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International Journal of Current Research
Vol. 5, Issue, 09, pp.2500-2505, September, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

FRESHWATER BIVALVE FAUNA IN THE WESTERN GHATS RIVERS OF KARNATAKA, INDIA: DIVERSITY, DISTRIBUTION PATTERNS, THREATS AND CONSERVATION NEEDS

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ARTICLE INFO

Article History:
Received 16th July, 2013
Received in revised form
19th July, 2013
Accepted 30th August, 2013
Published online 14th September, 2013

Key words:
Diversity,
Freshwater bivalves,
Karnataka,
The Western Ghats.

ABSTRACT

The diversity and distribution patterns of freshwater bivalves have been studied from January 2006 to December 2006 in the Western Ghats Rivers of Karnataka, India. The study was carried out in different sampling sites of 20 rivers. A total of 19 species of freshwater bivalves belonging to 3 families were recorded during the study period. Of these, a total of 15, 3 and 1 species of bivalves belong to families Unionidae, Corbiculidae and Etheriidae, respectively. All the species represented by five genus viz, *Parreysia*-9 species *Lamellidens*-5 species *Corbicula*-3 species, whereas *Arcidopsis* and *Pseudomulleria* represented with one species each. The population density of bivalves was high in river Cauvery and *P. corrugata* was the most common species found in 17 rivers followed by *L. marginalis* (15 rivers). In the present study, three species of the bivalves are not assessed (endemic-*Arcidopsis footie*, *Parreysia khadakvaslaensis*; non endemic-*C. cashmiriensis*), *Pseudomulleria dalyi* is assessed as endangered and endemic, whereas *P. cylindrica* is listed as Data Deficient and rest of the 14 species are listed in Least Concern category by International Union for Conservation of Nature (IUCN).

INTRODUCTION

Freshwater bivalves are one of the most diverse and threatened groups of animals (Vaughan *et al*., 2004, Lydeard *et al*., 2004). The species of Unionoida, colloquially known as freshwater mussels, pearly mussels or naiades are conspicuous inhabitants of rivers and lakes on all continents except Antarctica (Graf and Cummings, 2007). Freshwater mussels have generated significant interest over the last few decades due to their worldwide imperiled status (Lydeard *et al*., 2004). The absence of global unionoid diversity patterns hinders the ability of ecologists, conservation biologists and freshwater malacologists, among other stakeholders, to apply patterns of freshwater mussel diversity and distribution to predictions. While freshwater mussels are indeed of practical interest, owing to their conservation status (Strayer, 2006) and economic importance (Baker, 1993; Anthony and Downing, 2001), they are also extremely interesting from a biological perspective (Strayer *et al*., 2004). Much information is not available on diversity, biology and ecology of bivalves from Indian subcontinent. Some sporadic studies were carried out in Pune which is the northern Western Ghats by Tonapi and Mulherkar (1963) and Tonapi (1971). Srinivasan (1980) has reported 3 species of freshwater mussel in the Cauvery river system, Tamil Nadu viz. *Lamellidens marginalis*, *L. consobrinus* and *Parreysia favidens*. Five species of bivalves belonging to 2 different families such as Unionidae and Corbiculidae have been reported by Amanullah and Hameed (1996) from river Cauvery at Tiruchirappalli, Tamil Nadu. Patil and Talmale (2005) documented freshwater bivalves of Maharastra State and listed 19 species and varieties. The reports on freshwater bivalves from the Western Ghats of Karnataka are meager and fragmentary. Four bivalve species were documented by Madhyastha and Mumbrekar (2006) from river Tunga. Ramesha and Thippeswamy (2009) studied allometry and condition index and Malathi and Thippeswamy (2012) studied fatty acid composition of *Parreysia corrugata* from rivers Kempuhole and Tunga respectively. There are only three books available on Indian freshwater molluscs, one is Fauna of British India by Preston (1928) and other two are by Subba Roa (1989) and Ramakrishna and Dey (2007). The latest and most updated information on distributions of molluscan fauna with maps has been given in the book entitled "Handbook on Indian Freshwater Molluscs" (Ramakrishna and Dey 2007). All these books failed to give the information about the freshwater bivalve species distributed in the rivers of the Western Ghats of Karnataka, India. The present study has been undertaken to fulfill the lacuna and the aim of investigation was to document the freshwater bivalve distribution and diversity in the Western Ghats rivers of Karnataka, India.

