Identification, Distribution and Abundance of Fresh-water Snails in Southwest Taiz Governorate: Wadii AL-Dhabab and Wadii AL-Barakani

Thekriyaat Mohammed Ali Alghunam*, Mohammed Abdo Al_Taj
Department of Biology, College of Applied Science, Taiz University, Taiz, Yemen
*thekriyaat@gmail.com

Abstract— Gastropoda (freshwater snails) play an essential role in public and veterinary health, and thus it is crucial to continuously investigate their distribution. This study aims to determine the distribution and abundance of freshwater snails in Southwest Taiz governorate, Yemen. Two different sites were selected, namely, Wadii AL- Dabab and Wadii AL- Barakani, where snails were collected on a monthly basis starting from February till October 2020. The collected snails were identified according to morphological characteristics using a standard identification guide. The study shows that a number of 3258 snails with an overall prevalence of snail's species was 3093 (99%) for *Biomphalaria arabica*,160 (7.20%) for *Bulinus beccarii*, and 5 (0.09%) for *Melanoides tuberculata*.

Index Terms— Freshwater snails, Gastropoda, Identification, Distribution, Abundance, Wadii AL- Dabab, Wadii AL- Barakani

1 Introduction

Snails are invertebrate animals with outer coiled shells that are big enough to pull in their entire soft body. Snails belong to the invertebrate phylum Mollusca class Gastropoda, the second-largest phylum of the animal kingdom[1]. Approximately 5000 species of freshwater snails have been found to inhabit different lakes, ponds, and streams worldwide[2]. Most of these freshwater snails are in Gastropoda, the largest Molluscan group, and is subclassed into two: prosobranchia with gills and pulmonta with lungs for respiration[3].

Freshwater snails are hermaphrodites, i-e they possess both male and female reproductive organs and can self-fertilize; thus, a single individual snail can reproduce offspring hatch out from the egg, and their juvenile is like tiny snails with small, coiled shells. The eggs are laid in 5-40 batches in numbers at a time, the young snail hatches after 6-8 days, and these young ones attain maturity in 4-7 weeks depending on the environmental conditions i-e temperature and food resources also it depends on the species. One individual snail can lay up to 1000 eggs in their life span. Some amphibious snails have separate sexes, and their life span may be in several years. For reproduction, the optimum temperature is usually in a range of 22-26 °C [4]. Many freshwater snails are of clinical and veterinary importance, serving as intermediate hosts of different helminthic parasites of humans and animals [5], [6].

The freshwater snails belonging to the planorbide family were mostly the intermediate host of the highly infective trematode larvae of the genus *Schistosoma* [7]. There are nine species of *Schistosoma* transmitted by *Bulinus*, three that infect humans and six that infect Bovids or rodents [8], *Bulinus* can survive outside freshwater as they can aestivate [9]. *Biomphalaria* belongs to the genus of freshwater gastropod snails, which are members of the *Planorbidae* family. They are otherwise known as *Taphius* and serve as intermediate hosts for the transmission of *S. mansoni* infection leading to intestinal Schistosomiasis Currently, four other species—*B. arabica, B. tenagophila*, *B. straminea*, and *B. glabrata* [10]. Infected freshwater snails released this parasite in the surrounding water because of water contamination. Freshwater snails are considered an intermediate host in this parasite's life cycle because freshwater snails have sporocysts of *Schistosoma* that later developed into cercariae that are released into the freshwater body. These cercariae are free-swimming in the water and then attach the human skin in contact with the freshwater. The cercariae in the human body are converted into larva, also known as the schistosomula, and then migrate to the blood vessels.

After that, larvae mature into male and female parasites, and then mating occurs in the portal blood system. Some of the eggs are shed in feces or urine into the water bodies where they gain maturity and complete their life cycle, while other remaining eggs are trapped in the body tissues. These eggs are the leading cause of inflammatory reactions because eggs' secret proteolytic enzymes start "eosinophilic inflammatory reactions" when eggs get trapped in the tissues. The Schistosomal infection expression depends on the timing of the migration of the cercariae after adult worms and their eggs. If these eggs migrate to the central nervous system, it can cause severe complications like seizures, paralysis, etc.

