International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 24-04-2022, Accepted: 09-05-2022, Published: 25-05-2022
Volume 7, Issue 5, 2022, Page No. 110-120

Distribution of molluscs in Devbhumi-Dwarka, Gujarat, India

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Abstract
The present study was conducted on the diversity and distribution molluscs along Devbhumi-Dwarka coast, India from December 2016 to August 2019. Total fifty-three molluscs species were identified. All the identified molluscs were belonging to four classes, fourteen orders and thirty-one families. The temporal study revealed that during winter season species richness, abundance, species concentration was higher found. Devbhumi-Dwarka has a subtropical low-latitude arid hot climate. The coast is a rocky and sandy shoreline. Besides above, the intertidal belt of the sampling area could be responsible for recorded molluscs diversity recorded. The Simpson index, species evenness and Shanon index for coast, is 0.94, 0.63 and 3.61 respectively. On the coast healthy molluscs diversity found. The study provides a baseline data for mollusc diversity in Devbhumi Dwarka, India.

Keywords: Devbhumi-Dwarka, molluscs, species richness, abundance, rocky, sandy, index

Introduction
The Intertidal zone is an amalgamation of hydrosphere and lithosphere, flora and fauna are adapted to survive under these zones(Castro, Peter, and Michael E. Huber, 2010; Dennings David, 1995).The nature of the rocky intertidal coast is significantly different from place to place in their ranges, structures, and spatial heterogeneity at both between and inside shores (Raffaelli, D and Hawkins, S, 1996). The class gastropods and class bivalves constitute 98% and they inhabit marine ecosystem, freshwater and terrestrial, except these two classes, and the rest all are exclusively marine inhabitant. morphologically and structurally molluscs are a varied group of animals with different structural form such as chiton, limpets, slugs, snails, clams, octopus and cattle fishes, etc. mainstream of the molluscs are more famous by their shell structure; but in some forms the shell is completely absent, secreting mucus-like substances *viz.*, slugs, octopus, etc.(Williams S. T. and Reid, D. G., 2004; Briggs, J. C., 1994; Ray, G. C., and Grassle, J. F. 1991; Angel, M. V. 1993).The mollusc is an extraordinarily varied phylum with estimates of 80,000-1,00000 described species (Venkataraman K Wafar M. 2005).The Indian coastsshow the occurrence of 3370 marine mollusc species (Viswanathan C, Vijay Kumar Deepak, *et. al.* 2017) While in Gujarat total of 395 species of gastropods belonging to 87families and 199 genera are recorded (Burnham, K.P., Anderson, D.R., *et. al.* 1980).The study area has enormously molluscs diversity were found, moreover several species are depend on sea weed.seasonal surveyed shown differences of species. During study *Lunella coronata (*Gmelin, 1791), *Cellana radiata (*Born, 1778),*Cerithium caeruleum*G.B.Sowerby II, 1855**,***Pirenella cingulata* (Gmelin, 1791)*Echinolittorina leucosticta*(Philippi, 1847)(Gohil Bharatsinh, and Kundu Rahul 2013; Bharatsinh Gohil and R. Kundu 2013).On the study site less survey is carried out. so, It endow with worthy information. Molluscs are vital for the marine ecosystem. It is providing livelihood to millions of people living in the coastal area so many coastal areas is a hotspot for overseas trading, fisheries, etc The ornamental mollusc is a promising source in India. Ancient period shells are tremendous impact on Indian tradition and economy. It leads to the increasing global demand for cowries, shells, etc. It has a highly prised in India as well as foreign countries. Several molluscs are threats towards agriculture and crops.(Appukuttan, K. K.,1996; Menon, N. G. and C. S. G. Pillai, 1996; English, S., Wilkinson, C. *et.al.* 1994)

Material and methods
Sampling site
The intertidal area is about one-kilometre width.The study carried out between Starting Point: N 22° 13′ 52.05″ E 68° 58′ 7.88″ and Ending Point: N 22° 13′ 25.49″ E 68° 58′ 22.55″. The survey for the study was made from December 2016 to August 2019. The samples of molluscan were collected and stored immediately in 10 % formaldehyde. They were then carried to the laboratory for further study. The quadrate method was used for generating the data on the selected chevron direction was followed to cover the utmost area on the intertidal area. The quadrates of$1^{x}1$ meter were laid at a distance of 10 meters on the intertidal belt while following an oblique direction covering a maximum area at almost regular occurrence vertically across the complete intertidal area of

the study site. About 100 quadrates laid out each of the seasons during study tenure. The Line transect method provides initiative details of a study area with the line transect (Strong, E. E. and O. Gargominy, *et. al.* 2008 ; Apte, D. 2014). All intertidal molluscan observed were recorded appropriately. Several photographs with dorsal and ventral side was employed for the identification of the species with the identification manuals,various literature available in the form of books, journals, other reports and with extensive use of the internet. Various websites resourceswere used for mollusc species identification such as WoRMS, IBP, ZSI, NMR-pics, EOL, Wikipedia, Encyclopedia, Gastropoda,etc.. The identification of molluscs was done through photographs and collected shells of animals with the help of sea shells of india (Panda F, Pati SG, *et. al.* 2021).

