

## Abundance and Ecological Relationships of *Physa acuta* in Freshwater Bodies of Chandigarh (U.T), India and its Surrounding Areas



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### ABSTRACT

**M**ollusks, the second most abundant animal fauna after arthropods, play an important role in their ecosystem's rejuvenation and recycling of locked nutrients. Being tolerant species many of these can also be used in biomonitoring and risk assessment studies of aquatic as well as terrestrial ecosystems. However, very little importance has been given to these animals despite of their abundance. The freshwater Indian gastropod fauna, 4.34% of the global freshwater gastropods, has remained neglected in major part of the country. The main focus of malacofauna had been around their taxonomy and their ecology had remained more or less a neglected field. The present investigation has focused on the ecological studies of an invasive species of Physidae (*P. acuta*) in different types of permanent water bodies in Chandigarh and its nearby areas and according to the results of Linear Regression and Pearson's Correlation Coefficient certain parameters are positively influencing (Ph, Chloride, and Hardness) and certain negatively (Temp., Alkalinity, TDS and EC) in determining the density of the species in relation to specific parameter. The Dominance Index indicates the species under study has been found in eudominant state at all the sites.

**Key Words:** Environmental factors, Invasive species, Pulmonates, Physidae, *P. acuta*

## I. INTRODUCTION

Mollusks are the second most abundant animal fauna after arthropods, in its species richness [1] because of the existence of a wide range of adaptive abilities in both of these phyla. Ecologically mollusks play a very important role, both in terrestrial and aquatic ecosystems. [2] The freshwater ecosystems harbor both Gastropoda and Pelecypoda or Bivalvia. Globally, 4,000-5,000 species of freshwater gastropods have been reported till date, of which 4.34% i.e. 217 were confirmed from India. [3-5] Molluscs play a very important role in the freshwater ecosystem’s rejuvenation and recycling of locked nutrients due to their detritivory food habit. Being tolerant species many of these can also be used in biomonitoring and risk assessment studies in their respective ecosystems. [6] However, very little importance has been given to these animals. Despite their abundance, the freshwater gastropod fauna has remained neglected in major part of India and the existing research primarily pivot around their taxonomic and distributional aspects while their ecological aspects have been more or less remained neglected, exhibited by scanty and scattered references.

Physidae- a freshwater pulmonate family is reported to be widely distributed throughout the world as a result of rigorous introductions and successive invasions. [7] Physids are New World snails, recognized by their high spire, sinistral shells and lack of operculum. [8] These being hermaphrodites produce a large number of offspring resulting in their abundances and high densities in their ecosystems. [9] Physids are known to show diversification in their life history traits which are influenced by the type of their habitat, presence or absence of predators and parasites, climate and other environmental factors. [9, 10]

*Physa acuta* Draparnaud, 1805 an invasive species is the most commonly and extensively studied representative of family Physidae. The snail has been reported to be originated from Eastern North America [11] and has undergone wide range spread through the continents of Asia [12], Africa [13, 14], Australia [15], Europe [16,17] and South America. [18] In India it was first reported from Maharashtra [19] and thereafter from many other parts of the country. [20] It has been frequently reported from man-made reservoirs, rivers, streams, ponds, and wetlands but has not been found to live in clay pit ponds. [21,22] In India *P. acuta* has been found commonly inhabiting both lotic and lentic freshwater bodies characterized with ecological variables, along with other species of freshwater malacofauna but the exclusive ecological responses of *P. acuta* have not been undertaken by any limnologist from the country till date.

The present study, hence, has been undertaken to fill the existing gap. The study focused on the existence, abundance and ecological relationships of the *P. acuta* in different freshwater bodies of Chandigarh (U.T.) and its surroundings.

## II. MATERIALS & METHODS

### Study area

During the study, following freshwater bodies from Chandigarh and its surrounding areas were studied for their water quality and occurrence of *P. acuta* (Fig. 1) from May 2016 to December 2016.

