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Research Article

FRESHWATER SNAILS (MOLLUSCA: GASTROPODA) AS BIO-INDICATORS FOR DIVERSE ECOLOGICAL AQUATIC HABITATS

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ABSTRACT
A survey was performed for freshwater stenotopic snail (Mollusca: Gastropda) species inhabiting different types of lentic (stagnant water) and lotic (running water) habitats of southern Rajasthan, India. A total of fifteen snail species were recovered from diverse habitats. Of these nine species [*Lymnaea acuminata* f. *patula, L. acuminata* f. *chlamys, L. acuminata* f. *typica, L. acuminata* f. *rufescens, L. luteola* f. *australis,* L. *luteola* f. *typica* , *L. luteola* f. *impura*, *Planorbis* (*Indoplanorbis*) *exustus*, and *Anisus* (*Gyraulus*) *convexiusculus*] were pulmonates and six species [*Faunus ater, Melania* (*Plotia*) *scabra, Thiara* (*Tarebia*) *lineata, M. striatella tuberculata*, *Vivipara bengalensis* race *gigantica* and *V.bengalensis* race *mandiensis*] were operculates. Most of them were widely distributed in various aquatic habitats and had wide range of tolerance. However, few stenotopic species (*L. acuminata*, *L.luteola, A. convexiusculus*, *Melania scabra* and *Thiara lineata*) were also found to be entirely or nearly restricted to particular habitats. These stenotopic snail species are good bio-indicators for ecologically diverse freshwater habitats and are useful in their classification as well as identification which is focussed in the present communication.

***Key Words*:** *Bio-indicators, Eurytopic, Freshwater snails, Gastropods, Lentic and lotic habitats, Molluscs, Operculates, Pulmonates, Stenotopic*

INTRODUCTION
It is generally accepted that freshwater snails (gastropods) complete life cycle of digenetic trematode parasites of vertebrates including humans (Cheng, 1964; Erasmus, 1972). Hence, in any geographical area presence of snail species indicates presence of particular endemic trematodiasis (Choubisa, 2010). Several countries forecasted spreading of trematodiasis on the basis of snail species in a particular area (Choubisa, 1986, 2008) so that preventive measures can be taken in advance. Many molluscan species are also good bio-indicators for paleoenvironments as well as for water quality or pollution on the basis of their tolerance power against extremes of physico- chemical components of water (Harman, 1974; Edmondson *et al.,* 2010; Druart *et al.,* 2011). The biological communities that are exposed to pollutants act as integrators of multiple past and present environmental effects in any ecosystem. This attribute makes them suitable to act as bioindicators (Cranston *et al.,* 1996) and indicate changes in condition and functioning of a system through change in their morphology / physiology/ genome organisation etc. They may be used to understand the response, adaptation and recovery of an ecosystem and its inhabitants to both natural and anthropogenic disturbances. Jonson (1995) stated that ideal bio-indicators should provide an indication of changes, either at the ecosystem, population or genetic level as well as provide an insight into potential causal mechanism. Those organisms that have wide tolerance tend to be less informative and are poor health indicators. In aquatic and terrestrial ecosystems there are a number of vertebrate and invertebrate species that respond to physical or chemical changes in an ecosystem (Choubisa, 1992, 2010; Cranston *et al.,* 1996; Druart *et al.,* 2011). Some workers have also reported that certain gastropods and pelecypods are ideal bio-indicators for trophic stages (eutrophic, mesotrophic and oligotrophic) of lakes as well as for lotic environments (Clarke, 1979 a, b; Choubisa, 1992). In India, various freshwater snail species have been reported from different geographical provinces (Subbarao, 1989). From the state of Rajasthan also snail species belonging to diverse aquatic habitats have been reported (Ray and

