Research Article

Journal of Indian Fisheries Association 50 (2) April 2023 page 26-32

Journal of Indian Fisheries Association

https://epubs.icar.org.in/index.php/JIFA/issue/view/3850

Species Richness of Bivalves at Aare-Ware and Mirya Rocky Shore of Ratnagiri, Maharashtra, India

P.K. Pakhmode*, S.A. Mohite, R. A. Pawar, S. S. Lokhande & A.M. Meshram

College of Fisheries, Shirgaon, Ratnagiri - 415 629, Maharashtra, India.

Abstract

In the present study data was collected fortnightly intervals from May 2014 to April 2016 from Aare-Ware and Mirya rocky shore of Ratnagiri. Total 12 species of bivalves representing 4 orders, 5 families and 10 genera were recorded from the Aare-Ware and Mirya rocky shore of Ratnagiri. Bivalves belonging to families Ostreidae, Mytilidae and Veneridae were recorded during the study. Species richness of Aare-Ware shore in the year 2014-2015 was high as compared to 2015-2016 while at Mirya shore species richness in the year 2014-2015 was low as compared to 2015-2016.

Keywords:
Bivalves, Richness, Aare-Ware, Mirya, Rocky shore, Ratnagiri

***Corresponding author:**
pallavi.pakhmode@gmail.com

Received : 20 February 2023
Accepted : 25 May 2023

Introduction

India has the vast coastline of 8,118 km and a very wide range of coastal ecosystems such as estuaries, backwaters, mangroves, rocky coasts, sandy stretches, coral reefs lagoons and salt marshes are rich in bivalve resources (Venkataraman and Wafar 2005). Bivalves, being economically and ecologically significant component of marine biodiversity, have long been linked to a healthy food source, cultivable resource, source of pearl, decorative shells, lime, meditational drugs, models for understanding deep-sea diversification, for explaining global, ecological and biogeographical patterns (Anil *et al.* 2002; Bieler *et al.* 2014). The most commonly utilized bivalves for food in India include clams (Veneridae), sea-mussels (Mytilidae) and edible oysters (Ostreidae) (Mohan *et al.* 2013). The global bivalve diversity numbers of 9,620 species included 101 families, 1380 genera with 8360 marine species, grouped in 4 subclasses and 93 families (Huber 2015). Of these species, 652 of marine bivalves represented in 173 genera, 69 families and 4 subclasses have been reported from India (Tripathy and Mukhopadhyay 2015).

The estimated bivalve production of India in 2018 was 1,32,531 tonnes. The fishery was dominated by clams consisting of 76.3%, followed by mussels 15.3% and oyster 8.4%. Estimated bivalve landing of Maharashtra was 1,318 tonnes, oysters dominated the fishery (80%) followed by clams (15%) and mussels (5%). Clams landing composed of *Meretrix meretrix* (47%), *M. casta* (22%), *P. malabarica*

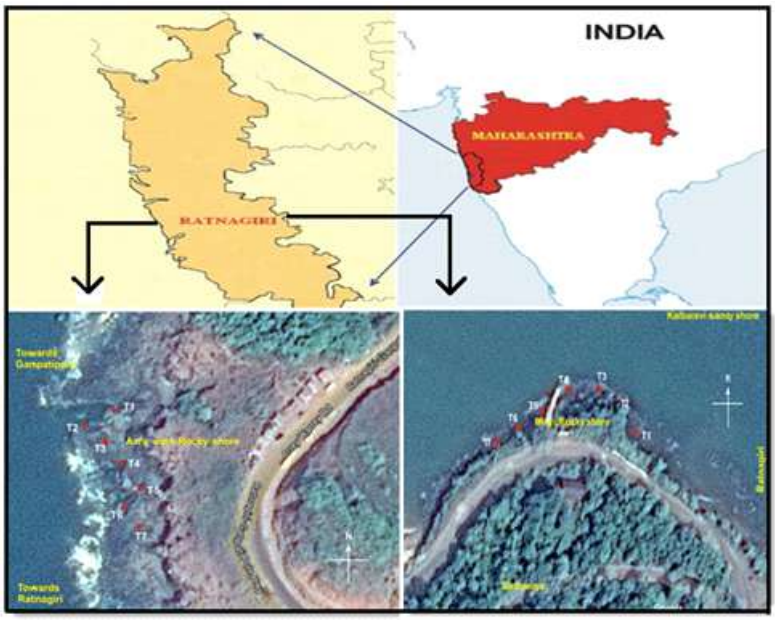

Fig. 1. Sampling location at Aare-Ware and Mirya rocky shore, Ratnagiri, Maharashtra