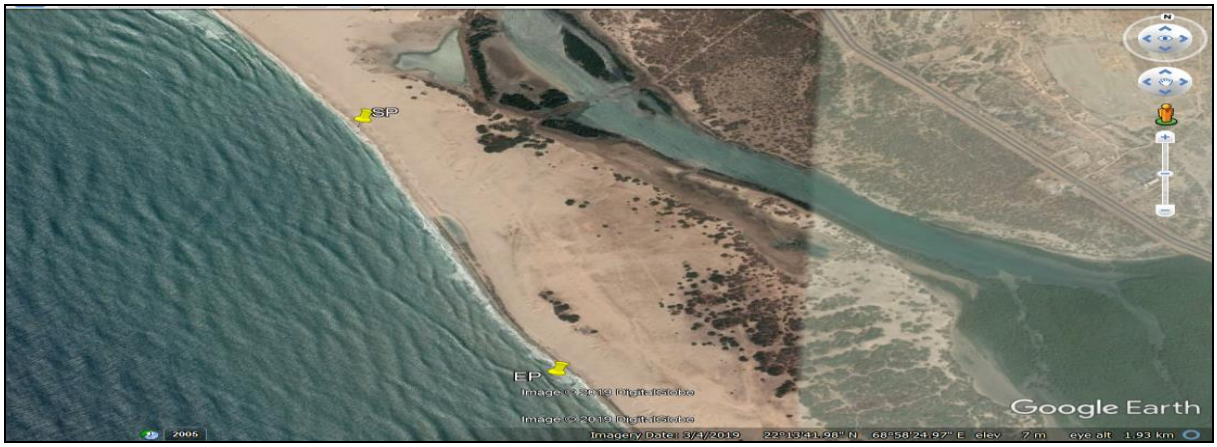

Fig 1: Study site DevbhoomiDwarka

Result and discussion

This study site is situated in a DevbhoomiDwarka district. It has sandy with a rocky shoreline. A total of fifty-six molluscs species were found. In the winter *Lunella coronata (*Gmelin, 1791) has the most Density (0.48), relative density (0.07%), Abundance (1.5), and relative abundance (5.23%) occurred. While, *Pollia undosa*(Linnaeus, 1758) has the lowest frequency (7%), relative frequency (1.34%) was found.

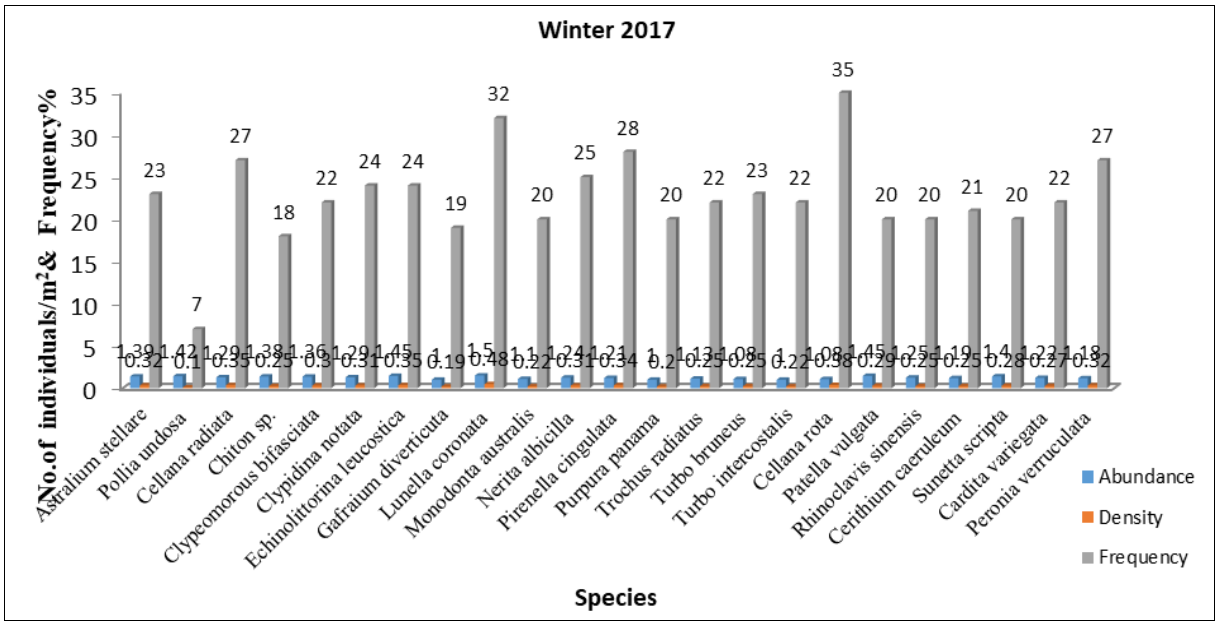

Fig 2: Abundance, frequency, and density of molluscs at devbhoomidwarka coast during winter (2017)

Table 1: Relative abundance, relative frequency, and relative density of molluscs at devbhoomidwarka during winter and summer (2017)

Species name	Winter			Summer		
	Relative Abundance (%)	Relative Frequency (%)	Relative Density (%)	Relative Abundance (%)	Relative Frequency (%)	Relative Density (%)
*Astraliumstellare (*Gmelin, 1791)	*4.85*	4.41	*4.93*	*7.37*	6.25	*5.03*
*Polliaundosa (*Linnaeus, 1758)	4.90	1.34	*1.54*	-	-	-
*Cellanaradiata (*Born, 1778)	4.52	5.18	*5.40*	8.83	7.03	*7.54*