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Study area

The Western Ghats provide a principal geographical barrier in the path of the Arabian Sea branch of the southwest monsoon, and are principally responsible for the heavy rainfall over the western coastal belt. The southwest monsoon season (June to September) is the principal rainy season and over 90% of annual rainfall is realised in this period. The west flowing rivers of Karnataka generally originate in the Western Ghats at an elevation ranging from 400 meters to 1,600 meters above the mean sea level, close to the Western Ghats ridge. The rivers generally flow westward and meet the Arabian Sea after a short run varying from 50 kms to 300 kms. Few rivers of the Western Ghats flow eastward and drain into Bay of Bengal after a long run. The rivers are very steep in the upper reaches and fairly steep in the middle reaches. The rivers in the lower reaches are relatively wide, flat ingredient and have flood plains (Fig. 1). The

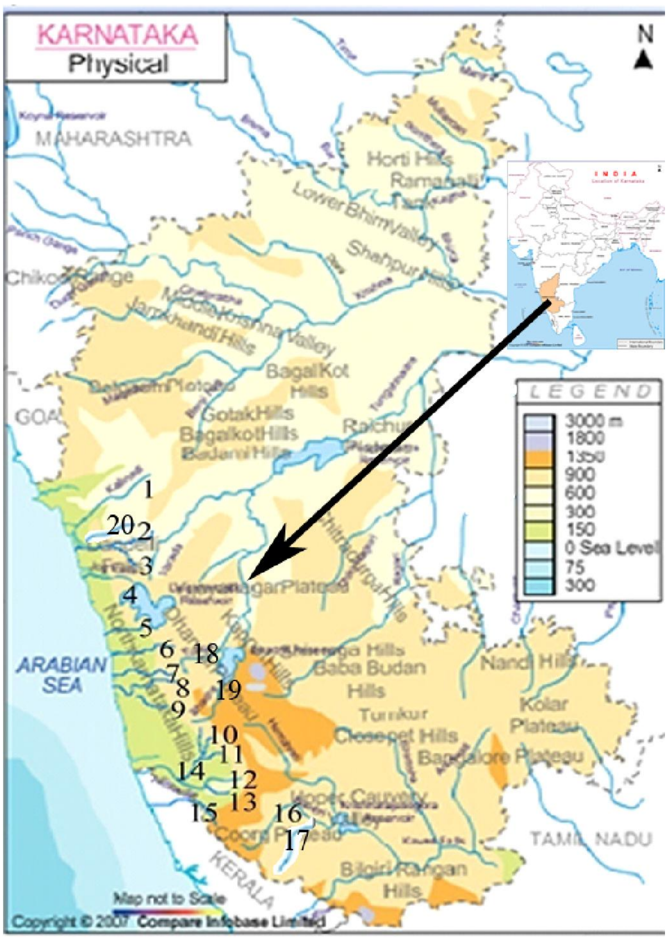

Figure 1. The rivers of the Western Ghats where mussel diversity survey was carried out during the study period. Rivers: Kali, 1; Aghanashini, 2; Rama, 3; Sharavathi, 4; Kollur, 5; Haladi, 6; Swarna, 7; Seeta, 8; Yannehole, 9; Neriya, 10; Sisila, 11; Kempuhole, 12; Kumaradhara,13; Netravathi, 14; Payaswini, 15; Cauvery, 16; Harangi, 17; Tunga, 18; Bhadra, 19; Gangavalli, 20

biodiversity survey for freshwater bivalves was carried out in the Western Ghats rivers of Karnataka (Fig. 1). The study was undertaken in the west flowing rivers Kempuhole, Kumaradhara, Neriya, Sisila, Nethravathi and Payaswini in Dakshina Kannada district. The rivers namely, Seeta, Varahi (Haladi), Swarna and Yennehole were surveyed in Udupi district, whereas the rivers Kali, Ganagvalli and Aghanashini were studied for bivalve diversity in Uttar Kannada district. River Sharavathi (Shivamogga district) was also assessed for bivalve diversity. The bivalve diversity assessment was carried out in the east flowing rivers Cauvery, Harangi (Kodagu district), Tunga (Shivamogga district) and Bhadra (Chikkamagalor district) as well.