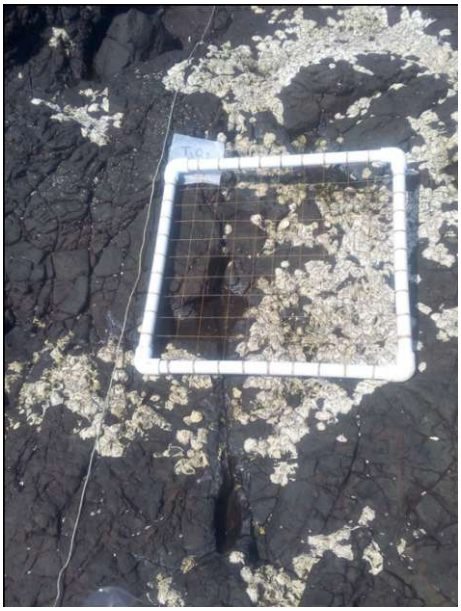

Fig. 2. Quadrant with transect line

(21%), *Marcia opima* (7%), and other clams (2%) (CMFRI, 2019). Bivalves are filter feeders, help to purify silted marine waters (Picardal and Roger 2014). It plays a significant role in nutrient recycling at the seagrass area by forming an important links between the primary detritus and consumers (Long, 2014). Till now many studies have been undertaken to evaluate the species diversity of marine molluscs in India, no specific studies have been carried out on the marine bivalves of rocky shore; hence, the present study is undertaken. The objective of the study is to study the species richness of bivalves at the Aare-Ware and Mirya rocky shores of Ratnagiri.

Materials and methods

Site Selection

The study of bivalves was carried out from May 2014 to April 2016 on the intertidal exposed rocky shore of Aare-Ware (Lat. 16.9902^0 N, Long. 73.312^0 E) and Mirya (Lat. 17.01779^0 N, Long. 73.27482^0 E) Ratnagiri (Fig. 1). Aare-Ware rocky shore showed high tidal heights and wave action. Topographically it had larger boulders and deeper rock pools. Whereas at Mirya rocky shore low tidal height and wave action were observed. This shore had a gradual slope and rocks spread out. Both the shores were associated with sandy fringe beaches extending to completely sandy shore areas.

Collection and Preservation

The intertidal zone i.e. the zone between high tide and low tide covering an area of around 10,000 m^2 was selected for the study. All samples were collected fortnightly during the lowest low tide of each month when maximum intertidal exposure prevailed. In the present study, a total of seven transect lines were fixed at a distance of 14 m at different locations on the Aare-Ware and Mirya rocky shore. On each transect line the three numbers of quadrates having size 50 × 50 cm (Fig. 2) (Boaventura et al. 2002) were sampled at each shore. Digital photographs of 50 × 50 cm quadrants were taken by using the camera Sony Cyber-shot (16.2 megapixel camera). From these photographs, the percent cover of bivalves species like clams, oysters and mussels, etc. was estimated. At the same time, the foulers like mussels and oysters were collected by scrapping those using knives or spatula. Further, in-faunal bivalves like clams were collected by hand digging the substratum by hand picking. After collection, samples were brought to the laboratory, cleaned with brush and specimens were sorted out according to major taxa and fixed by the addition of 5% formalin.

Species richness:

Species richness was calculated using a non-parametric estimation of "Chao index" given by (Walther & Morand, 1998) and (Henderson & Magurran, 2014) and calculated using the following formula:

$$S_{max} = S_{obs} + (a^2 / 2b)$$

Where,

a and *b*= number of species represented by one and two individuals respectively

S_{obs} = actual number of species observed

Results and discussion

At Aare-Ware shore, total of 7 species were encountered during the study period. The richness of this shore in the year 2014-2015 was 23 which was high as compared to the richness (19.25) of 2015-2016 (Table 1 & 2). During study periods total of 8 species were encountered at Mirya shore. The richness in the year 2014-2015 was 12.16 which was low

Table 1. Species richness of bivalves at Aare-Ware rocky shore of Ratnagiri during May 2014-April 2015.