Chiton sp.	4.84	3.45	*3.86*	7.38	3.91	*3.14*
*Clypeomorusbifasciata (*G. B. Sowerby II, 1855)	*4.75*	4.22	*4.62*	12.29	7.03	*9.43*
*Clpidinanotata (*Linnaeus, 1758)	4.50	4.60	*4.78*	*10.21*	10.16	*11.32*
*Echinolittorinaleucostica(*Philippi, 1847*)*	5.08	4.60	*5.40*	9.98	13.28	*14.47*
Gafraiumdiverticuta	3.49	3.64	*2.93*	-	-	-
*Lunellacoronata (*Gmelin, 1791	5.22	*6.14*	*7.41*	10.78	10.15	*11.95*
Monodontaaustralis (Lamarck, 1822)	3.83	*3.84*	*3.40*	-	-	-
*Neritaalbicilla*Linnaeus, 1758	4.32	4.80	*4.78*	7.38	10.15	*8.18*
*Pirenellacingulata (*Gmelin, 1791)	4.23	5.37	*5.25*	8.68	*13.28*	*12.58*
*Purpura panama (*Röding, 1798)	*3.49*	*3.84*	*3.09*	-	-	-
*Trochusradiatus*Gmelin,1791	3.96	4.22	*3.86*	-	-	-
*Turbo bruneus (*Röding, 1798*)*	3.78	*4.41*	*3.86*	8.71	*8.60*	*8.18*
Turbo intercostalis Menke, 1846	3.49	4.22	*3.40*	-	-	-
*Cellana rota (*Gmelin, 1791*)*	3.79	6.78	5.86	7.38	10.15	*8.18*
Patella vulgata	5.05	3.84	4.48	-	-	-
*Rhinoclavissinensis (*Gmelin,1791)	4.36	3.84	3.86	-	-	-
*Cerithiumcaeruleum*G.B.Sowerby II, 1855	4.15	4.03	3.86	-	-	-
*Sunettascripta(*Linnaeus, 1758)	4.88	3.84	4.32	-	-	-
*Carditavariegata*Bruguière, 1792	4.28	4.22	4.17	-	-	-
*Peroniaverruculata (*Cuvier, 1830)	4.13	5.18	4.94	-	-	-

Ten mollusc species were found in the summer. The highest frequency (17%) and relative frequency (13.28%) were found in *Pirenella cingulata* (Gmelin, 1791)and *Echinolittorina leucosticta*(Philippi, 1847).The *Pirenella cingulata* was formerly known as *Cerithidea cingulata.* It is a 50 mm long, conical shell with elongated and thick. it is found on the east and west coast of India. It is broadly collected for food and shells are used to make lime in the Philippines. They are also traded for aesthetic and religious purposes. The highest abundance (1.66) and relative abundance (12.29%) were found in *Clypeomorus bifasciata (G. B. Sowerby II, 1855).*which is followed by*Lunella coronata*(Gmelin, 1791).

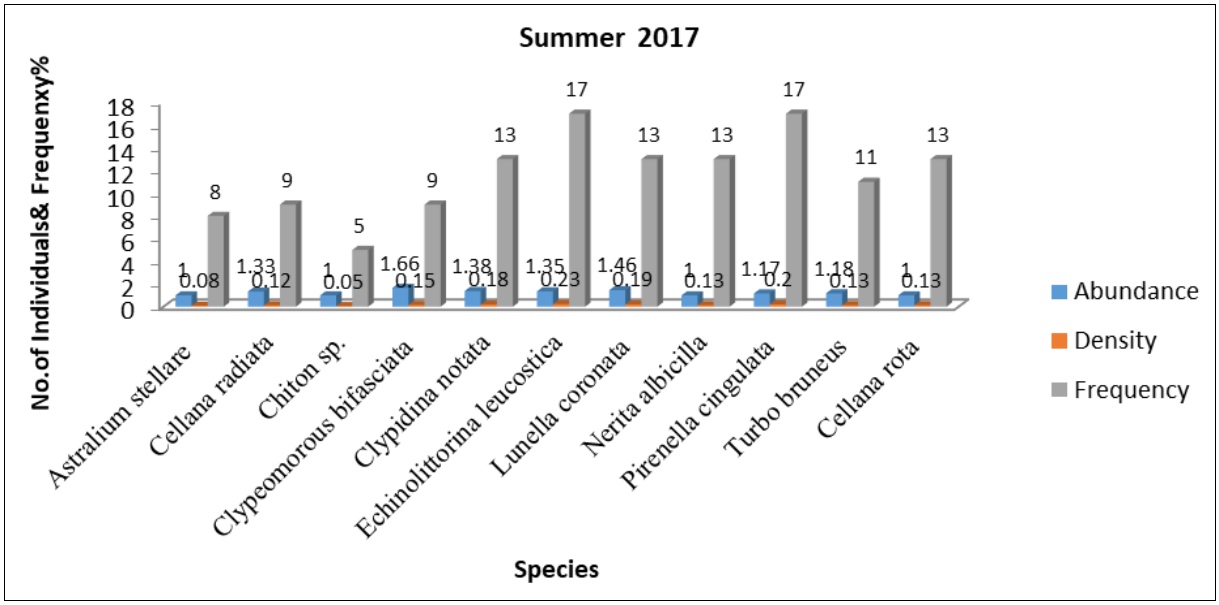

Fig 3: Abundance, frequency, and density of molluscs at devbhoomidwarka coast during summer (2017)

In the monsoon thirteen mollusc species were found. The highest density (0.23) and relative density (10.90%) were found in *Pirenella cingulata (*Gmelin, 1791*).* It is very commonly found in estuarine water, mudflats, mangrove patches, brackish water, etc. sometime its density reaches up to as high as 12000/m^2. In embryonic development, it has a veliger larval form. This is followed by *Echinolittorina leucosticta* (Philippi, 1847). The frequency (19%) and relative frequency (10.27%) were found in *Clpidina notata (*Linnaeus, 1758*), Monodonta australis(*Lamarck, 1822), and *Pirenella cingulata* (Gmelin, 1791).