MATERIALS AND METHODS

The freshwater bivalves were collected between January 2006 and December 2006 from 26 sampling sites in 20 different rivers of the Western Ghats of Karnataka, India (Table 1 & Fig. 1). Bivalves were collected from each sampling site using Peterson's grab sampler (where depth was more than 1 meter) and Surber sampler (where depth is less than 1 meter). Collected samples were washed and external colour and morphology of the organisms were documented *per see*. Then the organisms were preserved in plastic screw cap bottles by adding 70% alcohol. Bivalve taxa were identified using different identification keys (Subba Rao, 1989; Ramakrishna and Dey, 2007). Seasonal samplings were conducted on each sampling site. Population density was estimated by counting the total number of species per square meter for each sample.

RESULTS

The data on the distribution of freshwater bivalves in the rivers of Western Ghats of Karnataka is depicted in Table 2. A total of 19 species of freshwater bivalves belonging to 3 families were recorded during the study period. Of these, a total of 15 species of bivalves belonged to family Unionidae, 3 species belonged to Corbiculidae and only 1 species belonged to family Etheriidae. The genus *Parreysia* was represented by 9 species (*P. corrugata, P. cylindrica, P. favidens, P. gowhattensis, P. khadakvaslaensis, P. rajahensis, P. shurtleffiana, P. theobaldi, Parreysia* sp.) followed by *Lamellidens* with 5 species (*L. marginalis, L. jenkinsianus, L. generosus, L.*

Table 1. Latitude and longitudes, population density of the study area where freshwater bivalves were collected

Sl. No.	River	Latitude and longitude of the sampling site	Population density of bivalves (no. m^{-2})			
			S1	S2	S3	Mean
1	Kali	14^0 52′ 18.05″N 74^0 23′ 09.62″ E	13	8	9	10
2	Aghanashini	14^0 25′ 46.10″N 74^0 38′ 38.41″ E	8	7	9	8
3	Rama	14^0 20′ 59.59″N 74^0 44′ 33.16″ E	5	2	2	3
4	Sharavathi,	14^0 13′ 36.88″N 74^0 49′ 20.94″ E	3	4	2	3
5	Kollur	13^0 47′ 49.73″N 74^0 48′ 44.71″ E	4	5	3	4
6	Haladi	13^0 35′ 01.49″N 74^0 51′ 58.62″ E	9	13	11	11
7	Swarna (Site 1)	13^0 17′ 38.54″N 74^0 59′ 18.43″ E	6	5	4	5
	Swarna (Site 2)	13^0 22′ 03.10″N 74^0 52′ 24.48″ E	5	4	6	5
8	Seeta,	13^0 28′ 30.89″N 75^0 02′ 22.95″ E	18	13	14	15
9	Yannehole	13^0 17′ 43.56″N 74^0 59′ 13.25″ E	3	4	2	3
10	Neriya	12^0 56′ 15.90″N 75^0 25′ 16.83″ E	15	12	12	13
11	Sisila	12^0 55′ 09.58″N 75^0 30′ 34.84″ E	4	5	3	4
12	Kempuhole	12^0 46′ 21.02″N, 75^{0}26′47.03″ E	21	16	17	18
13	Kumaradhara	12^0 48′ 12.11″N, 75^{0}28′41.12″ E	3	2	4	3
14	Netravathi (Site 1)	12^0 56′ 08.59″N 75^0 22′ 13.66″ E	5	6	4	5
	Netravathi (Site 2)	12^0 50′ 35.56″N 75^0 17′ 30.91″ E	6	4	6	5
15	Payaswini	12^0 34′ 41.39″N 75^0 23′ 01.91″ E	11	13	9	11
16	Cauvery (Site 1)	12^0 18′ 54.90″N 75^0 41′ 57.44″ E	6	5	4	5
	Cauvery (Site 2)	12^0 18′ 37.86″N 75^0 52′ 49.25″ E	20	18	22	20
	Cauvery (Site 3)	12^0 26′ 58.07″N 75^0 58′ 20.92″ E	45	40	44	43
17	Harangi	12^0 30′ 04.19″N 75^0 56′ 52.35″ E	19	15	20	18
18	Tunga (Site 1)	13^{0}43′ 48.87″ N 75^0 27′ 39.25″ E	9	8	7	8
	Tunga (Site 2)	13^{0}40′ 40.73″ N 75^0 20′ 13.65″ E	10	7	10	9
19	Bhadra (Site 1)	13^{0}21′ 01.61″ N 75^0 28′ 12.74″ E	5	4	6	5
	Bhadra (Site 2)	13^{0}50′ 36.85″ N 75^0 41′ 47.11″ E	6	5	4	5
20	Gangavalli	14^0 44′ 00.46″ N 74^{0}32′ 08.66″ E	14	15	10	13