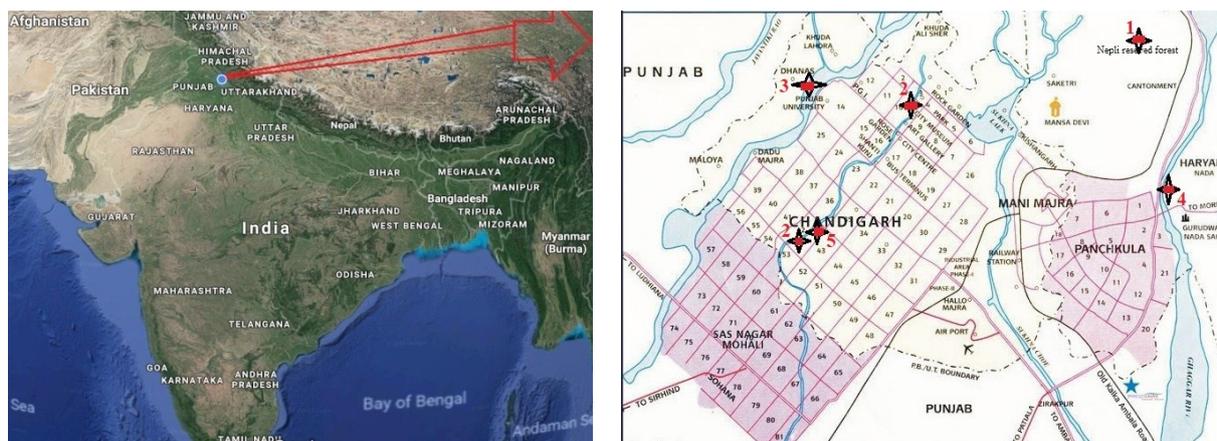


Figure 1- Location of sites

### Sample collection

The water and soil samples were collected from the selected sites (Fig. 2) manually and brought to the laboratory in sampling bottles and polythene bags respectively. The soil samples were sieved using Standard Test Sieves (as per IS: 460) of different mesh sizes and shells picked from the sieves (75mm, 44mm, and 30mm) were cleaned using brushes. The identification of *P. acuta* has been done using standard keys. [7] Water samples were analyzed for parameters like (pH, Temperature, Electrical Conductivity (E.C.), TDS, Chloride, Alkalinity, Hardness) using electronic probes and standard titration methods. [23]



Site 1 – Nepli reserve forest (Chandigarh)



Site 2 – N-Choe (Chandigarh)



Site 3 – Dhanas Lake (Chandigarh)



Figure-2 Sampling sites (understudy) showing occurrence of *P. acuta*

III. STATISTICAL ANALYSIS

- a) To study the relationship between the species and any particular physicochemical parameter of its habitat with the application of linear regression using *XLSTAT*.
- b) Dominance index (D) was also calculated using the formula:  $D = k/K \times 100$ , where *k* is the number of individuals of species and *K* is the total number of individuals in a sample. The dominance classes were categorized following. [24]
- c) Pearson’s correlation coefficient was performed to analyze the significance of a correlation between the species’ abundance and any particular physicochemical variable.

IV. RESULTS

During the study, *P. acuta* was found inhabiting all lentic and lotic water bodies from the sites under study. All the sites were found to have alkaline water with narrow to broad range variations in other parameters (Table 1). The species was found to adapt to these variable ecological environments. Along with *P. acuta*, other gastropods were also found at all the sites but site 4 and 5 were found to show its exclusive dominance. The maximum abundance of *P. acuta* was recorded from S-4 while the minimum at S-3.

Table 1: The ranges of physicochemical parameters and abundance of Mollusc fauna at different sites

Parameters	S-1	S-2	S-3	S-4	S-5
pH	7.39-8.21	7.15-8.99	7.57-10.14	7.52-8.49	7.91-8.23
Temperature (C)	18-22	16.2-29.9	16.7-32.1	15.2-31.9	28.7-31.3
E.C (µS)	327-456	205-621	204-383	289.5-645	373-442
T.D.S (ppm)	212.5-296.4	133-359	130-248.9	188-420	200-240
Cl(mg/l)	21.27-24.8	55-360.2	42.54-127.6	65.5-126.1	32.8-61.9
Hardness (mg/l)	225.1-485.3	28.3-200.16	65.05-380.3	200.9-320.7	102-219.2
Alkalinity (mg/l)	30.61-384.42	55-435	40-180	50-395	30-201.5
Total molluscan fauna	56	107	28	205	155
Total <i>P. acuta</i>	39	56	16	199	146

Value of the D (dominance index) of *P. acuta* was found more than 20 at all the sites, thus the species is found belonging to the eudominance category (Fig. 3). [24] Site-4 and 5 were found to show the maximum abundance of the species while the minimum was found at site 2 and 3.