Species	Quadrant sample (2014-2015)																					Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
S. cucullata	206	64	68	209	118	31	188	123	118	180	89	59	175	99	87	195	118	80	150	121	83	**2561**
P. malabarica	12	10	11	12	13	4	10	9	15	14	20	17	7	17	6	9	19	15	13	17	12	**262**
P. viridis	2	2	10	5	9	24	3	8	16	9	10	16	2	7	24	0	9	28	1	10	17	**212**
B. striatulus	12	9	42	5	7	20	3	13	28	0	3	12	3	0	28	3	2	51	9	2	17	**269**
K. opima	2	7	7	1	2	1	0	0	2	1	5	1	5	4	5	2	2	7	2	0	3	**59**
P. textile	2	1	6	0	3	3	2	5	1	2	5	3	3	8	1	5	7	2	1	4	1	**65**
M. casta	5	5	10	0	6	4	2	5	3	4	8	7	6	8	2	7	8	5	4	7	4	**110**
No. observed (Sobs)	7	7	7	5	7	7	6	6	7	6	7	7	7	6	7	6	7	7	7	6	7	7
No. of singletones, (a)	0	1	0	1	0	1	0	0	1	1	0	1	0	0	1	0	0	0	2	0	1	8
No. of doubletones, (b)	3	1	0	0	1	0	2	0	1	1	0	0	1	0	1	1	2	1	1	1	0	2
$a^2/2b$	8.16	24.5			24.5		9		24.5	18			24.5		24.5	18	12.25	24.5	24.5	18		16
Estimated total species (S_{max})	15.16	31.5			31.5		15		31.5	24			31.5		31.5	24	19.25	31.5	31.5	21		**23**

Table 2. Species richness of bivalves at Aare-Ware rocky shore of Ratnagiri during May 2015-April 2016.

Species	Quadrant sample (2015-2016)																					Total
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
S. cucullata	211	159	120	185	160	103	177	170	118	199	132	130	150	138	92	193	105	96	170	147	126	**3081**
P. malabarica	20	21	13	12	18	6	12	12	10	12	24	6	9	13	14	11	17	11	23	16	15	**295**
P. viridis	3	5	30	3	8	26	7	5	20	3	6	30	0	4	31	0	13	14	0	7	28	**243**
B. striatulus	16	8	30	4	9	35	8	10	45	0	7	41	0	15	68	6	19	30	2	25	43	**421**
K. opima	1	6	3	3	2	2	1	7	11	4	11	0	6	2	3	3	0	1	5	5	6	**82**
P. textile	3	4	0	4	2	5	3	3	3	4	2	6	3	7	2	0	3	1	1	1	0	**57**
M. casta	2	2	3	5	3	5	1	3	4	3	1	1	5	4	2	1	1	0	1	3	0	**50**
No. observed (Sobs)	7	7	6	7	7	7	7	7	7	6	7	6	5	7	7	6	6	7	6	6	5	7
No. of singletones, (a)	1	0	0	0	0	0	2	0	0	0	1	1	0	0	0	1	1	2	2	1	0	7
No. of doubletones, (b)	1	1	0	0	2	1	0	0	0	0	1	0	0	1	2	0	0	0	1	0	0	2
$a^2/2b$	24.5	24.5			12.25	24.5					24.5			24.5	12.25				18			12.25
Estimated total species (S_{max})	31.5	31.5			19.25	31.5					31.5			31.5	19.25				24			**19.25**

Table 3. Species richness of bivalves at Mirya rocky shore of Ratnagiri during May 2014-April 2015.

