EGYPTIAN ACADEMIC JOURNAL OF
BIOLOGICAL SCIENCES
ZOOLOGY

B

ISSN
2090-0759

WWW.EAJBS.EG.NET

Vol. 12 No. 2 (2020)

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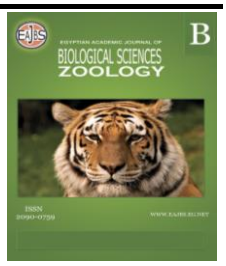
www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (B. Zoology) Vol. 12(2) pp: 155-160(2020)*

Egypt. Acad. J. Biolog. Sci., 12(2):155-160 (2020)

Egyptian Academic Journal of Biological Sciences
B. Zoology
ISSN: 2090 – 0759
http://eajbsz.journals.ekb.eg/



Abundance and Diversity of Snails in Various Agroecosystems in District Multan, Pakistan

Ghulam Murtaza[1*], Unsar Naeem Ullah[2], Muhammad Ramzan[3], Fatima Razzaq[4], Noshaba Munawar[4], Azhara Perven[4], Assad Ullah[4], Abid Ali[5], Javaira Altaf[6] and Rukhsar Beanish[4]

1- Department of Entomology, College of Plant Protection, China Agricultural University, Beijing, China
2- Institute of Plant Protection, MNS. University of Agriculture, Multan, Pakistan
3- State Key Laboratory for Biology of Plant Disease and Insect Pests, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing 100193, China
4- Department of Zoology Wildlife and Fisheries, University of Agriculture, Faisalabad, Pakistan
5- Department of Biology, Govt. Degree College, Akbarpura, Nowshera, Pakistan
6- Department of Zoology. Government College University, Faisalabad
Email: murtazabwn54@gmail.com

ARTICLE INFO
Article History
Received:25/9/2020
Accepted:1/12/2020

Keywords:
Snails, Pulmonata, *Ariophanta bistrialis ceylanica*, *Oxychilus draparnaudi*, Population diversity, Multan.

ABSTRACT

Snails are the second largest group of invertebrates after insects and make a major part of the world's fauna. There are 35,000 described species of land snails (subclass: Pulmonata) from class gastropods in the world. With the present scenario of climate change, their occurrence has been observed many-fold. Despite their economic importance, population diversity and distribution of these creatures on different host crops in Punjab Pakistan is not much more studies. For this purpose, the present study was conducted to identify the snail species and their diversity on different hosts in the agroecosystems of Multan. The snails were collected from different crops like wheat, vegetable (spinach), fodder, citrus orchard, and plant nurseries. A total of 8264 specimens were collected and preserved in the form of a dry shell and 70% alcohol in Ecology Lab, MNS - the University of Agriculture, Multan for identification purpose. The preserved specimens were identified under microscope using available taxonomic keys. *Ariophanta bistrialis ceylanica, Ariophanta bistrialis cylix, Ariophanta solata, Oxychilus draparnaudi, Monacha catiana, Cernuella virgata, Pupoides abilabris* and *Oxyloma elegans* were identified during the study. The highest and lowest population of *Ariophanta bistrialis cylix* (1592) and *Ariophanta solata* (446), respectively was recorded. The population diversity was found maximum in plant nurseries followed by fodder crop (Berseem) and citrus orchard while least in vegetable (Spinach) and wheat crop. The maximum population was found in July and August, while least in March and May. In the rainy season, the population of snails was recorded maximum as compared to the dry season.

INTRODUCTION

Snails belong to the invertebrate Phylum Mollusca of animals that live in a variety of habitats including marine to freshwater and terrestrial landscapes around the globe. Molluscs are the second largest and successful creatures after insects in the world (Chapman, 2009). Gastropods are snails that inhabit the land. About 35000 species of land snails have been recognized (Sallam and Al-Wakeil, 2012). These are nocturnal in nature and its populations are well established on moist and shady areas because they prefer to live in high Relative Humidity. Moreover, their diversity depends on climatic fluctuations and seasonal variation. The climate factors such as temperature and humidity affect the population and species diversity of snails (Nunes *et al*., 2012).

Several species of snails were reported that cause the transmission of schistosomiasis in mankind and in domestic animals around the globe which are directly or indirectly linked with a change in the climate. The range of human schistosomiasis increases with temperature increases but reduces transmission in those areas where already occurred (Martens *et al*., 1995). Northward in possible range for Schistosoma japonicum in China over the next few decades using *Oncomelania hupens*is and *Schistosoma japonicum* at the minimum requirement of temperature (Zhou *et al*., 2008; Nijhof *et al*., 2001). The incidence of schistosomiasis increases as the population of snails increases. Snails are the most important factors that transmit parasitic diseases in humans and animals.