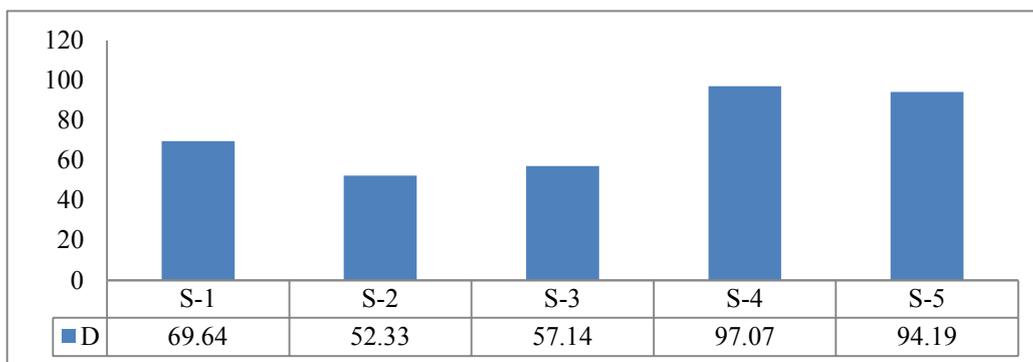


Figure-3: Dominance Index values showing the dominance of *P. acuta* at different sites

Correlation between the abundance of *P. acuta* with specific physicochemical parameter (Table 2) shows that out of seven parameters studied in the current case, four were found to have negative correlation while remaining three positives but none was found significantly correlated (at  $p < 0.05$ ) with the selected parameters of the water bodies. The result makes it clear that the species under study can adapt and flourish in a wide range of ecological conditions.

Table 2: Pearson’s correlation coefficients between the abundance of *P. acuta* and physicochemical parameters

Parameters	Pearson’s correlation coefficient	Inference
pH	0.6885	Moderately positive correlated
Temperature (C)	-0.1857	Negative correlated
E.C. (µS)	-0.4266	Negative correlated
TDS (ppm)	-0.0986	Negative correlated
Chloride (mg/l)	0.1064	positive correlated
Total Hardness (mg/l)	0.126	positive correlated
Alkalinity (mg/l)	-0.2143	Negative correlated

\*p<0.05

The relationships between *P. acuta* with independent ecological variables were studied using linear regression (Fig. 4 (a-g)). The results show a positive relationship with pH, Hardness, and Chloride while Temperature, E.C., Alkalinity, and TDS were found having a negative relation with *P. acuta*.