Species	Quadrat sample																					Total
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
S. cucullata	148	124	70	112	68	74	162	178	110	124	137	95	373	177	185	151	90	62	105	141	134	**2820**
P. malabarica	4	7	10	8	10	16	5	7	15	3	12	15	9	9	10	3	15	12	6	18	14	**208**
P. viridis	0	2	20	0	4	13	0	1	20	5	2	26	1	2	9	3	6	21	1	2	18	**156**
G. divaricutum	19	21	24	23	23	30	21	41	21	19	14	16	16	31	12	17	37	13	11	10	12	**431**
S. scopula	10	18	7	8	23	1	2	14	9	2	4	7	4	4	11	6	2	3	1	5	10	**151**
D. elegans	4	2	3	5	5	3	4	3	2	1	1	5	6	6	2	7	2	3	3	6	3	**76**
D. lupinus	3	1	2	2	3	1	2	3	3	1	1	7	3	1	4	3	5	1	6	6	7	**65**
T. (A.) rhombea	3	3	1	1	2	2	2	3	4	0	2	2	1	0	0	2	3	1	1	3	4	**40**
No. observed (Sobs)	7	8	8	7	8	8	7	8	8	7	8	8	8	7	7	8	8	8	8	8	8	8
No. of singletones, (a)	0	1	1	1	0	2	0	1	0	2	2	0	2	1	0	0	0	2	3	0	0	5
No. of doubletones, (b)	0	2	1	1	1	1	3	0	1	1	2	1	0	1	1	1	2	0	0	1	0	3
$a^2/2b$		16	32	24.5	32	32	8.16		32	24.5	16	32		24.5	24.5	32	16			32		4.16
Estimated total species (S_{max})		24	40	31.5	40	40	15.16		40	31.5	24	40		31.5	31.5	40	24			40		**12.16**

Table 4. Species richness of bivalves at Mirya rocky shore of Ratnagiri during May 2015-April 2016.

Species	Quadrat sample																					Total
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**231**
S. cucullata	112	121	101	157	131	67	167	144	73	137	134	106	172	133	76	167	131	117	134	171	97	**2648**
P. malabarica	4	14	11	7	10	12	7	11	8	9	13	9	5	18	11	7	14	8	15	14	10	**217**
P. viridis	1	1	20	1	3	18	1	4	24	6	1	21	2	14	24	0	10	17	4	2	24	**198**
G. divaricutum	25	22	8	37	34	23	19	29	13	21	18	11	27	24	16	27	23	17	27	40	20	**481**
S. scopula	7	8	11	8	17	8	12	12	9	7	23	5	5	11	13	5	15	5	8	14	7	**210**
D. elegans	2	8	5	8	5	8	1	3	18	18	6	3	3	7	4	10	2	4	4	4	7	**130**
D. lupinus	6	4	8	8	6	7	1	15	6	3	8	8	7	6	15	4	10	1	5	2	4	**134**
T. (A.) rhombea	1	2	0	1	2	1	2	0	1	1	1	3	0	1	2	0	2	0	2	6	0	**28**
No. observed (Sobs)	8	8	7	8	8	8	8	7	8	8	8	8	7	8	8	6	8	7	8	8	7	8
No. of singletones, (a)	2	1	0	2	0	1	3	0	1	1	2	0	0	1	0	0	0	1	0	0	0	6
No. of doubletones, (b)	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	2	0	1	2	0	2
$a^2/2b$	32	32			32		32						24.5		32		16		32	16		9
Estimated total species (S_{max})	40	40			40		40						31.5		40		24		40	24		**17**

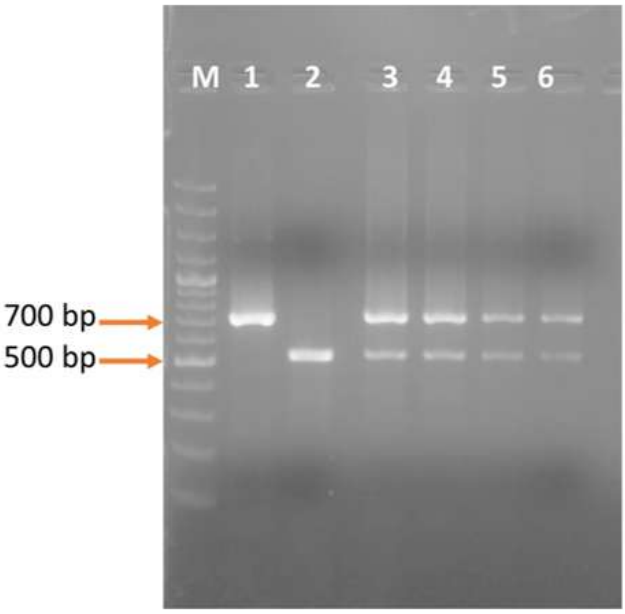

Fig.2. Identification of hybrids of *Tor putitora* X *Tor khudree* using PCR amplification of ITS1-5.8S-ITS2-28S rRNA gene. Lane M: 100bp DNA ladder; Lane 1: *Tor khudree*; Lane 2: *Tor putitora*; Lane 3-6: Hybrids of *T. putitora X T. khudree*.

compared to the richness observed (17.0) during the year 2015-2016 (Table 3 & 4).

