COMU J Mar Sci Fish 2023 6(1): 56-69
https://doi.org/10.46384/jmsf.1239146

e-ISSN: 2651-5326

COMU Journal of Marine Sciences and Fisheries

Journal Home-Page: http://jmsf.dergi.comu.edu.tr Online Submission: http://dergipark.org.tr/jmsf

RESEARCH ARTICLE

A Checklist of Marine Ornamental Molluscs of India: A Case Study from Dwarka and Bet-Dwarka, Gujarat

Mayurdan Gadhavi*, Zahra Makda, Dudhagara Darshita, Shiyani Jenisha, Shabanam Saiyad

Department of Zoology, H. & H. B. Kotak Institute of Science, Rajkot-360001, Gujarat, India https://orcid.org/0000-0002-0899-8333
Department of Zoology, H. & H. B. Kotak Institute of Science, Rajkot-360001, Gujarat, India https://orcid.org/0000-0003-4611-7282
Department of Zoology, H. & H. B. Kotak Institute of Science, Rajkot-360001, Gujarat, India https://orcid.org/0000-0002-2402-4416
Department of Zoology, H. & H. B. Kotak Institute of Science, Rajkot-360001, Gujarat, India https://orcid.org/0000-0001-7867-0571
Department of Zoology, H. & H. B. Kotak Institute of Science, Rajkot-360001, Gujarat, India https://orcid.org/0000-0002-9982-3976

Received: 19.01.2023 /Accepted: 05.06.2023 / Published online: 04.07.2023

Key words:

Conservation
Intertidal
Diversity
Shell craft industries
Exploitation

Abstract: Marine molluscs are economically very important and they are exploited by men for various purposes since the prehistoric times. Manufacture of ornaments is an age-old industry in the south and south-east India and molluscs as an ornament or souvenir are still in high demand. Although there is plenty of literature on the trade and economy of ornamental shells, exploitation of ornamental molluscs is less studied and limited to regions in the south and south-east India. The ornamental molluscs is widely traded in pilgrims places like Dwarka, Somnath and all along the coast of Gujarat, and with the exception of *Turbinella pyrum* (the chank shell), there is no literature available on ornamental mollusc taxonomy, utilization and trade in Gujarat. This is the first study on ornamental molluscs from Gujarat. We have reviewed the available literature on ornamental molluscs of India and established a comprehensive checklist as there is no checklist available for ornamental molluscs of India. A total 136 species were recorded as ornamental molluscs in India. Of these shells, 118 species were listed by reviewing the literature and 33 ornamental molluscs were added from on-site observations in which 18 species were recorded for the first time from the study area. A total of 11 species among the 136 species were protected under wildlife protection act 1972. Different use of ornamental species was studied and classified accordingly. With respect to families, the majority of contributions were from Cypraeidae (7 species) followed by Muricidae (3 species), Turbinellidae (2 species), Strombidae (2 species) and Cardiidae (2 species). The major source of ornamental imports was from south India with some souvenirs collected from nearby intertidal areas and sold by local vendors as whole shells. Due to the extensive trade of ornamental shells, there is a need to study the degree of exploitation of ornamental molluscs in India, particularly in Gujarat.

Anahtar kelimeler:

Koruma
Gelgit
Çeşitlilik
Kabuk el işi endüstrisi
Yararlanma

Hindistan'ın Deniz Süs Kabuklarının Bir Kontrol Listesi: Dwarka ve Bet-Dwarka, Gujarat'dan Bir Vaka Çalışması