Table 2. Distribution of freshwater bivalves in the rivers of Western Ghats of Karnataka, India. *Rivers: Kali, 1; Aghanashini, 2; Rama, 3; Sharavathi, 4; Kollur, 5; Haladi, 6; Swarna, 7; Seeta, 8; Yannehole, 9; Neriya, 10; Sisila, 11; Kempuhole, 12; Kumaradhara,13; Netravathi, 14; Payaswini, 15; Cauvery, 16; Harangi, 17; Tunga, 18; Bhadra, 19; Gangavalli, 20

SNo.	Bivalve species	Rivers*																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	Family: Unionidae																					
1	*Arcidopsis footei* (Theobald, 1876)																		+			1
2	*Lamellidens consobrinus* (Lea, 1860)	+																		+		2
3	*L. generosus* (Gould, 1847)	+							+		+	+	+	+	+			+				8
4	*L. jenkinsianus* (Benson, 1862)	+			+	+			+		+	+	+		+	+	+			+		11
5	*L. marginalis* (Lamarck, 1819)	+			+	+		+	+		+		+	+	+	+	+	+	+	+	+	15
6	*L. phenchooganjensis* (Preston, 1912)					+											+					2
7	*Parreysia corrugata* (Müller, 1774)	+	+			+	+	+	+	+	+		+	+	+	+		+	+	+	+	17
8	*P. cylindrica* Annandale & Prashad, 1919				+												+		+			3
9	*P. favidens* (Benson, 1862)	+	+		+	+	+		+	+						+	+	+			+	11
10	*P. gowhattensis* (Theobald, 1874)					+										+						2
11	*P. khadakvaslaensis* (Ray 1966)																		+			1
12	*P. rajahensis* (Lea, 1841)	+																			+	2
13	*P. shurtleffiana* (Lea, 1856)								+													1
14	*Parreysia* sp.					+					+	+			+	+		+				6
15	*P. theobaldi* (Preston, 1912)										+		+								+	3
	Family: Etheriidae																					
16	*Pseudomulleria dalyi* (Smith, 1898)																		+			1
	Family: Corbiculadae																					
17	*Corbicula assamensis* Prashad, 1928																+					1
18	*C. cashmiriensis* Deshayes 1854			+									+	+	+		+			+		6
19	*C. striatella* Deshayes, 1854							+									+		+			3
		7	2	1	4	7	2	3	6	2	6	3	6	4	6	6	8	5	7	5	5	

