



E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(3): 231-235
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Received: 04-03-2017
Accepted: 05-04-2017

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New locality report on freshwater clam; *Corbicula striatella* (Deshayes, 1854) (Bivalvia: Mollusca) with reference to freshwater bivalves from Baluchistan Province, Pakistan

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Abstract

The aim of present investigation is to study the distribution and diversity of freshwater Bivalves fauna from Balochistan Province during the year 2012-2013. Collection of specimens were done through hand picking, and scoop methods and preserved in 70% ethyl alcohol. Specimen were identified and categorized on the basis shell characteristics A total of 3 species including *Corbicula striatella* (Deshayes, 1854), *Parreysia favidens* (Benson, 1862) and *Lamellidens marginalis* (Lamark, 1892) were recorded from Zhob and Jaffrabad Districts of the Baluchistan Province. Among these, *Corbicula striatella* is presented in a new locality report from mountainous locality of Zhob District. Among these freshwater Bivalves species, the *Corbicula striatella* was tremendously facing threats due to modification and natural habitat destruction by extensive human's activity. Further, this newly threatened species requires its conservation from extinction

Keywords: Diversity, freshwater bivalves, *Corbicula striatella*, new locality report, Baluchistan

Introduction

The Province of Baluchistan is geographically largest among others Provinces of Pakistan and comprising of 347,190 km² area ^[1]. The Province has low population density due to the mountainous area and insufficient of water supply. The climate of the Baluchistan Province is found to have extreme hot and cold ^[2]. In winter season, the temperature can fall as low as -20 °C in some mountainous areas, while during summer it has been known to edge over 50 °C on the plains sites of this Province. Overall, temperature ranges around 18 °C to 50 °C ^[3].

A number of reports has been published on worldwide occurrence of *Corbicula* species ^[4]. A total of 14 *Corbicula* species was listed in India and other adjacent countries ^[5]. Baluchistan Province is in a drought conditions since last few decades, which might be directly effected on habitats and distribution of freshwater bivalves ^[6]. So far, little work has been done on freshwater molluscan fauna and focused on gastropod and bivalve fauna of Sindh and Punjab Provinces of Pakistan ^[7, 8, 9, 10]. However, few researcher have made some contributions on the gastropods and Bivalve molluscs except *Corbicula striatella* in Afghanistan with adjoining Baluchistan ^[11, 12].

The aim of present study is to throw some light on diversity, distribution, current status and threats related to freshwater Bivalve molluscan fauna of Baluchistan Province of Pakistan as no previous work has been performed before in this work.

Materials and Methods

Species collection sites

The molluscan samples were collected from 14 different localities (Fig. 1) of Baluchistan during the months of July 2012 till February 2013. The selected sampling sites were based on landscape, ecological distribution, presence and absence of water bodies, temperature differences, vegetation, rainfall and climatic condition variations. Different water bodies like rivers, streams, dams, ponds, lakes and paddy fields were preliminary surveyed for the collection of freshwater bivalve molluscs. Specimens were collected by hand picking, net and scoop methods ^[13]. Freshwater samples were placed in polythene bags and plastic containers containing 70% ethyl alcohol. Samples were brought to the Malacology Laboratory, Department of Zoology, and University of Baluchistan for further examinations.