Conclusion

In the present study, richness was low may be due to unstable substratum and species richness and diversity were slightly higher on a heterogeneous and stable substrate as per McQuaid and Branch (1984) and Roman-Contreras *et al*. (1991).

Acknowledgements

The authors are thankful to the Associate Dean, and Head, Department of Fisheries Biology, College of Fisheries, Ratnagiri, Maharashtra, India for providing the necessary facilities and suggestions.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Anil C., Ansari Z.A., Ingole B.S., Bichurina M.A., Sovetova M. and Boikov Y.A. 2002. Indian marine bivalves: Potential source of antiviral drugs, *Current Science*, 82: 1279-1282.

Bieler R., Mikkelsen P.M., Timothy M.C., Glover E.A., Gonzalez V.L., Daniel L.G., Harper E.M., Healy J., Kawauchi G.Y., Sharma P.P., Staubach S., Strong E.E., Taylor J.D., Temkin I., Zardus J.D., Clark S., Guzman A.M., McIntyree E., Sharp P. and Giribet G. 2014. Investigating the Bivalve Tree of Life- an exemplar-based approach combining molecular and novel morphological characters. *Invertebrate Systematics*, 28: 32–115.

Bhatade S.S. 2011. Seasonal changes in the biodiversity of macroflora and fauna of the rocky shore, Alawa, Ratnagiri. M.F. Sc. Thesis. Submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, p. 1 – 56.

Boaventura D., Re.P., Fonseca L.C. and Hawkins S.J. 2002. Intertidal rocky shore communities of the continental Portuguese Coast: Analysis of Distribution patterns. *Mar. Ecol.*, 23 (1): 69-90. Central Marine Fisheries Research Institute, Annual Report 2018-19. p. 320.

Datta S.N., Chakraborty S.K., Jaiswar A.K. and Ziauddin G. 2010. A comparative study on intertidal faunal biodiversity of selected beaches of Mumbai coast. *J. Env. Biol.*, 31(6): 981-986.

Henderson P.A. and Magurran A.E. 2014. Direct evidence that density-dependent regulation underpins the temporal stability of abundant species in a diverse animal community.

Long Shabdin Mohd, Abg Azizil Fansuri Abg Abdullah & Syahidatul Atiqah Ab Rahim, 2014. Marine Gastropod and Bivalves of Sampadi Island, Lundu, Sarawak. Monograph Aquatic Science Colloquium, p. 75-87.

McQuaid C.D. and Branch G.M. 1984. Influence of sea temperature, substratum and wave exposure on rocky intertidal communities and analysis of faunal and floral biomass. *Mar. Ecol. Prog. Ser.* (19): 145-151.

Mohan D., Elumalai V., Subbulakshmi G., Jayalakshmi S. and Srinivasan M. 2013. Biodiversity of cultivable molluscan resources from Pulicat Lake, southeast coast of India. Arthropods, 2(2): 53-65.

Picardal, Rafael M. and Roger G. Dolorosa, 2014. The molluscan fauna (gastropods and bivalves) and notes on environmental conditions of two adjoining protected bays in Puerto Princesa City, Palawan, Philippines. India Journal of Entomology and Zoology Studies, 2(5): 72-90.

Rahman S. and Barkati S. 2012. Spatial and temporal variations in the species composition and abundance of benthic molluscs along 4 rocky shores of Karachi. *Turk J. Zool.* 36(3): 291-306.

Roman Contreras R., Cruz Abrego F.M. and Ibanez Aguirre A.L. 1991. Observaciones ecologicas de los moluscos de la zona intermareal rocosa de la Bahía de Chamela, Jalisco, Mexico. An. Inst. Biol. Univ. Nal. Autonoma de Mexico, Serie Zoologia, (62): 17-32.

Tripathy B. and Mukhopadhyay A.K. 2015. Marine Molluscan Diversity in India. In *Marine Faunal Diversity in India*. Elsevier, p. 39-74.

Venkataraman K. and Wafar M. 2005. Coastal and marine biodiversity of India. *Ind. J. Mar. Sci.*, 34(1): 57-75.

Walther B.A. and Morand S. 1998. Comparative performance of species richness estimation methods. *Parasitology* (116): 395-405.