consobrinus, L. phenchooganjensis). The genus *Corbicula* represented by 3 species (*Corbiula assamensis, C. cashmiriensis, C. striatella*). Whereas the genera *Arcidopsis (A. footei)* and *Pseudomulleria* (*P. dalyi*) represented with one species each. The river Cauvery was represented with maximum (9) species followed by the rivers Kali, Kollur and Tunga with 7 species each. The rivers Seeta, Neriya, Kempuhole, Nethravathi and Payaswini represented with 6 bivalve species each. Three rivers (Harangi, Bhadra, Gangavalli) represented with 5 bivalves species, whereas the rivers Sharavathi and Kumaradhara represented by 4 species. The rivers Swarna and Sisila represented by 3 species and rivers Aghanashini, Haladi and Yannehole represented by 2 species each. The river Rama represented with only one species (Table 2). The density of bivalves from different rivers is presented in Table 1. *Corbicula* spp. (*C. assamensis, C. cashmirensis, C. striatella*) showed highest density (43 no./m^2) at sampling site 3 in river Cauvery. *L. marginalis, L. jenkinsianus* and *P. corrugata* were abundant (20 no./m^2) at sampling site 2 and rests were rare (*L. phenchooganjensis, P. cylindrica, P. favidens*). The sampling site 1 of river Cauvery showed poor bivalve density (5 no. /m^2). The rivers Kempuhole and Harangi showed good bivalve density (18 no. /m^2). The bivalve *P. corrugata* was abundantly distributed in the river Kempuhole and the other species such as *L. generosus, L, jenkinsianus, L, marginalis, P. theobaldi, C. stratella* were recorded in lesser numbers. *L. marginalis* and *P. corrugata* were abundant in river Harangi, whereas *L. generosus, Parreysia* sp. and *P. favidens* were found rarely. The bivalve density in the river Seeta was 15 (no. /m^2), *P. favidens* were abundant followed by *P. corrugata*, other bivalves were scarce. The rivers Neriya and Gangavalli showed fairly good density (13 no. /m^2) at the sampling sites. The genera *Lamellidens* and *Parreysia* were also equally distributed in river Neriya, whereas in river Gangavalli *Lamellidens* were abundant followed by *Parreysia*. The bivalve density in the rivers Haladi and Payaswini was 11 no. /m^2. *P. corrugata* and *P. favidens* were the only available bivalves in river Haladi, whereas river Payaswini represent with 6 species, the predominant species were *L. jenkinsianus, L. marginalis* and *P. favidens*. The bivalve density at river Kali was 10 no. /m^2, the members of genus *Lamellidens* (*L. consorbrinus*, *L. generosus, L, jenkinsianus, L, marginalis*) were abundant in the river followed by *Parreysia* (*P. corrugata, P. favidens, P. rajahensis*). The bivalve density at river Aghanashini was 8 (no. /m^2), the common species were *P. favidens* and *P. corrugata*, other bivalves were uncommon in the river. The density of bivalves at site 1 and 2 in river Tunga was 8 and 9 (no. /m^2) respectively. At site 1 *Arcidopsis footei* and *Pseudomulleria dalyi* were abundant, however at site 2 the members of genus *Lamellidens* were abundant followed by *Parreysia*. The bivalve density in the rivers Bhadra, Nethravathi and Swarna was 5 no. /m^2. The rivers Sisila and Kollur showed low bivalve density (4 no. /m^2), whereas the rivers Rama, Sharavathi, Yannehole and Kumaradhara were having lowest bivalve density (3 no. /m^2). The distribution of bivalve species in the Western Ghats rivers of Karnataka is depicted in Table 2. *Parreysia corrugata* is the most common species found in the 17 rivers during the study period, followed by *L. marginalis*, which distributed in 15 rivers. *L. jenkinsianus* and *P. favidens* were documented from 11 rivers, whereas *L. generosus* found in 8 rivers. The bivalves *Parreysia sp.* and *C. cashmirensis* were found from 6 rivers. *P. cylindrical, P. theobaldi* and *C. striatella* were documented from 3 rivers. *L. consobrinus*, *L. phenchooganjensis, P. rajahensis, C. assamensis* were documented from 2 rivers. The bivalves *Arcidopsis footei, P. khadakvaslaensis* and *Pseudomulleria dalyi* were documented only from river Tunga.

DISCUSSION

Freshwater bivalves are the most characteristic and widespread of riverine biota. Rivers have been a major site of evolution and diversification of these animals and river systems worldwide support hundreds of species of these animals and quantitatively most important group throughout the year. The studies of freshwater bivalves in rivers are so few that it is difficult to make any firm generalization about the abundance and diversity of bivalves in such habitat. The present study showed that bivalves were widely distributed in the rivers of Western Ghats of Karnataka (Table 2). The most commonly encountered bivalves in the rivers studied included *P. corrugata*, *L. marginalis, P. favidens* and *Corbicula cashmiriensis*. All the species of the family Unionidae and Corbiculidae recorded in the present investigation are known from neighboring countries (Preston, 1928) such as Nepal, Bangladesh, Srilanka. The river Yannehole seems to be seasonal and having very little amount of water during pre monsoon season, resulting in low species richness. In other rivers such as Kempuhole, Payaswini, Cauvery, Neriya are perennial and this might be the reason for the abundance and species richness of the bivalves in these rivers. The bivalve *Corbicula* spp.

bivalves (*L. consobrinus, L. corrianus, L. lamellatus, L. marginalis, P. caeulea, P. corrugata, P. cylindrica, P. favidens, P. rajahensis, C. krishnaea, C. peninsularis, C. regulais*, *C. straitella*). Among the bivalves recorded from Maharashtra, the species *L. corrianus, L. lamellatus, C. krishnaea, C. peninsularis* and *C. regulais* were not found in the present study, which suggest that more studies in the Western Ghats Rivers of Karnataka may reveal much more bivalve species.