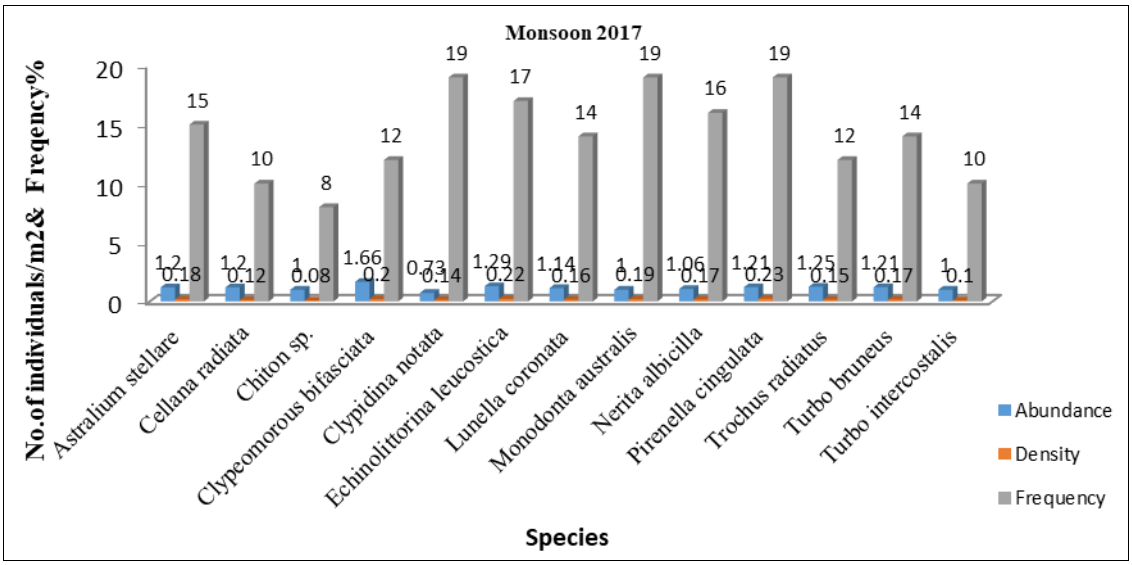

Fig 4: Abundance, frequency, and density of molluscs at devbhoomidwarka coast during monsoon (2017)

Table 2: Relative abundance, relative frequency, and relative density of molluscs at devbhoomidwarka coast during monsoon (2017)

Species name	Relative Abundance (%)	Relative Frequency (%)	Relative Density (%)
Astralium stellare(Gmelin, 1791)	*8.01*	8.10	*8.53*
Cellana radiata(Born, 1778)	8.01	5.41	*5.69*
Chiton sp.	6.68	4.32	*3.79*
Clypeomorus bifasciata(G. B. Sowerby II, 1855)	11.12	6.49	*9.48*
*Clpidina notata (*Linnaeus, 1758)	*4.91*	10.27	*6.63*
*Echinolittorina leucostica(*Philippi, 1847)	8.64	9.19	*10.43*
*Lunella coronata (*Gmelin, 1791	7.63	7.57	*7.58*
*Monodonta australis(*Lamarck, 1822)	6.68	10.27	*9.00*
*Nerita albicilla*Linnaeus, 1758	7.09	8.64	*8.06*
Pirenella cingulata (Gmelin, 1791)	8.08	*10.27*	*10.90*
*Trochus radiatus*Gmelin,1791	8.35	*6.49*	*7.10*
*Turbo bruneus (*Röding, 1798*)*	8.10	*7.57*	*8.06*
*Turbo intercostalis*Menke, 1846	6.68	5.40	*4.74*

The most density, relative density, frequency distribution, and relative frequency were found of *Lunella coronate* (Gmelin, 1791)in the summer and winter seasons. It is a heavy, turban shaped shell.the operculum is smooth to indistinctly covered with granules. It has 4-5 whorls among these whorls, end whorls is huge found. In the winter season, the abundance and relative abundance were high found in *Peroniaverriuculata* (Cuvier, 1830). The animals are elongated and ovute body. The body surface is covering with sturdy and warty tubercles, it is different in shape, size, and structure.it is commonly found on the west and east coast of India.

Table 3: Results of the population ecology at devbhoomidwarka during winter (2018)

Species name	Abundance (No. of Individuals/m^2)	Relative Abundance (%)	Frequency (%)	Relative Frequency (%)	Density (No. of Individuals/m^2)	Relative Density (%)
Astralium stellare (Gmelin, 1791)	1.07	3.61	57	5.78	0.61	5.14
Pollia undosa (Linnaeus, 1758)	1.15	3.89	20	2.03	0.23	1.94
Cellana radiata (Born, 1778)	1.11	3.76	62	6.30	0.69	5.81
*Chiton*sp.	1.33	4.48	40	4.07	0.53	4.47
*Chiton peregrenis*Thiele, 1909	1.08	3.65	49	4.97	0.53	4.47
Clypeomorusbifasciata (G.	1.37	4.64	43	4.37	0.59	4.97

B. Sowerby II, 1855)						
Clpidina notata(Linnaeus, 1758)	1.07	3.61	59	5.99	0.63	5.30
*Echinolittorina leucostica(*Philippi, 1847)	1.10	3.73	68	6.90	0.75	6.31
Anodontiaedenula(Linnaeus, 1758)	1.26	4.29	15	1.52	0.19	1.60
Lunella coronata(Gmelin, 1791	1.57	5.31	70	7.10	1.1	9.37
Monodonta australis (Lamarck, 1822)	1.2	4.06	55	5.58	0.66	5.56
*Neritaalbicilla*Linnaeus, 1758	1.19	4.01	59	5.99	0.7	5.89
*Pirenella cingulata (*Gmelin, 1791)	1.08	3.63	53	5.38	0.57	4.80
Purpura panama (Röding, 1798)	1.21	4.08	24	2.43	0.29	2.44
*Trochusradiatus*Gmelin,1791	1.16	3.93	43	4.37	0.5	4.21
Turbo bruneus(Röding, 1798)	1.33	4.50	30	3.05	0.4	3.37
Turbo intercostalis Menke, 1846	1.58	5.35	24	2.43	0.38	3.20
*Gafraium diverticuta*Gmelin, 1791	1.33	4.50	9	0.9	0.12	1.01
Architectonica laevigata (Lamarck, 1816)	1.25	4.22	20	2.03	0.25	2.10
Astraliumsemicostatum(Kiener, 1850)	1.03	3.49	58	5.89	0.6	5.05
Sunetta scripta(Linnaeus, 1758)	1.08	3.66	48	4.87	0.52	4.38
Nassarius stolatus (Gmelin, 1791)	1.27	4.30	22	2.23	0.28	2.36
Cardita variegate Bruguière, 1792	1.11	3.77	34	3.45	0.38	3.20
Peronia verruculata (Cuvier, 1830)	1.61	5.44	23	2.33	0.37	3.11

In the summer season, the highest abundance and relative abundance were found in *Astralium semicostatum* (Kiener, 1850).Followed by *Turbo intercostalis*Menke, 1846, and *Cellana rota* (Gmelin, 1791). The lowest found in *Ceraesignum maximum* (G. B. Sowerby I, 1825) species.