There are approximately 350 species of gastropods globally with medical or veterinary importance, including three main genera acting as intermediate hosts of schistosomes parasitizing humans[11]. On the other hand, it is noted that this disease most commonly occurs in children because children in developing countries are playing in contaminated freshwater, so the chances of transference of this disease in children are very high. Farmers, fishermen, and other people using contaminated water daily for any purpose are also at high risk for this parasitic attack[12]. Millions of people in approximately 90 countries have suffered from a parasitic disease in which snails serve as intermediate hosts[13].

As follows: *Biomphalaria*, *Bulinus*, and *Encomelania*.

The freshwater snails, liver infection, transmit several other diseases to sheep, and cattle, called fascioliasis, by transmitting a zoonotic parasite known as *Fasciola hepatica*. It is noted that several humans are also infected by this parasite [14].

There are further many diseases transmitted by freshwater snails, including cercarial dermatitis, fasciolopsiasis [15]. It is quite essential to find out the diseases transmitted by the snail in a locality. So, the authorities can control disease transmission and protect thousands of people from infection. In this regard, we are performing experimental research on the freshwater snail disease transmission within the locality of Taiz, Yemen.

Snails are obtained from different freshwater bodies and identify by observing the morphology of snails. Shell morphometric is a useful tool and first step in identifying mollusc taxonomy and ecological studies [16], [17]. In malacology, shell morphology has been helpful in describing, identifying, characterizing [18], and recognizing intraspecific morphological variations [19]. It has also assisted in deducing shell structures and properties affected by environmental variations to determine [20], [21] snail geographical distribution [22]. Few studies exist on the freshwater snails of the Republic of Yemen. Most other literature on freshwater snails of the Republic of Yemen is restricted to schistosomiasis surveys. This work aimed to study the distribution and seasonal abundance of freshwater snails in Southwest Taiz governorate (Wadii AL-Dabab &Wadii AL- Barakani).

2 Materials & Methods

2.1 Study area

This study was conducted in two sites; Wadii AL-Dhabab (13^0 31 N 43^0 57 E) and Wadii AL- Barakani (13^0 19N 44^0 55E), the samples were selected and studied randomly. Wadii AL-Dhabab and Wadii AL-Barakani are the areas engaged with a people activity consistently going to collect water, wash clothes, bath, swim or play (young children), and car wash.

2.2 Study population

The study population is freshwater snails collected from Wadii AL-Dhabab and Wadii AL- Barakani.

2.3 Collection method

The freshwater snails were collected monthly from the two wadies (AL-Dhabab and AL-Barakani) from February to October 2020. The samples were randomly collected using a wooden square of the side length of 50 cm and repeated three times during each month for each site. All Snails located inside the wooden square were picked by gloved hands. The snails were calculated from all squares and collected in a plastic container.

2.4 Identification method

The collected freshwater snails were transferred to labeled and perforated plastic containers and transported to the Biological Sciences, Faculty of Applied Sciences, Taiz University laboratory. The snails were identified to species level using the morphological characteristic standard key described by Mandle Barth (1962) key to the identification of East and Central African freshwater snails of Medical and veterinary.

3 Results

A total of 1037 freshwater snail specimens were collected from Wadii AL-Dhabab (13^0 31E, 43^0 57N) Southwest Taiz governorate. Based on the shell morphology, 1034 (99,7%) of the snails collected were putatively identified as *Biomphalaria arabica* (Figure 1), and 3 (0,29%) were identified as *Melanoides tuberculate* (Figure 2). Elsewhere 2221 freshwater snails were collected from Wadii AL – Barakani ($13^0$19E, 44^0 55N) Southwest Tazi governorate, of which 2059 (92,71%) were *Biomphalaria arabica*, 2 (0.09%) were *Melanoides tuberculata*, and 160 (7,20%) were *Bulinus beccarii* (Figure 3). Similar species of snails were recorded in the two Wadies' water (AL-Dhabab and AL-Barakani); they are playing an essential role in public health (Table 1).