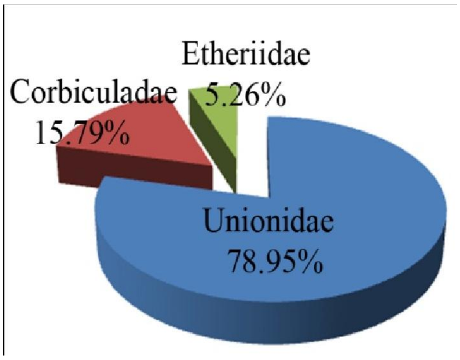

Figure 2. Bivalve distribution in the river of the Western Ghats of Karnataka

The family Unionidae is the dominant group containing 78.95% of the species found in the study area, followed by Corbiculidae (15.79%) and Etheriidae (5.26%) (Fig. 2). Among the bivalves documented in present study, three species (15.79%) of the bivalves are not assessed (endemic-*Arcidopsis footie*, *Parreysia khadakvaslaensis*; non endemic-*C. cashmiriensis*),

Table 3. List of freshwater bivalves in the rivers of the Western Ghats of Karnataka

S.No	Family	Species	Red List Category	Endemic to Western Ghats
1	Unionidae	*Arcidopsis footei* (Theobald, 1876)	NA	Endemic
2	Unionidae	*Parreysia cylindrica* Annandale & Prashad, 1919	DD	
3	Unionidae	*Parreysia khadakvaslaensis* (Ray 1966)	NA	Endemic
4	Etheriidae	*Pseudomulleria dalyi* (Smith, 1898)	ED	Endemic
5	Corbiculadae	*Corbicula cashmiriensis* Deshayes 1854	NA	

NA, Not Assessed; DD, Data Deficient; ED, Endangered

Table 4. Assessment of freshwater bivalves of the Western Ghats of Karnataka

Family	Genus	Species	Data Deficient	Least Concern	Endangered	Not Assessed
Unionidae	3	15	1	12		2
Corbiculidae	1	3		2		1
Etheriidae	1	1			1	
Total	5	19	1	14	1	3

found abundantly (Table 1) in river Cauvery at Khushalanagar (Site 3), could be of the river's perennial nature and it flows in the plains of Kodagu district. Many studies have shown that traditional habitat variables such as water depth, current speed, sediment granulometry, etc were unable to explain bivalve distribution in river water (Strayer *et al*., 1981; Strayer, 1999). Strayer (1999) argued that studies have focused on static properties of the sediments (grain size), where dynamic properties (distribution regime) of the river bed might be considerably more important for diversity and abundance of freshwater bivalves. All the species recorded in the present study were previously documented from other parts of India (Ramakrishna and Dey, 2007). The species such as *L. marginalis, L. jenkinsianus, L. consobrinus*, *P. corrugata* and *P. favidens* and were recorded from Nepal (Nesemann and Sharma, 2005). *L. marginalis, P. favidens* and *C. striatella* were reported from river Barak and its tributaries from Assam, India (Roy and Gupta, 2010). Kumar and Vyas (2012) documented *P. occata, P. corrugata, P. shurtleffiana, L. corrianus,* C. *straitella* and *Pisidium nevillianum* from river Narmada. Apart from *L. corrianus, P. occata* and *Pisidium nevillianum* other bivalves were recorded in the present study. Patil and Talmale (2005) prepared a check list of molluscan's of Maharashatra State, India and reported 13

Pseudomulleria dalyi (15.79%) is assessed as Endangered (EN), whereas *P. cylindrical* (15.79%) is listed as Data Deficient (DD) and rest of the 14 species (73.29%) are listed in Least Concern (LC) category by International Union for Conservation of Nature (IUCN) (Table 4, Fig. 3).