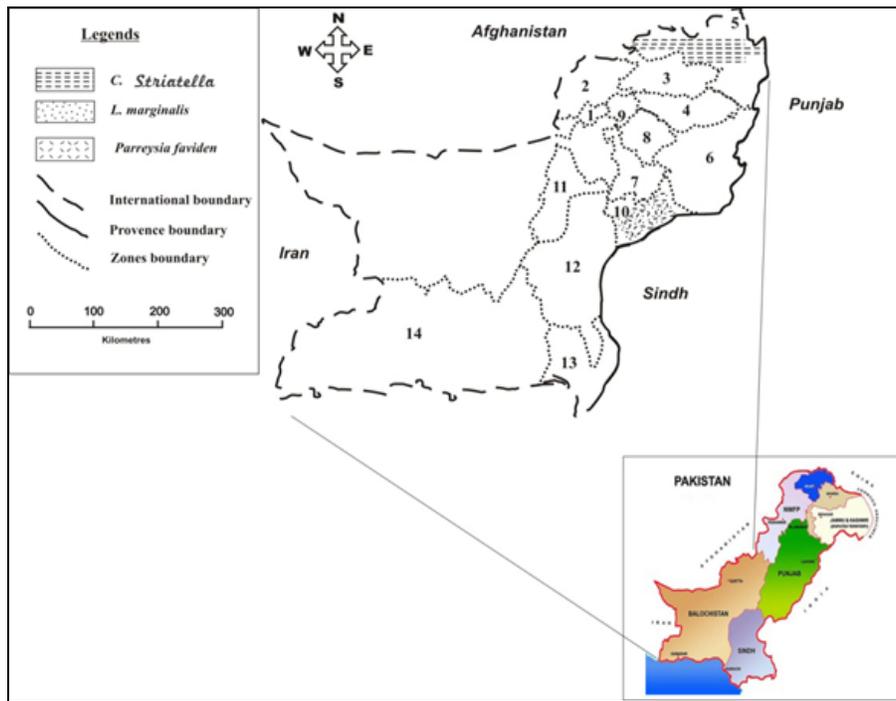


Fig 1: The map illustrates the different localities of Baluchistan Province with distribution of the bivalve species; 1-Quetta; 2-Pishin and Killa-Abdullah; 3-Killa- Saifullah; 4-Loralai; 5-Zhob; 6-Kohlu / Barkan; 7-Bolan; 8-Sibi; 9-Harnai; 10-Jaffarabad; 11-Kalat; 12-Khuzdar; 13-Lasbella; 14-Panjgoar

Morphological identification

Prior to examination, some samples were placed in oxalic acid aqueous solution in order to remove attached coatings, then washed with tap-water and lastly preserved in 70% ethyl alcohol.

The freshwater bivalves were identified and categorized on the basis of shell shape, size, colour and ornamentation. The morphological indicators such as periostracum, striated/ribbed, position of ligament, ligament scar were noted. Adductor muscles scar, dentition, pallial lines with scar, umbo shape, position were also checked. Major identification keys and available literatures were consulted to identify the species of freshwater Bivalves [5, 9, 12, 14, 15, 16, 17, 18, 19,20]. Species were identified under a Binocular Stereo Microscope (Wild Heerbrug ER.59-1990). Measurements were performed using Vernier caliper and photographs were taken using a digital camera.

Population estimation

Diversity index and statistical analysis were adopted for estimation of population diversity and species richness of freshwater bivalves. Simpson index was used using following formula:

$$\text{Simpson Index (D)} = \frac{N(N-1)}{\sum n(n-1)}$$

Test for equal means based on two way ANOVA without replication was applied using paleontological statistics software version 3.15 to calculate the population density.

Results

In the present study, 3 species, belonging to 2 orders and 3 families with 3 genera have been reported and their detail is given as below:

1. *Corbicula striatella*, Deshayes, 1854 (Fig. 2 and 3).

Diagnostic Features: Shell was moderately large, thick and triangularly ovate tumid. The dorsal margin arched, more on

the anterior than posterior. Umbones were almost central, prominent and periostracum shining violet in young, dark brown colour in adults, streak regular, concentric and raised into ridges. The muscle scars deeply developed and pallial line continuous with a mark of sinus. Three divergent cardinal teeth were present in each valve. The lateral teeth were elongated and lamelliform. The right valves had 2 lateral teeth both anteriorly and posteriorly, while the left valve had 1 on each side. Average adult shell length, height and width about 21.20mm, 17.19mm and 11.58mm respectively (Table 1).

Distribution and habitat: This specie was dispersed in river and stream of the Zhob locality only and it has been reported for the first time in the Province of Baluchistan, Pakistan. It is a native species of southern and eastern Asia. Elsewhere, it has been distributed in Myanmar, Peshawar and Sindh Province of Pakistan, India, Seri lanka. Generally inhabits rivers, streams, lakes, man-made canals, lakes and prefers fine gravel, sand or mud substratum [21]. We have collected the specimens from canals and streams of the Zhob locality only.