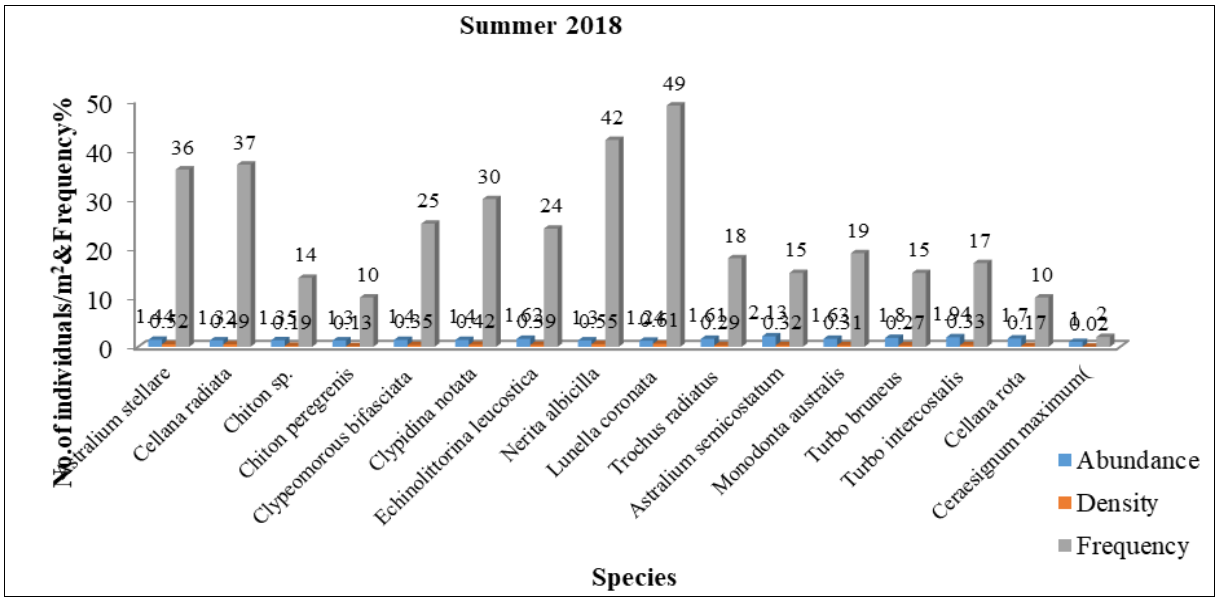

Fig 5: Abundance, frequency, and density of molluscs at devbhoomidwarka coast during summer (2018)

Table 4: Relative abundance, relative frequency, and relative density of molluscs at devbhoomidwarka coast during summer (2018)

Species name	Relative Abundance (%)	Relative Frequency (%)	Relative Density (%)
Astralium stellare (Gmelin, 1791)	5.96	9.91	9.70
Cellanaradiata (Born, 1778)	5.46	10.19	9.14
*Chiton*sp.	5.60	3.85	3.54
Chitonperegrenis Thiele, 1909	5.37	2.75	2.43
Clypeomorusbifasciata (G. B. Sowerby II, 1855)	5.78	6.88	6.52
Clpidinanotata (Linnaeus, 1758)	5.78	8.26	7.84
Echinolittorinaleucostica (Philippi, 1847)	6.70	6.61	7.28
Nerita albicilla Linnaeus, 1758	5.40	11.57	10.26
Lunellacoronata (Gmelin, 1791	5.14	13.50	11.38
Trochusradiatus Gmelin,1791	6.65	4.95	5.41
Astraliumsemicostatum (Kiener, 1850)	8.80	4.13	5.97
Monodontaaustralis (Lamarck, 1822)	6.74	5.23	5.78
Cellana rota (Gmelin, 1791)	7.43	4.13	5.03
Turbo intercostalis Menke, 1846	8.01	4.68	6.16
Cellana rota (Gmelin, 1791*)*	7.02	2.75	3.17
Ceraesignum maximum (G. B. Sowerby I, 1825)	4.12	0.5	0.3

The highest frequency and relative frequency were found in *Lunellacoronata (*Gmelin, 1791) species.it is followed by *Neritaalbicilla* Linnaeus, 1758. The Density and relative density were found in *Echinolittorinaleucostica (*Philippi, 1847).

Table 5: Relative abundance, relative frequency, and relative density of molluscs at devbhoomidwarka coast during monsoon (2018)

Species name	Abundance (No. of Individuals/m^2)	Relative Abundance (%)	Frequency (%)	Relative Frequency (%)	Density (No. of Individuals/m^2)	Relative Density (%)
Astraliumstellare (Gmelin, 1791)	1.18	4.62	38	5.57	0.45	4.87
Cellana radiate (Born, 1778)	1.10	4.32	37	5.42	0.41	4.45
Chiton sp.	1.52	5.91	29	4.25	0.44	4.78
Chitonperegrenis Thiele, 1909	0.94	3.69	37	5.42	0.35	3.80
*Clypeomorusbifasciata (*G. B. Sowerby II, 1855)	1.85	7.20	39	5.71	0.72	7.81
Clpidinanotata (Linnaeus, 1758)	1.31	5.12	48	7.03	0.63	6.84
Echinolittorinaleucostica (Philippi, 1847)	2.22	8.69	40	5.87	0.89	9.67
Lunellacoronata (Gmelin, 1791	1.18	4.63	69	10.11	0.82	8.90
Monodontaaustralis (Lamarck, 1822)	153	5.97	32	4.69	0.49	5.32
Neritaalbicilla Linnaeus, 1758	1.32	5.15	62	9.09	0.82	8.90
Pirenellacingulata (Gmelin, 1791)	1.29	5.03	38	5.57	0.49	5.32
*Turbo bruneus (*Röding, 1798)	1.12	4.37	25	3.67	0.28	3.04
Turbo intercostalis Menke, 1846	1.27	4.94	30	4.39	0.38	4.12
Sunettascripta(Linnaeus, 1758)	1.26	4.90	39	5.71	0.49	5.32
Cellana rota (Gmelin, 1791)	1.31	5.09	36	5.27	0.47	5.10
Carditavariegata Bruguière, 1792	1.22	4.74	23	3.37	0.28	3.04