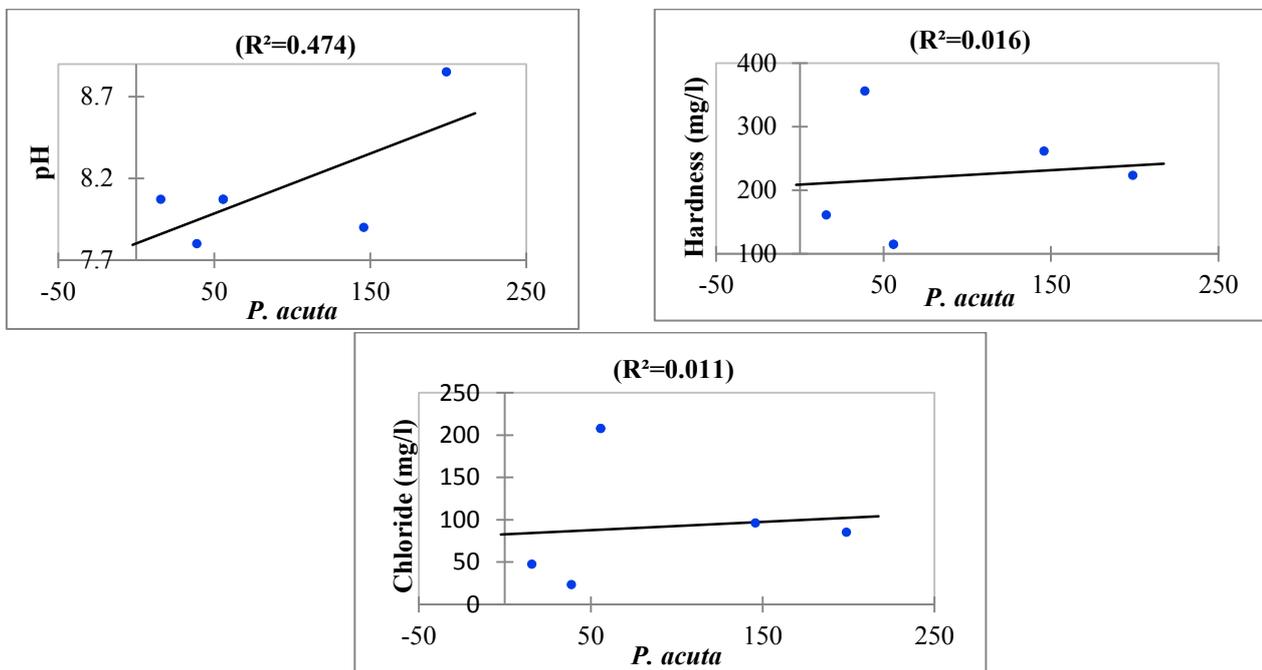


Figure 4. (a-c): Linear regression lines showing positive relationship between abundance of *P. acuta* and physico-chemical parameters

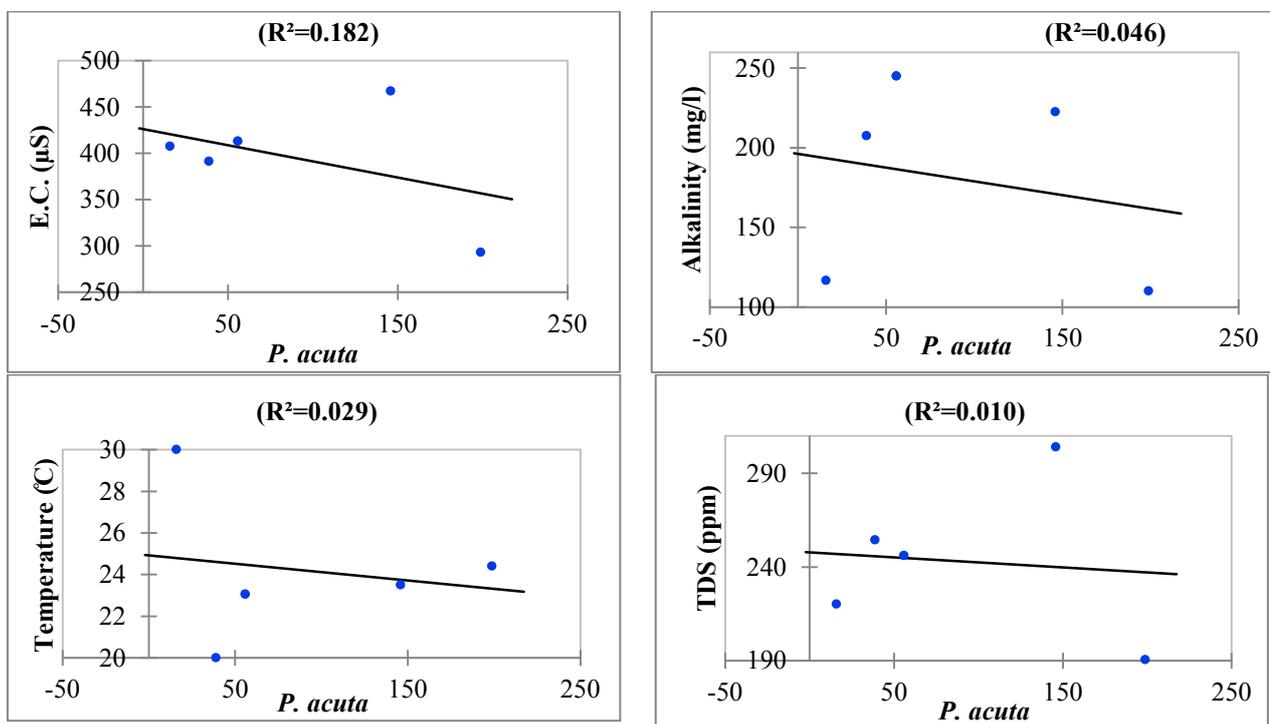


Figure 4. (d-g): Linear regression lines showing negative relationship between abundance of *P. acuta* and physico-chemical parameters

## V. DISCUSSION

Majority of permanent freshwater bodies in Chandigarh are facing varied levels of degradations due to natural as well as anthropogenic interventions, leading to the loss of their biodiversity. Due to the decline in water quality the native fauna of the water bodies, sometimes get replaced by other invasive or alien species with better adaptive features to thrive in changed ecological conditions. These invasive species were also found to act as another major threat to indigenous biodiversity and the ecosystem's health. [25] *P. acuta* was found to be one of the types of invader in freshwater bodies of India but is very less investigated in terms of its ecological, biological and physiological behaviors. The present study suggests that *P. acuta* is found to be the most successful invader into all permanent freshwater bodies of Chandigarh where it is flourishing along with other gastropods though at certain sites it was found as the only representative of gastropods, though during selected months of the year.