Status: The total 14 different localities of Baluchistan Province were studied for collection of *Corbicula striatella*. This species was located in the streams, canals and small ditches of the Zhob sites of the Province only. This species is mainly of Asian origin and hence it is commonly called Asian clam or Asiatic clam. In South Asia, it is known as the prosperity clam or good luck clam. This species was introduced to many parts of the world, particularly the America and Europe. The predators of the *Corbicula* are mostly birds, ducks, Cray fish and turtle, frog, and salamander have been reported to feed occasionally on small bivalves. Free living oligochaetes and fishes known as molluscivores feed also on clams [22]. It is sold as fish bait and sold through the aquarium trade in the United States, It is also famous as good fortune like gold. They purify the water bodies as feed primarily on phytoplankton (algae). They can tolerate salinities of up to 13ppt for short periods and temperature between 2 °C to 30 °C [23].

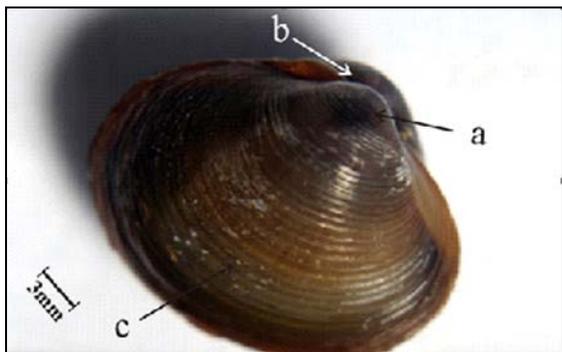


Fig 2: *Corbicula striatella* external view showing; a. elevated umbo, b. ligament and c. surface ribs.

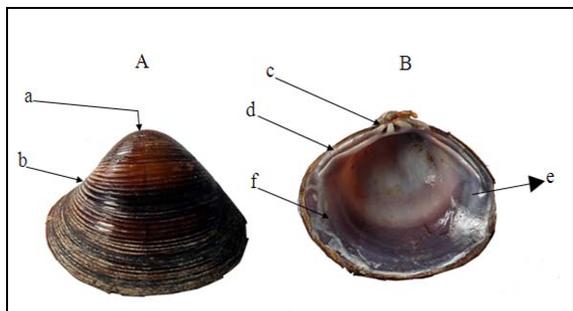


Fig 3: *Corbicula striatella* showing; a. umbo, b. surface ribs, c. cardinal teeth, d. lateral teeth, e. adductor muscle scar and f. pallial line.

2. Parreysia (P) favidens Benson, 1862 (Fig. 4).

Diagnostic Features: The shell was thickened, broad and oval to elliptical in shaped. The outer surface was roughened showing surface ribs while inner surface was nacreous, white and glossy. The anterior side was slightly rounded while the posterior margin was pointed or triangular. The dorsal side was straightened but not as such long and ventral margin was rough and dark. Shell was somewhat but distinctly inflated. Umbo was elevated with strong edge and prominent with v and win shaped distinct lines. Cavity of the umbo was deep. Lateral teeth were elongated whereas the Cardinal teeth present in both valves. Scar was distinctive, while Pallial line was very prominent anteriorly and slightly visible as it extends to the posterior end. The colour of Shell mixed with yellow and green-brown while umbo colour is white and

opaquely shiny. Average adult shell length, height and width about 43.67mm, 32.47mm and 22.99mm respectively (Table 1).

Distribution and habitat. Distributed in the Jaffar-Abad site of the Baluchistan Province. Generally inhabits in freshwater ponds, streams and rivers of muddy bottom. But we collected from pat feeder canals of Dera Murad Jamali and linked areas of the Baluchistan Province.