Architectonicalaevigata (Lamarck, 1816)	1.38	5.40	13	1.90	0.18	1.95
Polliaundosa (Linnaeus, 1758)	1.27	4.94	15	2.19	0.19	2.06
Rhinoclavissinensis (Gmelin,1791)	1.34	5.24	32	4.69	0.43	4.67

On the study site,the most Density, relative density, Frequency, and relative frequency were found in *Lunellacoronata* Gmelin, 1791 throughout all seasons. It is also known as the crowned turban shell or coronate moon turban. In summer the highest abundance and relative abundance were found in *Neritaalbicilla*Linnaeus, 1758. It is the benthic shell, which can be found up to 7 meters. It is abundantly found on the rocky coast and it forms dense colonies near to mid littoral zone. In the monsoon season, the highest abundance and relative abundance were found in *Turbo intercostalis* Menke, 1846.It is herbivorous species and mainly feeds on algae especially *Caulerparacemsa, Gracilaaria*, and *Centroceras*. Commonly distributed in Andaman and Nicobar Islands, Gujarat, Goa, Tamil Nadu, etc.

Table 6: Relative abundance, relative frequency, and relative density of molluscs at devbhoomidwarka coast during winter (2019)

Species name	Abundance(No.of Individuals/m^2)	Relative Abundance (%)	Frequency (%)	Relative Frequency (%)	Density(No.of Individuals/m^2)	Relative Density (%)
Astraliumstellare (Gmelin, 1791)	1.36	3.86	33	3.78	0.45	3.89
Polliaundosa (Linnaeus, 1758)	1.2	3.39	15	1.71	0.18	1.55
Cellanaradiata (Born, 1778	1.37	3.88	43	4.92	0.59	5.10
*Chiton*sp.	1.23	3.48	35	4.00	0.43	3.72
Chitonperegrenis Thiele, 1909	1.26	3.57	38	4.35	0.48	4.15
Clypeomorusbifasciata (G. B. Sowerby II, 1855)	1.48	4.20	31	3.55	0.46	3.98
Clpidinanotata (Linnaeus, 1758)	1.45	4.10	40	4.58	0.58	5.02
Echinolittorinaleucostica (Philippi, 1847)	1.48	4.18	42	4.81	0.62	5.36
*Anodontiaedenula (*Linnaeus, 1758)	1.3	3.68	20	2.29	0.26	2.24
Lunellacoronata (Gmelin, 1791)	1.68	4.76	47	5.38	0.79	6.83
*Monodontaaustralis (*Lamarck, 1822)	1.32	3.75	37	4.24	0.49	4.23
Neritaalbicilla Linnaeus, 1758	1.48	4.18	44	5.04	0.65	5.62
*Pirenellacingulata (*Gmelin, 1791)	1.33	3.77	39	4.47	0.52	4.49
*Purpura panama (*Röding, 1798)	1.31	3.72	19	2.17	0.25	2.16
*Trochusradiatus*Gmelin,1791	1.26	3.56	31	3.55	0.39	3.37
Turbo bruneus (Röding, 1798)	1.17	3.30	36	4.12	0.42	3.63
Turbo intercostalis Menke, 1846	1.28	3.61	29	3.32	0.37	3.20
*Rhinoclavissinensis (*Gmelin, 1791*)*	1.21	3.43	33	3.78	0.4	3.46
Cerithiumcaeruleum G.B. Sowerby II, 1855	1.13	3.21	38	4.35	0.43	3.72
*Vasticardiumflavum (*Linnaeus, 1758)	1.39	3.95	28	3.21	0.39	3.37
*Architectonicalaevigata (*Lamarck, 1816)	1.22	3.44	23	2.63	0.28	2.42
Astraliumsemicostatum (Kiener, 1850)	1.30	3.70	39	4.46	0.51	4.41
Sunettascripta (Linnaeus, 1758)	1.21	3.41	34	3.89	0.41	3.54
*Strigatellascutulata (*Gmelin, 1791)	1.24	3.49	17	1.94	0.21	1.81

Nassarius olivaceus (Bruguière, 1789)	1.08	3.07	23	2.63	0.25	2.16
Carditavariegata Bruguière, 1792	1.29	3.65	31	3.55	0.4	3.46
Peroniaverruculata (Cuvier, 1830)	1.25	3.54	28	3.20	0.35	3.02