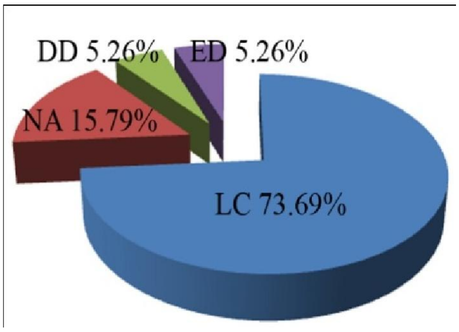

Figure 3. Assessment of bivalves documented in the river of the Western Ghats of Karnataka LC, Least Concern; NA, Not Assessed; DD, Data Deficient; ED, Endangered

Habitat change is also a reason for population decline of bivalve species. The construction of dam at Gajanur across the river Tunga would have affected endemic bivalves (*A. footie*, *P. dalyi*). The endemic bivalves of the Western Ghats such as *A. footie* and *P. dalyi* (EN) (IUCN, 2012) are in need of conservation plan (Table 3 & 4, Fig. 3). The major source of pollution in the Western Ghats is due to human interference mainly by deforestation, industrial effluents (Laxmilatha and Appukuttan, 2002), agriculture and fish harvesting. The decline in freshwater bivalves has generally been attributed to pollution (Bogan, 1993; 2008) and the effects of invasive species (Strayer, 1999). Moreover river management (building of dams and dredging) (Vaughn and Taylor, 1999; Aldridge, 2000) affects the molluscs diversity by variation of water flow system, increased sedimentation and loss of host fish and habitat degradation. Bivalves are benthic and filter feeders therefore any change in the soil chemistry affect this population diversity.

In some part of India sand mining affect the river aquatic biota but there are no data available regarding the impact of sand mining on bivalves from the Western Ghats. According to the report by IUCN, *Pseudomulleria dalyi* (EN) is the only threatened bivalve species. Its population in River Tunga is threatened by the overharvesting of the fishes (using explosive and toxic chemicals) that provide *P. dalyi* with a host to complete its life cycle. Several bivalves are predominantly susceptible to water pollution, as they accumulate toxins quickly (Salanki *et al*., 2003), and have been unfavorably affected in polluted habitats. Anthropogenic (bathing and washing), agricultural pollution, tourism and fishing using chemicals and explosives are all major threats to bivalve population. To avoid this effect on freshwater bivalves in future continuous monitoring of pollution aspects and population, ecological studies are needed. In some part of Western Ghats region, freshwater bivalves are used for minor ailments by native people but no work on has been done on these aspects (Prabhakar and Roy, 2009). The data on bivalve diversity and other studies are not complete so the statuses of many species are not known. The freshwater bivalve population is declining worldwide (Bogan, 1993), conservation of this fauna is vital due to their unique role in the river ecosystem. Apart from this, they form a part of our natural heritage and biodiversity. Hence they should be conserved for future generations and their loss will have negative consequences for the freshwater ecosystems in which they live and on which we depend.

Conclusion

A total of 19 species of freshwater bivalves belonging to 3 families were recorded in the Western Ghats rivers of Karnataka and all the species have been assessed according to the IUCN Red List Categories and Criteria. Among these 1 species (5.26%) was identified as endangered and 1 species (5.26%) listed as Data Deficient. Three species (15.79%) of the bivalves were not assessed (NA) and rest of the 14 species (73.69%) listed in Least Concern category. Three bivalve species (*Arcidopsis footie*, *Parreysia khadakvaslaensis, Pseudomulleria dalyi*) are endemic to the Western Ghats. The bivalves such as *A. footie* (NA) and *P. dalyi* (EN) which are endemic to the Western Ghats need to be conserved and other bivalves need extensive study on distribution pattern, density and population trends to get a complete picture. As more records become available, the portrait may change in future and conservation strategies can also be made in the Western Ghats of Karnataka.

Acknowledgement

The first author is grateful to Professor B. Hanumaiah, Former Vice Chancellor of Mangalore University and Ex Vice Chancellor of Dr. Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow. The first author is thankful to Mangalore University for financial assistance during the study period.

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