Figure(1). *Biomphalaria arabica*

Figure(2). *Melanoides tuberculata*

Figure(3). *Bulinus beccarii*

Table (1). Distribution of freshwater snails collected from Wadii Al-Dhabab and Wadii Al –Barakani in Taiz governorate.

Snail species	Wadii AL - Dhabab		Wadii AL - Barakani	
	No. Collected	%	No. Collected	%
Biomphalaria arabica	1034	99.71	2059	92.71
Melanoides tuberculata	3	0.29	2	0,09
Bulinus beccarii	0	0	160	7.20
Total	1037	100	2221	100

Table (2). Monthly abundance of freshwater snails collected from Wadii Al-Dhabab in Taiz governorate.

Snail species	Wadii AL – Dhabab								
	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.
Biomphalaria arabica	379	319	0	0	0	0	24	0	312
Melanoides tuberculata	1	0	0	0	0	0	0	0	2
Bulinus beccarii	0	0	0	0	0	0	0	0	0

Table (3). Monthly abundance of freshwater snails collected from Wadii Al-Barakani in Taiz governorate.

Snail species	Wadii AL – Barakani								
	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.
Biomphalaria arabica	1169	771	0	0	0	0	0	0	119
Melanoides tuberculata	1	0	0	0	0	0	0	0	1
Bulinus beccarii	31	2	0	0	0	0	0	0	127

The snails' spatial distribution shows that sampling Wadii AL – Barakani had the highest percentage of snail abundance of 68.17%, while sampling Wadii AL – Dhabab had 31.83%. The monthly variation in abundance of snail assemblages shows that *Biomphalaria arabica* and *Bulinus beccarii* were the most abundant snails during dry months (February, March, and October), while the absent during the rainy months (April, May, June, July, and September), as shown in table 2. *Biomphalaria* is more widespread and is found in most small streams running inside valleys, and their density usually is very significant, reaching to than 100 snail/cm^2.

4 Discussion

In the present study, *Biomphalaria arabica* was the most relatively abundant in both AL-Dhabab and AL-Barakani wasdies (99.71% and 92.71%), respectively. This result agrees with the previous study's findings [23] that studied the distribution of freshwater molluscs of the Yemen Arab Republic. The present work also revealed that *Bulinus beccarii* was more abundant in Wadii AL-Barakani (7.20%) and not found in Wadii AL-Dhabab. Simultaneously, *Melanoides tuberculata* was recorded as the lowest distribution in the two wadies AL-Dhabab (0.29%) and AL-Barakani (0.09%). This agrees with a previous study [23]. Snails displacement in wet months as water levels rise and flow increases and creating turbidity, intensifying impact on snails already being washed away. Rain may also affect cumulative impacts through sudden temperature reduction causing thermal shock in snails, reducing egg-laying success, and dampening post- rain recruitment as overall numbers will be reduced; our results here are in agreement with a previous study [24].

Most of the snails showed marked monthly variation in abundance. Pulmonate species were more abundant in late dry months and tended to reduce in abundance in rainy months; this study agrees with the report of several works [25], [26]. *Bulinus beccarii* was found in small sandy bed streams; it is in high abundance after the peak rainfall, which occurs during June –September, while *Biomphalaria arabica* is more widespread and found in most small streams running inside valleys; our results here are in agreement with a previous study [27].

5 CONCLUSIONS

Freshwater snail acts as an intermediate host to *S. haematobium* (*Bulinus beccarii*) and *S.mansoni* (*Biomphalaria arabica*).

In this study, we have made a monthly survey to investigate distribution of freshwater snails in Wadii AL-Dhabab and Wadii Al-Barakani, and found impact of abundance monthly on *Biomphalaria arabica* and *Bulinus beccarii*, where increased numbers of the snails in dry months (February, March, and October) and reductions in the wet months (June, July, and September).

This study with the resolution to reveal significant monthly and spatial in snail's abundance, which could be used in an evidence-based intervention strategy to control Schistosomiasis in Wadii AL-Dhabab and Wadii AL-Barakani.

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