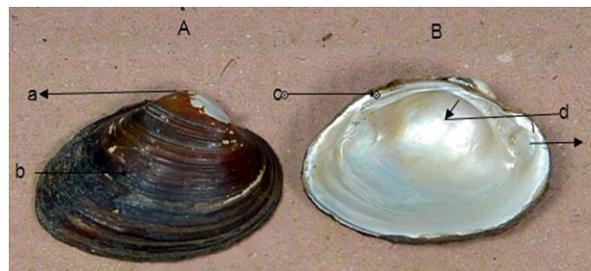


Fig 4: *Parreysia (parreysia) favidens* indicates features including are marked external view A. a. elevated umbo with strong edge, b. surface ribs; interior view includes B; c. lateral teeth, d. umbo cavity and e. adductor mussel scar are indicated on the interior view

3. Lamellidens marginalis Lamarck, 1819 (Fig. 5, 6).

Diagnostic Features: The shell was thick, heavy, and transversely oblong-ovate in shaped and equilateral as well as greater in length than height. The periostracum of the shell was dark reddish brown in colour and strongly concentrically striated towards the ventral side. Umbo was shining nearly white in colour and more nearer to the anterior side and contained weakly visible surface ribs. The Cavity of the umbo was not deep. The interior side of the shell was pearly white and iridescent. The anterior side of the shell was rounded than the posterior side which was sloped angularly. The hinge plate was narrowed and almost straightened. Dorsal side behind the umbo was straightened and extended as a more or less well defined winged-like expansion. Infront of umbo, the dorsal margin was shortened and slopes were steeply downwards. Both lateral and cardinal teeth were present. Scars were distinct while the Pallial line was clearly visible. The anterior adductor scar was circular and deeper than the posterior scar. Average adult shell length, height and width were about 77.88mm, 41.45mm and 28.63mm respectively (Table 1).

Table 1: Shell measurement (mm) for freshwater Bivalves species collected from different localities of Baluchistan.

N*	Freshwater Bivalves								
	<i>Corbicula striatella</i>			<i>Parreysia favidens</i>			<i>Lamellidens marginalis</i>		
	Length	Height	Width	Length	Height	Width	Length	Height	Width
1	16.30	13.13	9.00	33.15	28.40	17.35	68.40	35.15	23.15
2	17.35	14.20	10.00	40.00	30.05	21.05	73.15	33.15	22.15
3	18.40	14.20	10.00	41.05	30.05	21.05	73.15	37.35	24.20
4	19.45	16.30	11.05	42.10	31.05	22.10	75.25	38.40	25.25
5	21.05	17.35	11.05	43.15	32.10	23.15	78.40	42.10	28.40
6	22.70	18.40	12.10	44.20	32.10	24.20	78.40	42.10	29.45
7	23.15	19.45	13.15	45.25	33.15	24.20	79.45	45.20	33.15
8	24.20	19.45	13.15	46.30	34.20	25.25	81.05	46.30	33.15
9	24.20	19.45	13.15	49.45	36.30	25.25	84.20	45.35	36.30
10	25.25	20.00	13.15	52.10	37.35	26.30	87.35	49.45	31.15
Mean	21.20	17.19	11.58	43.67	32.47	22.99	77.88	41.45	28.63
SD	3.16	2.57	1.57	5.16	2.83	2.67	5.61	5.29	4.82

* N stands for the number of species used for measurement purpose.

Distribution and habitat: It was reported from Jaffar-Abad locality of the Baluchistan Province, elsewhere in Bangladesh, India, Sri-lanka and Burma. Generally it is found in the freshwater streams, rivers and ponds of muddy bottom. Samples were collected from put feeder canals of the Dera Murad Jamali.

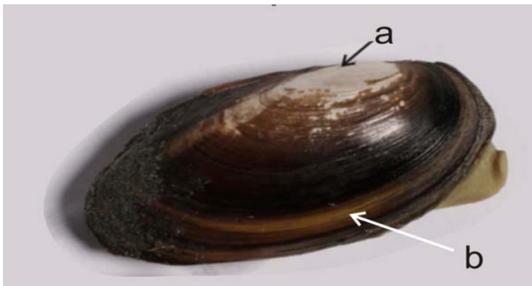


Fig 5: *Lamellidens marginalis* with external valve view showing; a. depressed umbo, b. surface ribs.