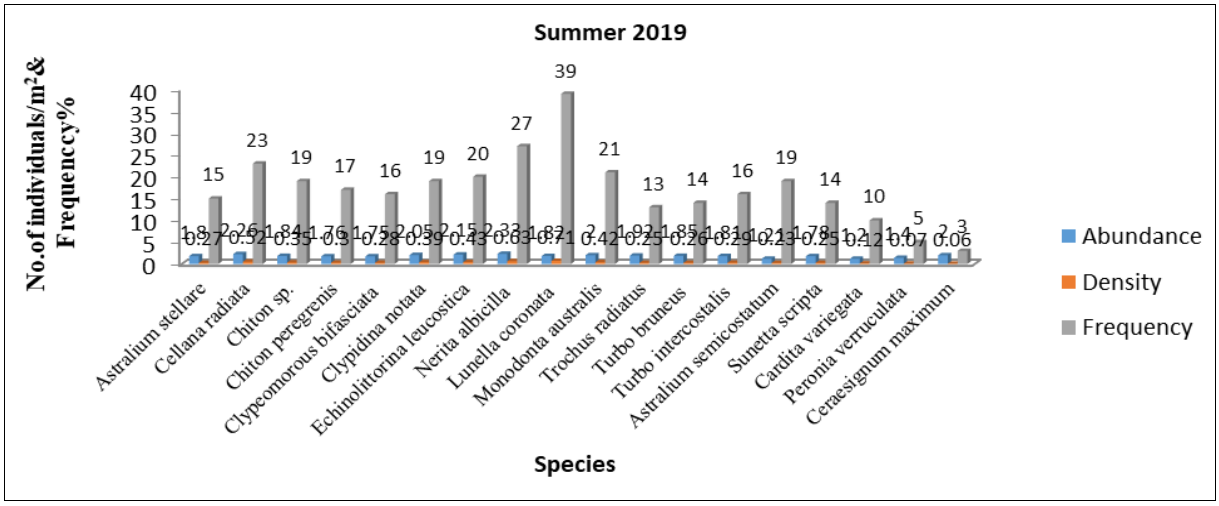

Fig 6: Abundance, frequency and density of molluscs at devbhoomidwarka coast during summer (2019)

Table 7: Relative abundance, relative frequency, and relative density of molluscs at devbhoomidwarka during summer and monsoon (2019)

	Summer			Monsoon		
Species name	**Relative Abundance (%)**	**Relative Frequency (%)**	**Relative Density (%)**	**Relative Abundance (%)**	**Relative Frequency (%)**	**Relative Density (%)**
Astraliumstellare(Gmelin, 1791)	5.46	4.84	4.63	5.68	3.99	4.11
Cellanaradiata(Born, 1778)	6.86	7.41	8.92	5.30	6.41	6.17
Chiton sp.	5.59	6.12	6.00	5.61	5.54	5.66
*Chitonperegrenis*Thiele, 1909	5.35	5.48	5.15	6.54	5.19	6.17
Clypeomorusbifasciata(G. B. Sowerby II, 1855)	5.30	5.16	4.80	5.79	6.24	6.56
Clpidinanotata(Linnaeus, 1758)	6.22	6.13	6.69	4.84	6.59	5.78
*Echinolittorinaleucostica(*Philippi, 1847)	6.52	6.45	7.38	6.12	4.50	5.01
*Neritaalbicilla*Linnaeus, 1758	7.08	8.70	10.80	5.21	8.15	7.71
Lunellacoronata(Gmelin, 1791	5.52	12.58	12.18	5.11	11.79	10.93
Monodontaaustralis(Lamarck, 1822)	6.07	6.77	7.20	5.94	5.71	6.16
*Trochusradiatus*Gmelin,1791	5.83	4.19	4.29			
Turbo bruneus(Röding, 1798)	5.63	4.51	4.46	5.45	5.19	5.14
*Turbo intercostalis*Menke, 1846	5.50	5.16	4.97	6.05	4.33	4.76
*Astraliumsemicostatum (*Kiener, 1850)	3.67	6.13	3.94	-	-	-
*Sunettascripta(*Linnaeus, 1758)	5.42	4.51	4.29	-	-	-
*Carditavariegata*Bruguière, 1792	3.64	3.22	2.05	-	-	-
Peroniaverruculata(Cuvier, 1830)	4.25	1.61	1.20	-	-	-
Ceraesignum maximum	6.07	0.9	1.02	-	-	-
Pirenellacingulata (Gmelin, 1791)	-	-	-	5.29	7.62	7.33
Sunettascripta(Linnaeus, 1758)	-	-	-	4.90	4.33	3.85
*Cellana rota (*Gmelin, 1791*)*	-	-	-	5.69	4.85	5.01
*Carditavariegata*Bruguière, 1792	-	-	-	6.04	3.99	4.37
Patella vulgata	-	-	-	4.90	2.60	2.31
Polliaundosa (Linnaeus, 1758)	-	-	-	5.53	2.94	2.96

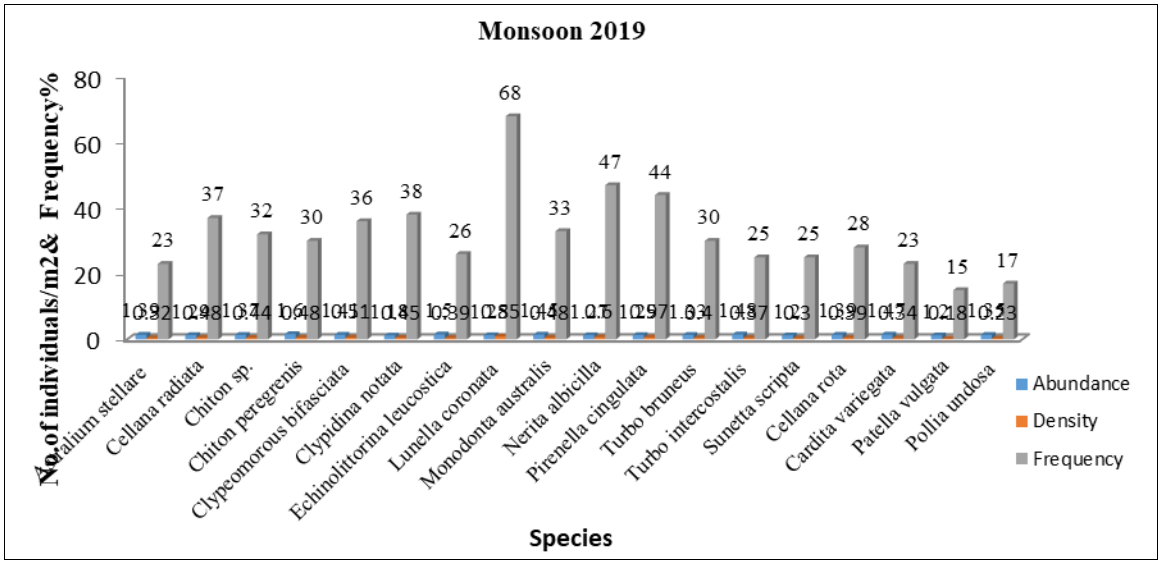

Fig 7: Abundance, frequency and density of molluscs at devbhoomidwarka coast during monsoon (2019)