The present study reports a positive relationship with pH and maximum abundance of the species has been recorded at 7.8 - 8.8. While a negative correlation of the population of *P. acuta* with pH has also been reported. [26] It was concluded that pH as an independent parameter has no influence the mollusk abundance, though has not specified for *P. acuta*. [27] Since calcium is the primary component of shell formation in all the shelled mollusks thus hardness is going to play a positive factor in their multiplication and longevity. In the current study also the positive relationship was observed with this parameter which falls parallel to the observations made by other workers. [28] The chloride contents of water also favor *P. acuta* abundance and shown to have a positive relationship with the abundance of this particular species of *Physa*.

*P. acuta* showed a negative correlation with temperature though the maximum abundance was recorded at a range of 24-25<sup>o</sup> C but is still able to survive at 30<sup>o</sup> C. Though, the other findings show that the freshwater snails (including *P. acuta*) are not able to survive in waters at higher temperature due to its impact on the decline of dissolved oxygen of water. [29] Alkalinity and abundance of *P. acuta* also showed a negative correlation and the similar impact of salinity on molluscan fauna in fresh water has been previously reported. [30] The species has been found showing a negative correlation with TDS, in the current investigation, and these readings are confirmed by the observations of other workers too [26] while EC was found negatively correlated unlike earlier findings. [26]

## VI. CONCLUSION

The present investigation concludes that the invasive species of Physidae (*P. acuta*) is successfully surviving, flourishing and even existing as an exclusively dominating gastropod, though seasonally, in all permanent and different types of freshwater ecosystems in Chandigarh and its surroundings. The native fauna of temperate is able to survive and adapt varied physical and chemical conditions of waters.

## VII. ACKNOWLEDGMENT

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## REFERENCES

[1] Strong EE, Gargominy O, Ponder WF, Bouchet P. Global diversity of gastropods (Gastropoda; Mollusca) in freshwater. *Hydrobiologia*. 2008 Jan 1;595(1):149-66.

- [2] Kalyoncu H, Barlas M, Yıldırım MZ, Yorulmaz B. Gastropods of two important streams of Gökova Bay (Muğla, Turkey) and their relationships with water quality. *International Journal of Science & Technology*. 2008;3(1):27-36.
- [3] Seddon MB, Killeen IJ, Bouchet P, Bogan AE. Developing a strategy for molluscan conservation in the next century. *Journal of Conchology*. 1998 Jun 1;2:295-8.
- [4] Lydeard C, Cowie RH, Ponder WF, Bogan AE, Bouchet P, Clark SA, Cummings KS, Frest TJ, Gargominy O, Herbert DG, Hershler R. The global decline of nonmarine mollusks. *BioScience*. 2004 Apr;54(4):321-30.
- [5] GhOSh A. AMit MUKhOpAdhyAy\*, BASUdev tripAthY And. FRESHWATER FAUNAL DIVERSITY IN INDIA. 2017:501.
- [6] Salánki J, Farkas A, Kamardina T, Rózsa KS. Molluscs in biological monitoring of water quality. *Toxicology Letters*. 2003 Apr 11;140:403-10.
- [7] Taylor DW. Introduction to Physidae (Gastropoda: Hygrophila); biogeography, classification, morphology. *Revista de biología tropical*. 2003 Mar 1;51:1-+.
- [8] Burch JB. North American freshwater snails. Malacological Publications; 1989.
- [9] Wethington AR, Guralnick R. Are populations of physids from different hot springs distinctive lineages. *American Malacological Bulletin*. 2004 Oct 14;19(1/2):135-44.
- [10] Harrold MN, Guralnick RP. Freshwater Mollusks of Colorado. Colorado: Colorado Division of Wildlife. 2010 Aug.
- [11] Dillon RT, Wethington AR, Rhett JM, Smith TP. Populations of the European freshwater pulmonate *Physa acuta* are not reproductively isolated from American *Physa heterostropha* or *Physa integra*. *Invertebrate Biology*. 2002 Sep 1;121(3):226-34.
- [12] Ali JH. The distribution of *Physa acuta* Dr aparnaud (Gastropoda: Physidae) in Malaysia and its suitability as test material for insecticide toxicity studies. *J Med Appl Malacol*. 1993;5:129-34.
- [13] Brackenbury TD, Appleton CC. recolonization of the umsindusi river, Natal, South Africa, by the invasive gastropod, *Physa acuta* (Basommatophora, Physidae). *Journal of Medical and Applied Malacology*. 1993;5:39-44.
- [14] Appleton CC, Miranda NA. Two Asian freshwater snails newly introduced into South Africa and an analysis of alien species reported to date. *African Invertebrates*. 2015 Jan;56(1):1-7.
- [15] Zukowski S, Walker KF. Freshwater snails in competition: alien *Physa acuta* (Physidae) and native *Glyptophysa gibbosa* (Planorbidae) in the River Murray, South Australia. *Marine and Freshwater Research*. 2009 Nov 11;60(10):999-1005.

