intermediate host of this yet to be identified trematode since they harbor the intramolluscan stage (sporocyst) of the parasite. Further studies should be carried out to identify the other stages of this trematode occurring in *Pilaovata* in Nigeria, and to ascertain the possible zoonotic status of the parasite.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF STUDY

Pilaovata is generally recognized to be a freshwater snail commonly known as “Apple snail”. The Apple snail is a species of freshwater snails which possess an operculum. (Shaheen *et al.*, 2020). *Pilaovata* belongs to the kingdom Animalia, phylum Mollusca, class Gastropoda, subclass Caenogastropoda, order Architaenioglossa, superfamily Ampullarioidea, family Ampullariidae, subfamily Ampullariidaenae, genus *Pila*. (Olivier, 1804). There are various species of the genus *Pila*. Seven species of the genus *pila* have been recognized which are *Pilaovata*, *P. specciosa*, *P. wernei*, *P. gradate*, *P. adusta*, *P. accidentalis*, *P. africana*.

However the genus *pila* contain about 30 species found in different parts of the world. (Apple snail website, 2005).

The body of *Pila* is made up of a head, a foot, and a visceral surface. The head and the foot projects out of the mouth of the shell during expansion while the visceral mass is retained in the shell whorls (Shaheen *et al.*, 2020). Most apple snail species possess an oval shell, subglobose or globose conic, while some species like *Marisa cornuarietis* have a rather discoidal shell (flat shell). Apple snails are known to be distributed primarily in humid tropical and subtropical habitats in Africa, South and Central America, and Asia. There are up to seven to ten genera known and, the two largest are *Pila*, with about 30 species (Berthold, 1991) and

Pomacea, with conceivably about 50 real species, although 117 nominally valid species were recognized (Cowie *et al.*, 2003). Snails in these two genera, specifically, are often known as “apple snails” because many species show large, round, often greenish shells. Apple snails are especially well acclimated to tropical regions where periods of drought are interchanged with periods of extreme rainfall. Apple snails possess amphibious qualities, in that they are able to live in both land and water. This is observed in their partly amphibious lifestyle and their anatomy. Apple snails also possess a shell door that allows closing of the shell to prevent desiccation while hibernating in the mud during dry seasons. They have a voracious appetite, reproduce rapidly, are resistant to desiccation during dry periods, and act as vectors of zoonotic diseases, all of which have made them serious agricultural, environmental, and potential human health pests (Apple snail website, 2005).

Several species of aquatic snails have been found to serve as intermediate hosts to many parasites of humans and domestic animals. These parasites include blood fluke (*Schistosoma*), and the liver fluke (*Fasciola*). The larval stages of this parasite which occur in the snail comprise miracidium, sporocyst, redia and cercaria. Digenetic trematodes have a complex life cycle that begins in their first intermediate hosts, such as freshwater snails, which are widespread in water sources in most geographical regions; the larval stages, such as sporocysts, and cercariae, develop within the snails. Therefore, the extent of human infection is primarily related to the rate of exposure to infective larvae. (Epidemiol health, 2019).

*Pilaovata*s of great economic importance and they serve as a source of animal protein to humans wherever they occur worldwide. They are also used as a food source to feed prawns in aquaculture and also used as poultry feed. It serves as a source of animal protein. Due to its increasing demand around the globe, trade in apple snails has evolved into an important component of the International World Trade. Additionally, countries like France and Italy have shown a considerable amount of interest in snail farming over the recent years. Apart from being a food source to many, it also has its unique medicinal values. They serve as medicines in many ailments such as cardiac diseases, rheumatism, blood pressure, asthma, rickets, calcium metabolism, nervousness, and giddiness. Additionally, it is known to possess the medicinal ability to cure skin diseases such as urticaria, commonly known as hives, high body temperatures, constipation and hemorrhoids. The extract from this animal is used in the treatment of osteoporosis, a skeletal disease. (Shaheen Fatima, 2020)

The aim of this study is to investigate the parasite infecting the aquatic snail, *Pilaovata*, and to determine the prevalence and mean intensity of infection of parasites found in the snail.

CHAPTER TWO

2.0

LITERATURE REVIEW

Gastropoda contain more than 65,000 species and dwell in nearly every place on earth. They belong to the largest group within the phylum Mollusca. Terrestrial species of this group can be seen in woodlands, gardens, deserts, or on mountains; while aquatic representatives can dwell in every niche from small ditches to rivers, lakes, estuaries, mudflats, the rocky intertidal, the sandy subtidal, to the depths of the oceans. Due to their high adaptability to diverse ecosystems, gastropods have long been known to serve as ideal hosts for a variety of parasites, often of medical or veterinary significance. Apart from serving as the exclusive intermediate hosts for all known species of the group Trematoda, which contains over 18,000 vertebrate parasites, individuals from this group also serve as hosts for dozens of species of metastrongylid nematodes (Littlewood & Bray, 2000). The documentation of the larval trematode fauna is not only vital for its own sake, but it also provides a more naturalistic understanding of the ecological settings in which schistosomiasis, fascioliasis and other snail borne diseases occur (Locker *et al.* 1981). It is necessary to note that trematodes that are known to infect humans, specially liver fluke and intestinal flukes, are widespread in southeast Asian countries (Wongratanacheewin *et al.* 2001, Chai *et al.* 2005). Most aquatic snails dwell in freshwater and are of great economic benefit to man. They are edible in different parts of Africa and Asia where they play vital roles in the transmission of some trematodes, nematodes and protozoans. They also serve as a source of animal protein (Smyth, 1994).