Snails damage agricultural and horticultural crops eating bark from a tree, green vegetation, vegetables, tender foliage, young seedling, herbaceous plants, and ripening fruits (Agriculture, 2020). They also feed on avocado and citrus foliage and fruits. They have been observed to feed on both living and non-living or decaying plants (Rana, 2012). They can cause a nuisance around homes, greenhouses, nurseries, outbuildings, and sheds. Golden snails cause damage in rice fields and effect badly on yield. Further, they observed that snail size positively correlates with field damage and more damage was observed in those fields with herbicide application (Rana, 2012).

On this little creature, very few studies are conducted by scientists relating to its biodiversity in Pakistan and in the world. Few works have been done with reference to the taxonomy and ecology of snails in the agroecosystem. Previously Ali, (2005), Altaf (2006), and Rahman (2002) conducted a study on the diversity of snails in agroecosystem of Faisalabad which has augmented the previous information of the malacofauna in Faisalabad. The work of Ali (2005); and Altaf, (2006) was limited to the sugarcane and wheat fields near Gutti village area; however, some researchers described the biodiversity of only one family in few villages of Faisalabad focusing only on one family of snails (Rahman, 2002; Rana *et al*., 2000).

Gastropods are important for the ecosystem. They can play important role in ecological services such as i.e. use as bioindicators, host for various parasites, source of food for many birds and other predators during the breeding season, provide protein and calcium in their food. They also enhance organic matter in soils by recycling and decomposition of decaying particles (Altaf and Qureshi, 2017). Besides the feeding of crop plants, snails are also observed to feed on empty snail shells, live snails, nematodes, animal wastes, and carcasses, and even rasp limestone rock or cement (Nekola, 2012; Nekola, 2018). The objective of the present study is to estimate the diversity of this little creature in district Multan.

MATERIALS AND METHODS

Study Area:

The study was conducted at Muhammad Nawaz Shareef University of Agriculture, Multan during 2017.

Collection of Snails:

Samples of molluscs were collected from district Multan including Tehsil (Multan and Shujabad). Samples were taken from different places of each tehsil. One-meter square iron quadrat was used for the sample collection. Iron quadrat was placed on the selected crops and snails were collected under the coverage area by iron quadrat. Samples were placed in different tagged bottles.

Sample Preservation:

Collected samples were taken into the Ecology lab, Muhammad Nawaz Shareef University of Agriculture, Multan. Samples were washed in running water to remove the debris and then placed into the light. The soft part of the molluscs was removed with hot boil water and the snail shell was preserved. For wet preservation, 70% ethanol was used. Bottles were assigned a number, labelled with the site, collector's number, and date of collection.

Identification:

The specimens were identified based on the following characteristics like the number of whorls, shell coiling, umbilicus, shell shape, shell colour, the shape of aperture presence or absence of operculum, height, and diameter of specimens. Vernier caliper was used to measure the diameter of the aperture. Snail samples were identified under a microscope by using scientific keys and diagrams like BRERC snails key by Andrew Daw and Tessa Ivison, Bouchet and Rocroi (2005) and Anderson, (2005).

Statistical Analysis:

Relative abundance was calculated by the following formula.

$$\text{Relative abundance} = \frac{\text{Number of snails found in a habitat or month}}{\text{Total number of snails}} \text{ X } 360.$$

RESULTS AND DISCUSSION

Snails were collected from district Multan (Tehsil Multan and Tehsil Shujabad). Total 8264 specimen were collected from different habitats such as (Wheat, Vegetable (Spinach), Fodder (Berseem), Citrus orchard and Nurseries. Species were identified on the physiological and morphological basis. Total eight species were identified *Ariophanta bistrialis ceylanica, Ariophanta bistrialis cylix, Ariophanta solata, Oxychilus draparnaudi, Monacha catiana, Cernuella virgata, Pupoides abilabris* and *Oxyloma elegans* (Table 1). Ariophanta bistrialis cylix were found maximum in number (1592) followed by *Cernuella virgata, Oxychilus draparnaudi, Oxyloma elegans, Monacha catiana, Ariophanta bistrialis ceylanica, Pupoides abilabris* and *Ariophanta solata* was (1566, 1361, 1201, 859, 639, 600 and 446) elaborated in table 1.

Ariophanta spp. were found in wheat, spinach berseem citrus orchard, and plant nurseries, respectively. Only *Ariophanta bistrialis cylix* was observed in plant nurseries while *Ariophanta bistrialis ceylanica* and *Ariophanta solata* were not found in plant nurseries, during the study. Maximum population of *Ariophanta bistrialis ceylanica* (342) was recorded in wheat crop and *Ariophanta solata* was maximum in fodder crop (berseem). While *Ariophanta bistrialis cylix*, *Oxychilus draparnaudi* and *Monacha catiana* were recorded maximum (1135, 857 and 583) in plant nurseries (Table 1).