The diversity indices are important statistical tool for species diversity in ecology. The species. The Simpson index, species evenness and Shanon index for coast is 0.94, 0.63 and 3.61 respectively. The results revels that study area has a high molluscs biodiversity found. The devbhoomi dwarka has enhanced and rich for molluscs diversity.

Table 8: Checklist of the molluscs at devbhoomi-dwarka

Class	Order	Family	Species Name
Gastropoda	Neogastropoda	Pisaniidae	*Engina zea*Melvill, 1893
		Planaxidae	*Planaxis sulcatus* (Born, 1778)
			Pollia undosa (Linnaeus, 1758)
		Muricidae	*Orania subnodulosa(* Melvill, 1893)
			Drupella margariticola (Broderip, 1833)
			Purpura panama (Röding, 1798)
			*Semiricinula tissoti(*Petit de la Saussaye, 1852)
		Mitridae	*Strigatella scutulata* (Gmelin, 1791)
		Nassariidae	*Nassarius stolatus* (Gmelin, 1791)
Gastropoda	Caenogastropoda	Cerithiidae	*Cerithium caeruleum* G. B. Sowerby II, 1855
			Cerithium columna
			Rhinoclavis sinensis (Gmelin, 1791)
			Clypeomorus bifasciata (G. B. Sowerby II, 1855)
	Trochida	Turbinidae	*Astralium semicostatum (* Kiener, 1850)
	Trochida	Turbinidae	*Astralium stellare* (Gmelin, 1791)
			Lunella coronata (Gmelin, 1791)
			Turbo bruneus (Röding, 1798)
			*Turbo intercostalis*Menke, 1846
		Trochidae	*Trochus radiatus*Gmelin, 1791
			Trochus chloromphalus A.Adams,1853
			Monodonta australis (Lamarck, 1822)
Gastrooda	Littorinimorpha	Littorinidae	*Echinolittorina leucosticta* (Philippi, 1847)
		Vermetidae	*Ceraesignum maximum* (G. B. Sowerby I, 1825)
		Potamididae	*Pirenella cingulata* (Gmelin, 1791)
		Tonnidae	*Tonna tessellata* (Lamarck, 1816)
			*Mauritia eglantina (*Duclos, 1833*)*
		Ranellidae	*Cymatium Tripum*Lamarck,1822
			*Gyrineum natator(*Roding,1798)
		Bursidae	*Bufonaria echinata (*Link, 1807)
Gastropoda	Lepetellida	Fissurellide	*Clypidina notata* (Linnaeus, 1758)
			Diodoras ingaporensis (Reeve, 1850)
	Cycloneritida	Neritidae	*Nerita albicilla* Linnaeus, 1758
			*Nerita polita*Linnaeus, 1758
	NIL	Nacellidae	*Cellana radiata* (Born, 1778)

			*Cellana rota (*Gmelin, 1791)
			Cellana karachiensis (Winckworth, 1930)
		Architectonicidae	*Architectonica laevigata* (Lamarck, 1816)
	NIL	Plakobranchidae	*Elysia tomentosa* K. Jensen, 1997
Bivalvia	Cardiida	Cardiidae	*Vaasticardium flavum(Linnaeus,1758)*
Bivalvia	Carditida	Carditidae	*Cardita variegata*Bruguière, 1792
	Venerida	Veneridae	*Sunetta scripta* (Linnaeus, 1758)
			Gafrarium divaricatum (Gmelin, 1791)
			Periglypta reticulata (Linnaeus, 1758)
	Lucinida	Lucinidae	*Anodontiae dentula* (Linnaeus, 1758)
Gastrooda	Aplysiida	Aplysiidae	*Aplysia oculifera* A. Adams & Reeve, 1850
	NIL	Patellidae	*Patella vulgata* Linnaeus, 1758
	NIL	Olividae	*Olivia sp.*
	NIL	Patellidae	*Patella vulgata* Linnaeus, 1758
			*Scutellastra flexuosa(*Quoy&Gaimard
	Systellommatophora	Onchidiidae	*Peronia verruculata* (Cuvier, 1830)
Polyplacophora	Chitonida	Chitonidae	*Chiton peregrinus* Thiele, 1909
			Chiton sp.
Cephalopoda	Octopoda		*Octopus* sp.

Conclusion

The study aims to prepare a database of the intertidal molluscan fauna and the present ecological status of few prominent molluscan species. A totals of fifty-Three molluscs species were found. It is noted that several molluscs species depend on the seaweeds and other vegetation. Furthermore the rocky habitat and shelters, favourable environmental conditions were found. The present work provided a comprehensive list of molluscs species with their taxonomic position, identification references. The seasonal survey of study sites revealed that in the winter season species richness, abundance, species concentration is higher found.It is interesting to note that *Cerithium caeruleum, Clypeomorus bifasciata,Astralium semicostatum,Astralium stellar, Lunella coronate, Turbo bruneus, Trochus radiatus, Monodonta australis, Echinolittorina leucosticta, Pirenella cingulata, Clypidina notate, Nerita albicilla, Neritapolita, Cellana radiate, Cardita variegate, Sunettascripta, Peronia verruculata, Chiton peregrines, Chiton* sp. etc. found predominantly in study site.

Conflicts of interest

Authors declared that there are no conflicts of interest.

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