Several stages of trematode parasites occur in freshwater snails which include the mother and daughter sporocysts, the mother and daughter reidia, the daughter reidia may sometimes give rise to 3rd generation reidia, then the cercariae and metacercariae. These stages are known as the intramolluscan stages in the life cycle of trematode parasites. The sporocyst and the reidia are known to have different forms morphologically. (Bednarz, 1973).

The different forms of Cercariae may include; *Gasterostome*, *Monostome*, *Amphistome*, *Distome*, *Rhopalocercous*, *Cystocercous*, *Gymnocephalous*, *Echinostome*, *Trichocercous*, *Furcocercous*, *Monocercous*, *Xiphidiocercariae*, and Cercariae, (Dawes, 1946). *Gymnocephalous*, *Echinostome*, and *Xiphidiocercariae* are sometimes grouped as *Leptocercous Cercariae*. eCercariae having tails that are straight, slender and narrower than the body. (Ukoli, 1990).

Apple snail refers to a number of species of freshwater snails belonging to the family Ampullariidae (Caenogastropoda) inhabiting tropical and subtropical regions (Hayes *et al.*, 2015). Some species have invaded parts of the world to which they are not native, altering ecosystems and becoming problematic for a range of human activities (Joshi, 2017). Some parasites of aquatic snails common in one geographical area may be rare or totally absent in other areas and infection levels may be caused by several factors, including physical nature of water, the size of host population and susceptibility of host population to infective agents (Brown, 1976). Several investigators have tried to produce infection in experimental animals by feeding them on snails harbouring, the long tailed cercariae, and considered to be the larval form of

lancet fluke, *Dicrocoelium dendriticum* with alleged success (Banker, 1950 and Cameroon, 1981).

Apple snails have been introduced to Africa and Asia to control Snail (*Planorbidae*, *Bulinus* sp. and *Biophalaria* sp.) that serves as intermediate host for trematode parasites, *Schistosoma* sp. These parasites can cause swimmers itch and Schistosomiasis, a disease that affects over 200 million people in tropical regions. One of the species introduced as bio-agent is *Maricuscarnuarietis* (Cowie, 2001).

A mass culture experiment was carried out by (Hodasi, 1972). In this experiment, different batches of 20 *Lymnaea truncatula* snails were exposed to infection with rediae of *Fasciola hepatica*. 18 out of 20 juvenile snails were infected, 10 of 20 adults were infected, and 5 out of 20 adolescent snails were also infected. In some places in China, *Pila* species, which is known to be a daily food of native populations was implicated as the second intermediate host of *Echinostoma angustitestis* and the cause of the parasite infections in humans, during a nationwide survey of parasitic infections between 1989-1992 (Yu *et al.*, 1994). *Pila* species were also found to be the second intermediate host of the trematode *Echinostoma ilocanum* in Luzon, Mindanao, and Leyte in the Philippines. Prevalence of the infection was reported to be 1.44% (Cross *et al.*, 1981). Radomyes *et al.*, (1982) reported also, cases of human infections with *E. ilocanum* in Yunnan, China, the Celebes, Java and Indonesia with *Pila conica* as second intermediate host.

A survey of parasites was carried out on the aquatic snail *Pila ovata* which reported different larval stages (sporocysts, rediae, cercariae) with a very low infection rate of

2.6%. Odubanwo (2004) also carried out a survey on parasites in economically important snails which include *Pilaovata* and found no infection in the snails. The first intermediate hosts of trematodes being the freshwater snails, can result in health hazards in animals and humans. (Epidemiol health, 2019). Apple snail's are vectors of at least three such diseases affecting humans, two caused by trematodes and one caused by a nematode, *Angiostrongylus cantonensis*. Snail-borne parasitic diseases target many organs, such as the liver, lungs, intestines, biliary tract, brain and kidneys, leading to overactive immune responses, cancers, infertility, organ failure, and even death. Developing countries in Africa, Asia and Latin America have the highest incidences of these diseases, while some endemic parasites have developed into worldwide epidemics through the global spread of snails. The intramolluscan development of trematodes starts with the ingestion of the eggs of the parasite or the active penetration by the miracidium. In both processes, the ciliated larva casts off the ciliated epithelium in the body of the snail, transforming into the next stadium mother sporocyst or redia. The remaining larvae can produce daughter stage sporocysts in which tens or even hundreds of thousands of cercariae are eventually formed, successively leaving the snail's body, with the time of release of the cercariae depending not only on the species of parasite but also the health of the host (Wright, 1971). Cercariae depending on the species, changes into the next stage, metacercariae, or penetrate directly into the definitive host. Metacercariae encyst in the outer environment or within the second intermediate host, which can be either vertebrates or invertebrates as well as snails (Furmaga, 1968; Wright, 1971). Cercariae of some species of trematodes can change into metacercariae in the snails in