In citrus orchard only five species were recorded, among them *Cernuella virgata* were found maximum in number (1365), followed by *Ariophanta bistrialis cylix*, *Ariophanta*

bistrialis ceylanica, *Oxychilus draparnaudi*, and *Monacha catiana* (table 1). In fodder crop (Berseem) all described species were present except *Cernuella virgata* and *Ariophanta bistrialis cylix*. Among them, *Oxyloma elegans* were found maximum in number (1146) during the study period. In vegetable crop (Spinach) all described species were recoded among them *Pupoides abilabris* were found maximum in number (328) shown in table 1. The population diversity was maximum in plant nurseries, fodder crop (Berseem), and citrus orchard, while least in vegetable (Spinach) and wheat crop. while some other scientists reported that maximum population diversity was found in sugarcane, wheat, fodder and vegetable (Altaf *et al*, 2016).

Table 1. Population distribution of Snails in Different Habitats of Agroecosystem in Multan

Species	wheat	Spinach	Berseem	Citrus orchard	Nurseries	Total
Ariophanta bistrialis ceylanica	342	132	85	80	0	639
Ariophanta bistrialis cylix	0	89	0	368	1135	1592
Ariophanta solata	8	96	342	0	0	446
Oxychilus draparnaudi	244	56	167	37	857	1361
Monacha catiana	38	74	153	11	583	859
Cernuella virgata	143	58	0	1365	0	1566
Pupoides abilabris	57	328	215	0	0	600
Oxyloma elegans	31	24	1146	0	0	1201
Total	863	857	2108	1861	2575	8264

The population trend shows that the maximum number of populations of all described species were recorded in the month of July while the least population in March and May (Figure 1). Our current findings contradict (Altaf *et al*, 2016) who reported that the maximum population was founded in August and the minimum in April.

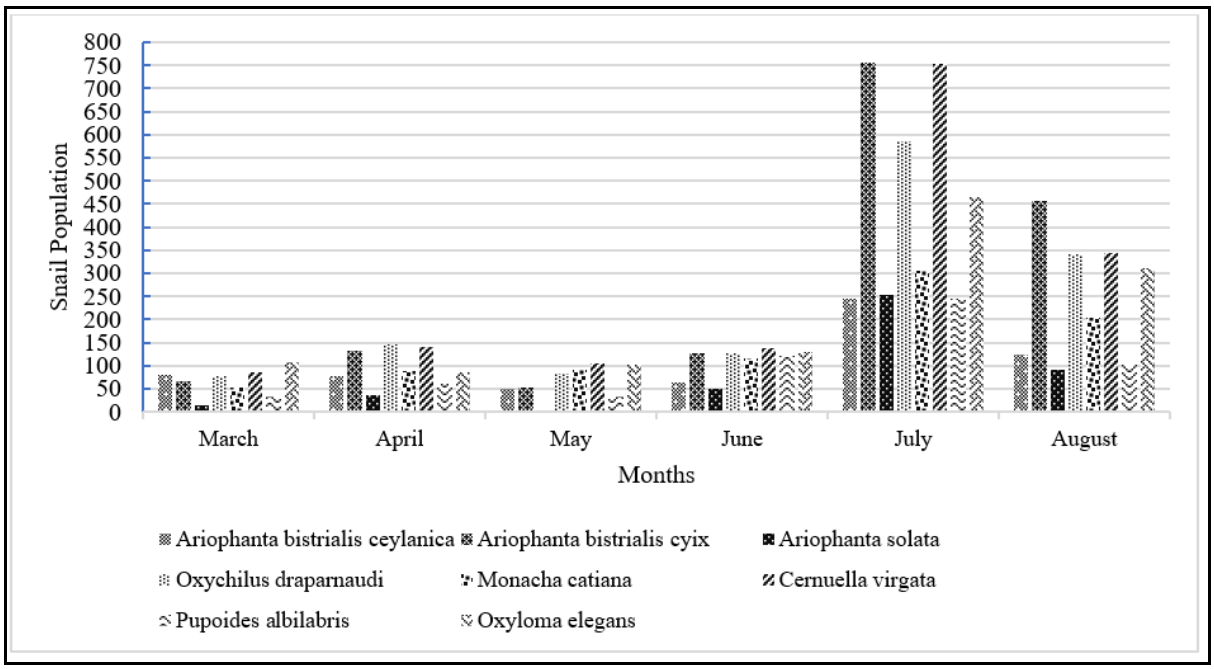


Fig. 1. Population fluctuation of Snails in different months of 2017.

Conclusion

Generally, it can be concluded that July is the favourite month for the multiplication of the snail population while March and May are not.

Acknowledgement

The authors are highly thankful to Muhammad Nawaz Shareef University of Agriculture, Multan for facilitating the present work. I am also highly thankful to Dr. Unsar Naeem Ullah and Dr. Javaira Altaf for helping in specimen identification.

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