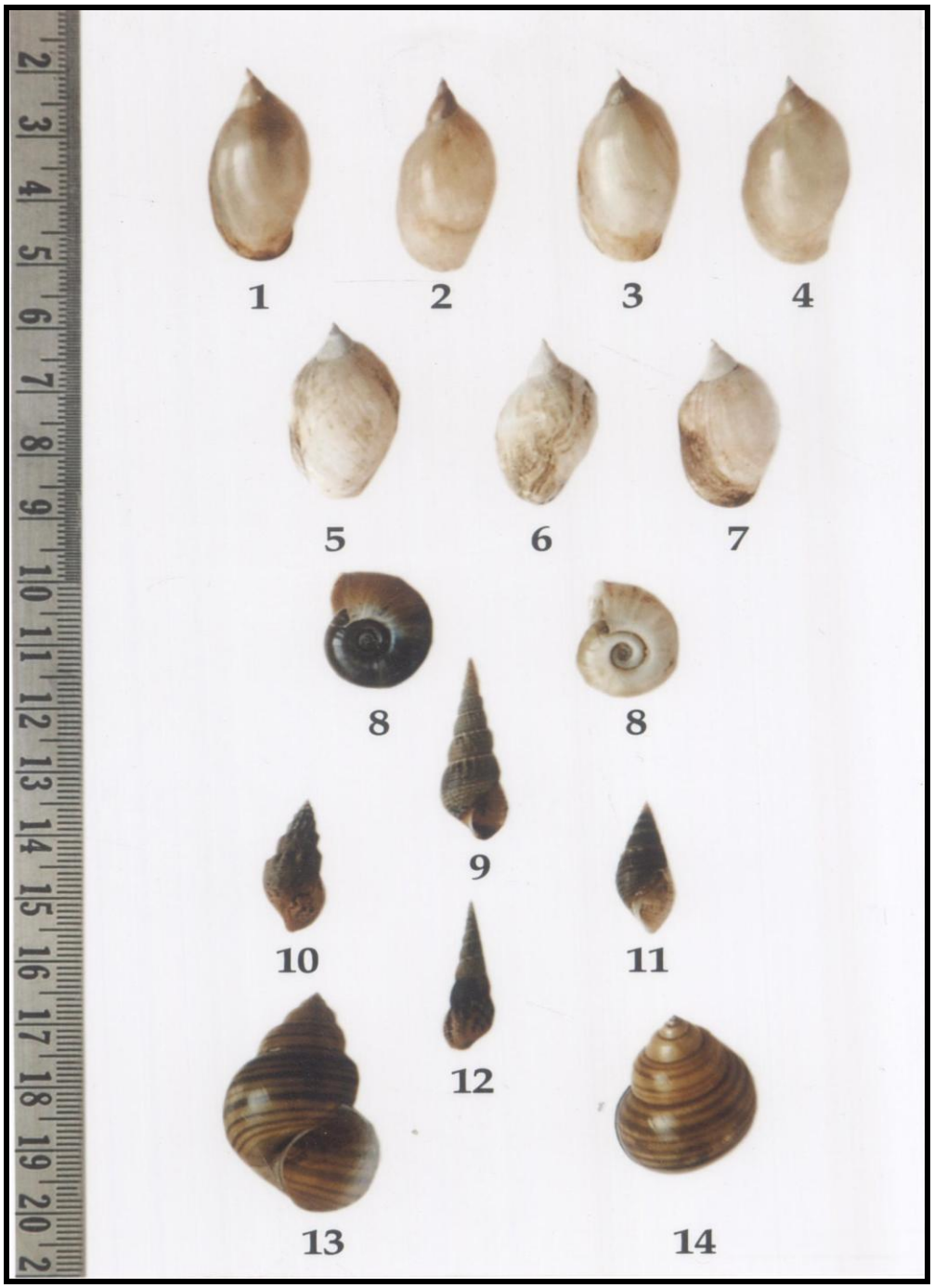
Mukherjee, 1963; Choubisa and Sharma, 1982, 1986; Rathore and Bohra, 1987). But none of these workers identified and reported habitat- specific snail species. Actually these species are entirely, or nearly, restricted in their distribution and survive in particular habitats only and they have less habitat tolerance. These are known as stenotopic species, which also indicate or reflect the habitat-specificity. In view of these, the present investigation was therefore undertaken to ascertain habitat-specific or stenotopic snail species of southern Rajasthan where diverse freshwater aquatic habitats are located.

MATERIALS AND METHODS

To find out a stenotopic snail species, a survey was carried out for their relative distribution in diverse lentic or stagnant waters (lakes, reservoirs, ponds etc.), lotic or running waters (rivers, streams, canals etc.), and confluence (Sangam) freshwater habitats located in different regions of Banswara, Chittorgarh, Dungarpur, Rajsamand, Sirohi, and Udaipur districts of southern Rajasthan, India. Survey was performed (2012-13) from post monsoon to late winter season in which snails mostly breed and increase their population and also attain maturity. Coastal regions of different freshwater bodies were visited from morning to noon hours in which bottom and surface dweller snail species are clearly visible and are more active. Living snail specimens 50-100 in numbers from each water body were collected by hand or by hand net. These snails were then brought to the departmental laboratory and maintained in separate aquaria containing tap water and certain aquatic plants. Snails were also collected from aquatic weeds spread in water bodies. A record was also prepared for collected snails and their habitats. These snail species were identified morphologically or by their shell structure as described earlier (Ray and Mukherjee, 1963; Tonapi, 1980).