which they were formed (Styczyńska-Jurewicz 1962) or after penetrating into other individuals of the same or another species, usually situating themselves on the lining of the mantle cavity, pericardial cavity and kidney lumen (Adam *et al.*, 1992). (Skirnisson *et al.*, 2004). Host snails in which cercariae or metacercariae appear are a vital link in the disposal of trematodes in vertebrate populations, including farm animals and humans.

In this study the parasite found in the snails were the trematode larval stages (sporocysts). Snails are primarily the intermediate hosts of trematode infections of man and domestic animals (Smyth, 1994). Previous studies carried out on apple snails showed that *Pila* and *Lanistes* spp have been formerly reported to serve as intermediate hosts in the life cycle of trematodes (Olsen, 1974).

Previous study showed that a total of 1181 freshwater Ampullarid snails (apple snails) comprising 973 *Pila ovata* and 208 *Lanistes varicus* which were examined showed that 90(9.3%) of *Pila ovata* and 23(11.1%) of *Lanistes varicus* were infected with parasitic stage. Infection rates in the snail from various sampling location showed a least value of 1.7% and the highest value of 16.9%. The same types of parasitic stages were isolated from the species of apple snail and they included ciliates, nematode larvae, sporocysts, rediae and cercariae (Awharitoma *et al.*, 2011).

Previous studies on the parasites of apple snails *Pila ovata* was carried out in Benin City, Edo state and several locations in Rivers State. The study reported a total of 3,030 parasites from 6 (six) natural infected snails. 36% of the parasites encountered were cercariae, 10.6% were sporocysts, 0.23% was rediae and 3.3% were ciliates. The

study showed that the digestive gland (hepatopancreas) had the highest infection rate of 54%, with the stomach and intestine having 27.5% and 15% respectively (Ilevbagie, 1999).

Some factors have been found to influence cercariae infection of aquatic snails in previous studies. These factors may include; climate, nutrition and species of snails available which are best found in tropical and subtropical climates (Sorensen *et al.*, 1998).

The most common vector of *Schistosomamansoni* according to Despommier and Karapelous (1987) which occurs throughout tropical, Central and South America is *Biomphalariaglabrata*. Although other vulnerable species of *Biomphalaria* occur in Africa. Most snails of the genus *Onchomelania* were found to serve as intermediate host for *Schistosomajaponicum*; *Bulinus* for *S. haematobium*; *Lymnaea*, *Stoynicola* and *Fassaria* for *Fasciola hepatica*; *Segmentina* for *Fasciolopsisbusky*; *Semisulcospira* for *Paragonimuswestermani*; *Bulinus* for *Opisthorchisviverni* and *Crithidia* and *Pironeda* for *Heterophyes* and *Heterophyes* in Asia and middle east respectively. (Despommier *et al.*, 1987).

Apple snails (Ampullariidae) are intermediate hosts of parasites known to effect at least three diseases in humans: cercarial dermatitis (“swimmer’s itch”) which is caused by trematode cercariae, eosinophilic meningitis caused by the nematode *Angiostrongylus cantonensis* and intestinal problems caused by flukes in the genus *Echinostoma* (Hollingsworth 2006).

Schistosome dermatitis occurs as a result of an individual becoming an accidental host of cercariae of non-human schistosome trematodes. The cercariae enters the skin where they soon die, resulting to a hypersensitive reaction of the skin (Hoeffler, 1974). Leedom & Short (1981) reported dermatitis caused by furcocercous cercariae from *Pomacea paludosa* in Florida (United States). (Joshi *et al.*, 2017). *Angiostrongyliasis* is caused by two species of nematodes of the genus *Angiostrongylus* (*Secernentea*, *Metastrongyloidea*).