Fig 6: *Lamellidens marginalis* interior valve view showing; c. lateral teeth, d. Adductor muscle scar.

Population estimation

The calculated value of Simpson index was 0.47, indicates the prevalence of greater species diversity in collected regions. This calculation also gives information regarding species richness. A total of 384 bivalves specimens were collected and the percentage prevalence was found higher in *Lamellidens marginalis* (47.13%) than *Parreysia favidens* (38.28%) and least in *Corbicula striatella* (14.58%) (Fig. 7). Significant results ($p < 0.001$) was obtained, that showed highly rich fauna occurrence of freshwater bivalves in collected sites (Table 2).

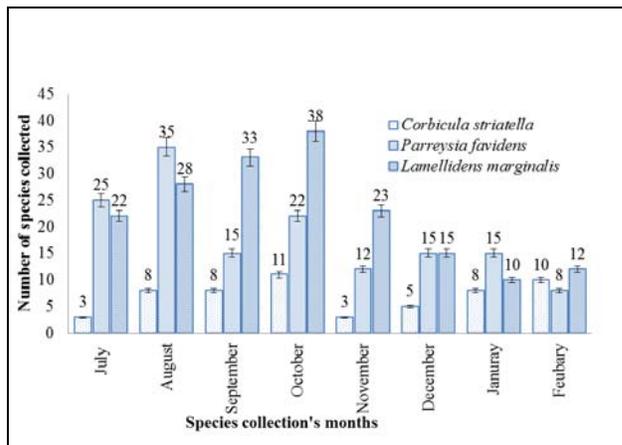


Fig 7: Indicates freshwater bivalves collection during the months of July 2012 till February 2013

Table 2: Calculation of population density using two way ANOVA without replication for freshwater bivalve in their respective collected sites of Baluchistan.

legends	Sum of square	df	Mean square	F-value	p-value*
Rows:	1044.25	2	522.12	11.5	0.001
Error:	635.75	14	45.41		
Total:	2328	23			

* Significant results ($p < 0.001$) was obtained less than 0.05 level of confidence level, and this calculation reflects higher population occurrence for bivalve species.

Discussion

A total 3 species of freshwater Bivalve were recorded from diverse sites of Baluchistan Province. Among these, *C. striatella* is found to be a new locality report in this province. Although, this species has been also reported from adjoining areas such in Lahore; Punjab Province, Peshawar; Khyber Pakhtoonkhawa and in Sindh Province of Pakistan [8, 17, 24]. In accordance to our work, a total of 4 species of Bivalves were previously reported from inland water bodies of Lahore District in Punjab Province [17]. While, 5 to 7 species of Bivalves has already been reported from various water bodies of Layari and Indus river of Sindh Province [25, 26].

Our results revealed that all 3 collected species were found uniquely in the 2 different areas. The *L. marginalis* and *P. favidens* species were found in southern Baluchistan having temperate condition, Muddy River and somewhat polluted water. These 2 species also have connection to their neighboring temperate areas of Sindh and Punjab Provinces [27]. The occurrence of *C. striatella* was confirmed in Northern mountainous regions which covers clean freshwater streams, canals, rivers of sand and mud substratum in Baluchistan.

Same specie has also adapted the mountainous sites as for their habitat in other Provinces of Pakistan (Peshawar, Sindh and Lahore) [12].

The results showed that Bivalve fauna of Baluchistan Province appears to be extremely poor in number of species particularly *C. striatella*. The reasons might be scarcity of water, facing drought from last few decades, rapid natural habitat modification and destruction due to increase in human’s activities and somewhat unawareness among people.

Conclusion

The aim of the present work is based on geographical distribution and morphological characterization of freshwater Bivalves especially *Corbicula striatella*. The same specie was previously not reported in this Province. However, conservative strategies are required to secure their natural habitats and population diversity in this region.

Acknowledgements

Authors would like to thanks all colleagues who provided critical evaluation and useful suggestion for this manuscript.

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