RESULTS AND DISCUSSION

More than 2000 snail specimens were collected from ecologically diverse freshwater habitats; fifteen snail species were detected and identified (Figures 1-14). Of these, six species [*Faunus ater, Melania (Plotia) scabra, Thiara (Tarebia) lineata, M. striatella tuberculata, Vivipara bengalensis* race *gigantica* and *V. bengalensis* race *mandiensis*] were operculate gastropods and remaining nine species [*Lymnaea acuminata f. patula, L. acuminata f. chlamys, L. acuminata f. typica, L. acuminata f. rufescens, L. luteola f. australis, L. luteola f. typica, L. luteola f. impura, Planorbis (Indoplanorbis) exustus,* and *Anisus (Gyraulus) convexiusculus*] were pulmonates (Table 1). Among these, some species were found to be widely distributed (eurytopic) in various lentic and lotic habitats while some were entirely or nearly, restricted (stenotopic) to particular habitats (Table 1) only. Different species of same genus occupied diverse niche, such as *Lymnaea acuminata* species inhabited mostly lentic habitats where as *L. luteola* was found to be restricted only to lotic waters. *Anisus (Gyraulus) convexiusculus*, *Melania (Plotia) scabra* and *Thiara (Tarebia) lineata* were found to be highly restricted (stenotopic) to ponds, rivers and both rivers and confluence habitats, respectively. But other operculate snail species, namely *Vivipara bengalensis* race *gigantica*, *V. bengalensis* race *mandiensis* and *M. striatella tuberculata* exhibited a wide range of distribution (eurytopic) and survival in various aquatic habitats. Since these snail species namely *L. acuminata, L. luteola, A. convexiusculus, M. scabra,* and *T. lineata* are highly stenotopic or habitat-specific hence they prove to be bio-indicators of ecologically diverse aquatic habitats. Many clades of marine invertebrates exhibit a trend towards increased frequency of stenotopic species and sometimes this leads to elimination of eurytopes completely as in case of volutid neogastropods (Hansen 1978). Variations are much more in the gene pool of stenotopes than eurytopes which make stenotopes long term survivors in the lineage. However, for further confirmation of habitat preference of freshwater snail species such surveys in different geographical regions are recommended. The significance of the present study is that these snail species can be used for identification and classification of freshwater habitats without going for detailed physico-chemical analysis of water.



Figures 1–14: Freshwater snail species collected from diverse ecological aquatic habitats of southern Rajasthan. (1) *Lymnaea acuminata* f. *patula* (2) *L. acuminata* f. *chlamys* (3) *L. acuminata* f. *typica* (4) *L. acuminata* f. *rufescens* (5) *L. luteola* f. *australis* (6) *L. luteola* f. *typica* (7) *L. luteola* f. *impura* (8) *Planorbis* (*Indoplanorbis*) *exustus* (9) *Faunus ater* (10) *Melania* (*Plotia*) *scabra* (11) *Thiara* (*Tarebia*) *lineata* (12) *M. striatella tuberculata* (13) *Vivipara bengalensis* race *gigantica and (*14) *V. bengalensis* race *mandiensis*.

Table 1: Snail species and their diverse ecological habitats of southern Rajasthan

S.no	Snail species	Lotic habitats			Lentic habitats		
		River	Stream	Canal	Lake	Reservoir	Pond
	(A) PULMONATES						
	Family - Lymnaeidae						
1.	*Lymnaea acuminata* f.*patula*	-	-	-	-	+	+
2.	*L. acuminata* f. *chlamys*	-	-	-	-	+	+
3.	*L. acuminata* f. *typical*	-	-	-	-	+	+
4.	*L. acuminata* f. *rufescens*	-	-	-	-	+	+
5.	*L. luteola* f. *australis*	-	+	+	-	-	-
6.	*L. luteola* f. *typical*	+	+	+	-	-	-
7.	*L. luteola* f. *impura*	-	+	+	-	-	-
	Family- Planorbidae						
8.	*Planorbis* (*Indoplanorbis*) *exustus*	-	+	+	-	-	+
9.	*Anisus* (*Gyraulus*) *convexiusculus*	-	-	-	-	-	+
	(B) OPERCULATES						
	Family- Melaniidae (Thiaridae)						
10.	*Faunus ater*	-	-	-	-	+	+
11.	*Melania* (*Plotia*) *scabra*	+	-	-	-	-	-
12.	*Thiara* (*Tarebia*) *lineata*	-	-	-	-	+	-
13.	*M. striatella tuberculata*	+	+	+	+	+	-
	Family- Viviparidae						
14.	*Vivipara bengalensis* race *gigantica*	-	+	-	+	+	-
15.	*V. bengalensis* race *mandiensis*	-	+	-	-	+	-

+, inhabited; –, not found

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