Angiostrongylus cantonensis causes eosinophilic meningitis and meningoencephalitis, and the disease is sometimes referred to as neuroangiostrongyliasis, while *A. costaricensis* causes abdominal angiostrongyliasis, a gastrointestinal syndrome (Mehlhorn, 2008, Murphy & Johnson, 2013). Chen in 1935 found *Angiostrongylus cantonensis* in the pulmonary arteries and hearts of domestic rats in China, and therefore became known as the rat lung worm. It is endemic in South Asia, the Pacific islands, Australia and the Caribbean islands (Chen, 1935). *Angiostrongylus cantonensis* life cycle involves rats as definitive hosts, snails and slugs as intermediate hosts, and several other animals, which include crustaceans (prawns and land crabs), land planarians, frogs and monitor lizards, as

paratenic (transfer or transport) hosts (Cowie, 2013). Humans get infected with *A. cantonensis* by consuming raw or undercooked intermediate or paratenic hosts that has the infective third larval stage of the worm, or unintentionally consuming vegetables contaminated with infected snails. When infective larvae are consumed, they enter the intestinal wall and reach the circulatory system, and finally get to the brain where the third stage larvae metamorphosis to a sub-adult stage. These worms eventually are not able to leave the brain and they end up dying. The immune reaction results in inflammation, and the meninges and cerebral vessels are infiltrated with lymphocytes, plasma cells and eosinophils (Wang *et al.*, 2008). Also, physical brain lesions, and even in the spinal cord, are caused especially by the movements of live worms (Chotmongkol & Sawanyawisuth, 2002; Cowie, 2013). The larvae can also migrate to the eyes and result in ocular angiostrongyliasis, which results in visual disturbance (Sawanyawisuth *et al.*, 2006). Several *Pila* species (*P. scutata*, *P. gracilis*, *P. virescens* and *P. ampullacea*) have been found infected with *A. cantonensis* in Malaysia and Thailand (Harinasuta *et al.*, 1965). These species are used as a food resource and thus could result in human infection.

Echinostomiasis a disease caused by infections by flukes of the family *Echinostomatidae* (echinostomes) through ingestion of improperly cooked infected snails and clams orally. Twenty species belonging to eight genera of this family are known to infect humans worldwide (Chai, 2009). The primary clinical symptoms involve diarrhoea, abdominal pain, anaemia and eosinophilia (Joshi, 2017). Several *Pila* species (*P. scutata*, *P. gracilis*, *P. virescens* and *P. ampullacea*) have been found infected with *A. cantonensis* in Malaysia and Thailand (Harinasuta *et al.*, 1965). These

species serve as a source of food and thus could result in human infection. Extensive Epidemiological evidence shows that *P. canaliculata* is becoming the most important natural intermediate host for *A. cantonensis* in mainland China because of its high susceptibility to the parasite and its broad environmental tolerance. Third stage larvae of *A. cantonensis* were originally detected in *P. canaliculata* in China in Wenzhou, Zhejiang province, from examination of 361 individuals of this snail species. The prevalence (proportion of the sample that were infected) was 69.4% and mean intensity (number of larvae per snail) was about 32.6. Subsequently, there have been several other reports from other parts of China. (Yang, 2013).

3.0 MATERIALS AND METHODS

3.1 Study area

Snails were collected from OviaRiver at Iguoriakhi and were taken to the laboratory for examination for parasites.

Ovia River is situated at the OviaNortheast LGA of Edo state, Nigeria. Ovia River takes its source from the Akpata hills in Ekiti state. Iguoriakhi lies between (Latitudes $06^{\circ}23'42.76''$ - $06^{\circ}27'10.15''$ N: Longitude $005^{\circ}25'55.0''$ - $005^{\circ}29'36.20''$ E) and is located about 23.9km from Benin City, off Lagos-Benin Express Road, Nigeria. The main river, the OviaRiver, flows through all the communities in the Local Government. The OviaRiver ranks amongst the largest inland freshwater bodies in Southern Nigeria (Olusegun *et al.*, 2010). The river is economically important in providing water for domestic irrigation, domestic fishing and industrial activities.