- [16] **Semenchenko V, Laenko T, Razlutskiy V.** A new record of the North American gastropod *Physellaacuta* (Draparnaud 1805) from the Neman River Basin, Belarus. *Aquatic Invasions*. 2008;3(3):359-60.
- [17] **Raković MJ, Raković MB, Petrović AM, Popović NZ, Đuknić J, Naunovic ZZ, Paunović M.** Haplotype variation in the *Physaacuta* group (Basommatophora): genetic diversity and distribution in Serbia.
- [18] **Núñez V.** Differences on allocation of available resources, in growth, reproduction, and survival, in an exotic gastropod of Physidae compared to an endemic one. *Iheringia. SérieZoologia*. 2010 Sep;100(3):275-9.
- [19] **Rao SNV, Mitra SC, Parashar BD, et al.** New records of two pulmonate freshwater Gastropods in India, with description of a new species, *Bulinusindicus*. *J. Bomb. Nat. Hist. Soc.*,1994; 91(1): 123-126.
- [20] **Maansi, Wats M.** First Report of Family Physidae (Gastropoda) with *Physaacuta* as its representative from freshwaters of Chandigarh (U.T.), India. Accepted for publication.
- [21] **Serafinski W, Rembecka I, Strzelec M.** Biometrics and life cycle of *Physaacuta* Dr aparnaud 1805 (Gastropoda, Basommatophora: Physidae) under human impact. *Folia Malacologica*. 1989;3:139-47.
- [22] **Saha C, Pramanik S, Chakraborty J, Parveen S, Aditya G.** Abundance and body size of the invasive snail *Physaacuta* occurring in Burdwan, West Bengal, India. *Journal of Entomology and Zoology Studies*. 2016;4(4):490-7.
- [23] **APHA.** Standard Methods for the Examination of Water and Waste Water. 24th Ed. American Public Health Association,1998, Washington, DC.
- [24] **Biesiadka E, Kowalik W.** Water mites (Hydracarina) of the western Bieszczady Mountains. 1. Stagnant waters. *Acta hydrobiologica*. 1980.
- [25] **Pimentel D, Zuniga R, Morrison D.** Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological economics*. 2005 Feb 15;52(3):273-88.
- [26] **Kader AA, Osman GY, Mohamed AH, Gharieb MM, Ismail NM, Abdel-motleb A.** Bioaccumulation of heavy metals in freshwater snails in relation to lining of water courses in Egypt.
- [27] **Ntonifor HN, Ajayi JA.** Studies on the ecology and distribution of some medically important freshwater snail species in Bauchi State, Nigeria. *International Journal of Biological and Chemical Sciences*. 2007;1(2):121-7.
- [28] **Şahin SK, Zeybek M.** Distribution of Mollusca fauna in the streams of Tunceli Province (East Anatolia, Turkey) and its relationship with some physicochemical parameters. *Turkish Journal of Fisheries and Aquatic Sciences*. 2016 Mar 1;16(1):187-95.
- [29] **El Deeb FAA, El-Shenawy NS, Soliman MFM, Mansour SA.** Freshwater snail distribution related to physicochemical parameters and aquatic macrophytes in Giza and Kafr El-Sheikh governates, Egypt. *Int. J. Vet. Sci. Res*. 2017; 3(1):008-013.
- [33] **Stockwell CA, Purcell KM, Collyer ML, Janovy J.** Effects of Salinity on *Physaacuta*, the Intermediate Host for the Parasite *Posthodiplostomum minimum*: Implications for the Translocation of the Protected White Sands Pupfish. *Transactions of the American Fisheries Society*. 2011 Sep 1;140(5):1370-4.

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