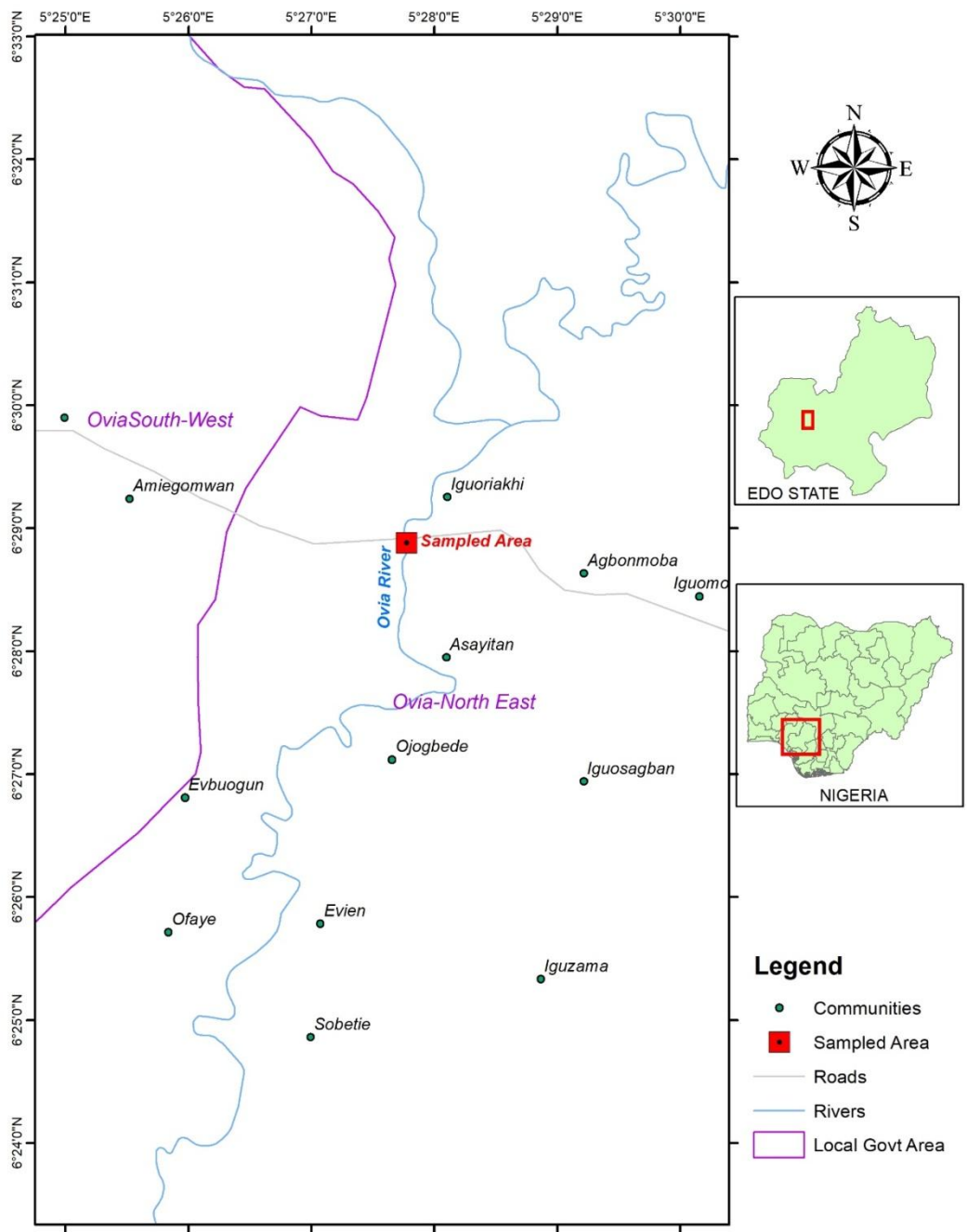


Fig 1: Map of study area

3.2 Materials

Several materials were used to carry out this study. These materials include; dissecting set, petri dish, Pasteur pipette, light microscope, cover slip, preservation bottle, thread, water, masking tape, tissue paper, plastic paper, crushing device, waste paper basket, lab coat, liquid soap, detergent, formalin, ethanol, disposable gloves, touch light, aquatic snails (*Pilaovata*)

3.3 Sample collection

The apple snails used for this study (*Pilaovata*) were collected from Ovia River at Iguoriakhi in Edo state. The snails were collected for a period of 4 months from October to January. A total of about 30 snails (*Pilaovata*) were collected for this work and were collected at different times. Snails were collected during the period of low rainfall and dry season in the month of October to January. Collection of snails (*Pilaovata*) started in October. The snails were purchased from traders who fish regularly at the river. The snails were kept in a plastic basket and were transported to the Parasitology Laboratory, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria.

3.4 Examination of snails for parasites

All collected apple snails were placed on a dissecting surface and were measured one at a time using a thread to measure from the opening of the snail shell up to the tip of the curly whorls of the snail and then placing the thread on a transparent meter rule to take the measurement. The shell of each apple snail was carefully broken and

separated. The cracked snails were placed in a petri dish containing 0.72% normal saline. The muscle, mantle, intestine, reproductive and digestive gland were separated using tweezers, forceps and a dissecting pin.



Plate 1: *Pilaovata*

The snail tissues were teased out to ensure that the parasites were properly separated from their hiding zones. The different petri dishes were viewed under the dissecting microscope.



Plate 2: Petri dishes containing teased out tissues of snails

3.5 Extraction of parasites

Extraction of parasites from the various petri dishes was carried out using pasteur pipette and examined under dissecting microscope. Counting of the parasite was done under the dissecting microscope.

For further examination, the parasite (sporocysts) were collected and washed thoroughly in normal saline. The parasite (sporocysts) were preserved in 10% formalin.

3.6 Identification, photography and measurement of parasites

Parasites were photographed using a camera and measured using a micrometer eyepiece

CHAPTER FOUR

4.0 RESULT

4.1 Parasitic infection in snail

Of the 30 snail samples examined, 4 were infected with parasites, giving a prevalence of 13.3%. The parasites were identified as trematode larval stages known as sporocysts. These were the only parasites observed during the study period.

4.2 Monthly parasite prevalence and mean intensity

Parasites were not observed from the snails in the month of December and January. However sporocysts were recorded in the month of October and November. A total of 8 parasites (sporocysts) were recovered from 3 specimens of *Pilaovata* which were observed in the month of October 2021 giving a prevalence of 27.3% and 3 parasites (sporocysts) were recovered from 1 infected snail giving a prevalence of 14.3% in the month of November. The 4 infected specimens of *P. ovata* were reported from the 30 specimens collected in the month of October to January with a total number of 11 parasites found. The sporocysts were mostly found in the intestine, muscle and mantle regions of *Pilaovata*.

4.3 Description of parasites isolated from snails

The sporocysts observed varied in shape from ovoid to elongate and to tubular shaped specimens having a golden brown colour. The sporocysts are elongated sacs that

produce either more sporocysts or redia.

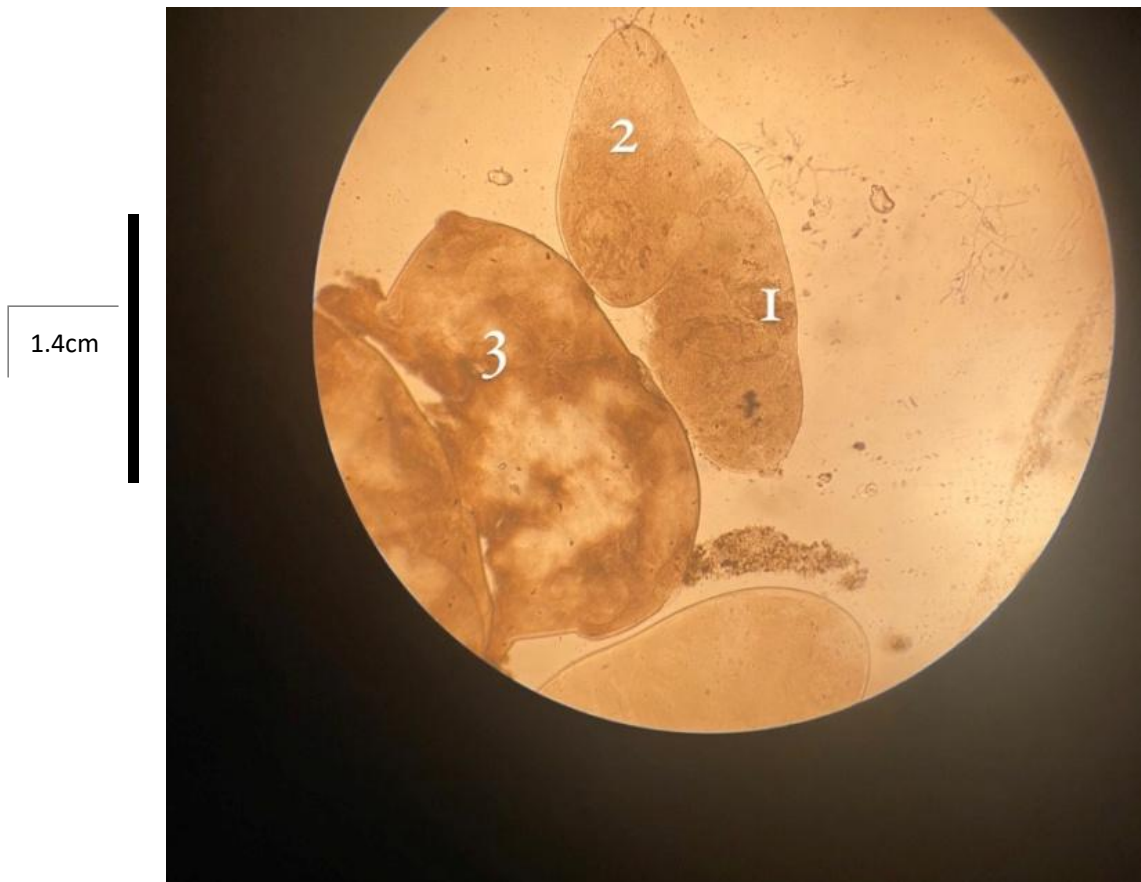


Plate 3:Sporocysts; Scale bar (0.2mm)

MONTHLY PREVALENCE OF PARASITES IN *Pilaovata*

Month	No. of snails Examined	No. of snail infected	Prevalence (%)	No. of parasites recovered	Mean intensity
October	11	3	27.3	8	2.7±1.5
November	7	1	14.3	3	3±0.00
December	4	0	0	0	0
January	8	0	0	0	0

CHAPTER FIVE

5.0

DISCUSSION

The observation in this study reveals that the parasite found in the snails were the trematode larval stages (sporocysts). Snails are primarily the intermediate hosts of trematode infections of man and domestic animals (Smyth, 1994). The apple snails; *Pila* and *Lanistes* spp. have been formerly reported to serve as intermediate hosts in the life cycle of trematodes (Olsen, 1974).

It is worthy of note that *Pila* species are generally recognized to serve as intermediate hosts of *Echinostoma angustitestis* and *E. ilocanum*, which are known to infect humans (Radomyoset *et al.*, 1994; Yu *et al.*, 1994).

A total of 1181 freshwater Ampullarid snails (apple snails) comprising 973 *Pila ovata* and 208 *Lanistes varicus* were examined by Awharitoma and Ehigiator (2011). These snails were collected from fourteen locations in Bayelsa, Edo and Delta states. *Pila ovata* was the more abundant apple snail in the study area. 90 (9.3%) of *Pila ovata* and 23 (11.1%) of *Lanistes varicus* were infected with parasitic stage. Infection rates in the snail from various sampling location showed a least value of 1.7% and the highest value of 16.9%. The same types of parasitic stages were isolated from the species of apple snail and they included ciliates, nematode larvae, sporocysts, rediae and cercariae.

Previous studies on the parasites of apple snails *Pila ovata* was carried out in Benin

City, Edo state and several locations in Rivers State. The study reported a total of 3,030 parasites from 6 (six) natural infected snails. 36% of the parasites encountered were cercariae, 10.6% were sporocysts, 0.23% was rediae and 3.3% were ciliates. The study showed that the digestive gland (hepatopancreas) had the highest infection rate of 54%, with the stomach and intestine having 27.5% and 15% respectively (Ilevbagie, 1999).

Some factors have been found to influence cercariae infection of aquatic snails in previous studies. These factors may include; climate, nutrition and species of snails available which are best found in tropical and subtropical climates (Sorensen *et al.*, 1998).

Irorere (2007) recorded a high infection rate of 32.5% and isolated nematode larvae and trematode larvae (sporocysts and xiphidiocercariae). These differences recorded in the various studies could be due to differences in geographical locations and season of study. The study by Irorere (2007) was carried out in the months of October 2006, February to March and July to August 2007. It was also observed that the prevalence of infection in these snails was in the dry season which was previously observed in other studies (Locker *et al.*, 1981; Chingwena *et al.*, 2002). The dry season period must have contributed to high infection rate recorded by Irorere (2007) because this is the period when mature parasitic stages are produced in the snail intermediate hosts from parasites recruited during the rainy season. Increase in infection during the dry season could be attributed to reduced water volume in the

habitat, which in turn lead to increased frequency of contact between parasite and snail intermediate hosts.

It is also worthy of note that in previous studies of other researchers, parasites such as trematode larvae were reported. 11.8% infection rate was recorded in *Pilaovata* and isolated trematode larvae and amphistome cercariae). (Avbara, 2002). such as sporocysts, redia and cercariae. (Igwe, 2005). Infection rate was recorded at a minimum rate of 2.6% in *Pilaovata*, isolated sporocysts, rediae, and two types of cercariae (xipidiocercariae).

5.1 CONCLUSION

It can be concluded that *Pilaovata* serves as an intermediate host of a yet to be identified trematode as they harbor the intramolluscanstage (sporocysts) of this parasite. Further studies should be carried out to identify the other stages of this trematode occurring in *Pila* species in Nigeria as well as the adult stage of this parasite. The zoonotic status of the parasite should also be ascertained.

REFERENCES

- Adam, M.E., Lewis, J.W., (1992) sites of encystment by the metacercariae of *Echinoparyphium recurvatum* in *Lymnaea peregra*. 66: 96-99
- Archatinalimicolaria and Pila species. Dissertation for B.Sc. (zoology), University of Benin, Benin City, Nigeria.
- Avbara, E. (2002). A survey of parasites of aquatic snails *Pila* spp. Dissertation for B. Sc. (zoology) University of Benin, Benin City, Nigeria.
- Awharitoma, A.O. and Ehigiator, F.A. (2011). Parasitic infection in the freshwater snail, *Pila ovata* and *Lanistes varicus*. Nigeria Society for Experimental Biology Journal, 12:15-21.
- Bednarz, S. (1973). The development cycle of the germ cells in several representatives of trematoda (Digenea). Zoological Poloniae. 23:279-326.
- Berthold, T. 1991. Vergleichende Anatomie, phylogenie and historishe Biogeographic der Ampullariidae (Mollusca, Gastropoda). Abhandlungen des Naturwissenschaftlichenvereins in Hamburg (NF) 29: 1-256.
- Cowie, R.H., and S.C. Thiengo. 2003. The apple snails of Americas (Mollusca: Gastropoda: Ampullariidae: *Asolene*, *Felipponea*, *Marisa*, *Pomacea*, *Pomella*): A nomenclatural and type catalog. Malacologia 45: 41-100.
- Cowie, R. H., (2013). Pathways for transmission of angiostrongyliasis and the risk of disease associated with them. Hawaii Journal of Medicine and public health 72 (6) supplement 2:6-9
- Chotomongkol, V. and Sawanyawisuth, K. (2002). Clinical manifestations and outcome of patients with severe eosinophilic meningoencephalitis presumable caused by *Angiostrongylus cantonensis*. Southeast Asian Journal of Tropical Medicine and Public Health 33: 231-34.
- Cristina, D., Francisco, B., and Lisandro, N., (2017). Symbionts and diseases associated with invasive apple snails. Philippine Rice Research Institute

Science City of Munoz, Nueva Ecija Philippines.

- Dawes, B. (1946). *The Trematoda*. Cambridge University Press, Cambridge. 644pp.
- Dodangeh, S., Ahmad, D., Mehdi, S., Shirzad, G., Elham, K., Mahmood, M., and Shahabeddin, S., (2019) *Epidemiol Health*.
- Hayes, K. A., Burks, R. L., Castro- Vazquez, A., and Darby, P.C., (2015). Insights from an integrated view of the biology of apple snails (Caenogastropoda, Ampullariidae) *Malacologia* 58: 245-302.
- Hollingsworth, R. G., (2006). Apple snails as disease vectors. Food and Agricultural Organization of the United Nations. 121-132.
- Hoeffler, D.F (1974). Cercarial dermatitis, its etiology, epidemiology and clinical aspects. *Archives of Environmental Health* 29 (4): 225-229.
- Ilevbagie, E.D. (1999). Parasites aquatic snails Lansites and *Pila* species. Dissertation for B.Sc (zoology), University of Benin, Benin City, Nigeria.
- Irorere, N.J. (2007). Parasites of *Pilaovata* snail. Dissertation for B.Sc. (zoology). University of Benin, Benin City, Nigeria.
- Igwe, N.J. (2005). Studies on the trematode larval stages in the freshwater snail *Pilaovata*. Dissertation for B.Sc. (zoology), University of Benin, Benin City, Nigeria.
- Joshi, R.C., Cowie, R.H., and Sebastian L.S., (2017). Biology and management of invasive apple snails. Philippine Rice Research Institute Science City of Munoz, Nueva Ecija Philippines. 3119.406pp
- Konecny, (2022). Snails as intermediate hosts for parasitic infections. Host – parasite relationships and intervention strategie. Department of Biosciences UCL, London. 10-14.
- Leedom, W.S., and Short, R.B., (1981). Cercariapomacaesp.n.Dermatitis – producing Schistosomercercaria from *Pomaceapaludosa*, the florida apple snail. *Journal of parasitology* 67(2): 257 – 261.
- Mehlhorn, H. (2008). *Encyclopedia of Parasitology*, Third Edition. Springer, Berlin, Heidelberg, New York.
- Olsen, W.O. (1974). *Animal parasites. Their life cycle and ecology*. 3rd Edition

University Park Press Baltimore USA 562pp.

- Odubanwo, O.O., (2004). A survey of parasite in economically important snails:
- Radomyos, S., Radomyos, B., and Tungtrongchita, A. (1994). Multiinfection with Helminthes in adults from Northeast Thailand as determined by post treatment faecal examination of adult worms. *Trop. Med. Parasitol.* 45(2):133-135.
- Robert, H. C., Kenneth, A.H., and Silvana C.T (2006). What are apple snails? Confused taxonomy and some preliminary resolution. *Global advances in ecology and management of golden apple snails.* Philippine Rice Research institute Science of Munoz, Nueva Ecija, Philippines.
- Stijin G. (1997). Apple snails' website.
- Skirnisson, K. Galaktionov, K.V, and Kozminsky, E.V. (2004). Factors influencing the distribution of digenetic trematode infections in a mudsnail (*Hydrobia ventrosa*) Population inhabiting salt marsh ponds in Iceland. 90:50-59.
- Styczynska, J.E., (1962). The life cycle of *Plagiorchiselegans* (Rud; 1802) and the revision of the genus *Plagiorchisluche*, (1889). *Acta Parasitol Pol* 10:419-445.
- Shaheen, F. Amritha, N. (2020). *Pilaglobosa* – Type study.
- Sorensen, R.E. and Minchella, D.J (1998). Parasite influences on host life history: *Echinostomarevolutum* parasitism of *Lymnanaeaelodes* snails. *Oecologia*, 115:188-195.
- Symth, J.D. (1994). *Animal Parasitology* 3rd edition, Cambridge University Press. Cambridge, 549p.
- Wright, C.A., (1971). *Flukes and Snails.* 168.
- Yang, Y.X., Hu YC., Li XH. (2013). Historical invasion, expansion process and harm investigation of *Pomaceacaniculata* in China. *Chin AgrSci Bull* (2010). 26(5):245-250.
- Zbikowska, E., and Cichy, A., (2009). One hundred years of research on the natural infection of freshwater snails by trematode larvae in Europe. Department of invertebrate zoology, Institute of General and Molecular Biology, Nicholas Copernicus University, Torun, Poland. 105 (2): 301-11