Öz: Deniz kabukları ekonomik açıdan oldukça önemlidir ve tarih öncesi çağlardan beri insanlar tarafından çeşitli amaçlarla kullanılmaktadır. Süs eşyası imalatı güney ve güneydoğu Hindistan'da asırlık bir endüstridir ve süs eşyası veya hediyelik eşya olarak yumuşakçalar hala yüksek talep görmektedir. Süs kabuklarının ticareti ve ekonomisi üzerine çok sayıda literatür olmasına rağmen, süs kabuklarının kullanımı daha az çalışılmıştır ve güney ve güneydoğu Hindistan'daki bölgelerle sınırlıdır. Süs kabukları, Dwarka, Somnath gibi kutsal yerlerde ve tüm Gujarat kıyılarında yaygın olarak ticareti yapılır ve *Turbinella pyrum* (chank kabuğu) dışında, Gujarat'ta süs kabukları taksonomisi, kullanımı ve ticareti hakkında hiçbir literatür yoktur. Bu, Gujarat'tan süs kabukları üzerine yapılan ilk çalışmadır. Hindistan'daki süs kabukları ile ilgili mevcut literatürü inceledik ve Hindistan'daki süs kabukları için herhangi bir kontrol listesi bulunmadığından kapsamlı bir kontrol listesi oluşturduk. Hindistan'da süs kabukları olarak toplam 136 tür kaydedildi. Bu kabuklardan 118 tür literatür taranarak listelenmiş ve ilk kez kaydedilen 18 türün yer aldığı 33 süs kabuğu çalışma alanından yerinde gözlemlerden eklenmiştir. 136 türden toplam 11 tür, 1972 yaban hayatı koruma yasası kapsamında korunmuştur. Süs türlerinin farklı kullanımları incelenmiş ve buna göre sınıflandırılmıştır. Ailelere göre, katkıların çoğu Cypraeidae'den (7 tür), ardından Muricidae (3 tür), Turbinellidae (2 tür), Strombidae (2 tür) ve Cardiidae'den (2 tür) gelmektedir. Süs kabuğu ithalatının ana kaynağı, yakınlardaki gelgit bölgelerinden toplanan ve yerel satıcılar tarafından bütün deniz kabukları olarak satılan bazı hediyelik eşyalarla birlikte güney Hindistan'dan geliyordu. Süs kabuklarının yaygın ticareti nedeniyle, Hindistan'da, özellikle Gujarat'ta süs kabuklarının kullanım derecesini incelemeye ihtiyaç vardır.

*Corresponding author: mayur.gadhvi111@gmail.com

How to cite this article: Gadhavi, M., Makda, Z., Darshita, D., Jenisha, S., & Saiyad, S. (2023). A checklist of marine ornamental molluscs of India: A case study from Dwarka and Bet-Dwarka, Gujarat. COMU J. Mar. Sci. Fish, 6(1): 56-69. doi:10.46384/jmsf.1239146

Introduction

Molluscs have been exploited by man for a wide variety of purposes since prehistoric times. Their variety of shape, colour and form has led to them being endowed with magical or religious attributes, used for personal decoration, as currency, or simply collected out of curiosity. Ornamental molluscs are any species that are marketed for their beauty or aesthetic purposes and used in decoration. Since the dawn of human civilization molluscs have a tremendous impact on Indian tradition and economy (Appukuttan & Ramadoss, 2000). Presently 150,000 tonnes of cephalopods, over 100,000 t of bivalves and nearly 20,000 t of gastropods are exploited from the Indian waters. The bivalve exports amount to US$ 1.2 million and gastropod exports amount to US$ 1.8 million per year (Mohamed & Venkatesan, 2017). Molluscs occupy an important place in the commercial shell-craft industry. The marine gastropod resources in India comprise a variety of species and are exploited regularly for various purposes. In some cases, this exploitation goes unnoticed in several places because it constitutes a very minor fishing when compared to other fishery resources (WWF, 2013). The commercially important molluscs of Indian coast fall into four categories: (1) Food molluscs (2) Molluscs yielding pearls, medicines and lime (3) Molluscs used in the manufacture of ornaments (4) Molluscs which cause damage to ships and marine structures as fouling organisms (Durvey, 1975).

Shell handicraft and manufacture of ornaments is an age-old industry in India and people of all walks of life since ancient times used to wear rings and bangles carved out of shells. Evidences from Franchthi Cave, Greece, suggested that *Cyclope neritea* was heat treated to obtain a shiny black finish for ornamental purposes in the Palaeolithic and Mesolithic age (Vanhaeren & Perle, 2010). There are evidences that chank shell cutting industries were present in the 1st and 2nd centuries AD in Tamilnadu and marine mollusc ornaments were traded from Tamilnadu to Egypt and Greece (Hornell, 1914). In recent times, molluscs have assumed a greater significance in our industrial, technological and aesthetic aspects of life. The demand for polished shells and hand-crafted products as ornament, souvenir and home decor encourages entrepreneurs in south India who have established several cottage industries producing beautiful curios and several utilitarian objects with molluscan shells (Appukuttan & Ramadoss, 2000). Among the molluscan resources exploited commercially from the Indian coast as ornaments and souvenirs, very little attention has been paid to the collection and utilization of gastropods, except for the chank shell (*Turbinella pyrum*), top shell (*Rochia nilotica*) and turbo shell (*Turbo murmoratus*). Chank shell collection, utilization and trade was described by many researchers all along the Indian coast (Hornell, 1914, Pillai & Devadoss, 1947). The collection and trade of *Turbo* and *Trochus* in the Andaman and other part of India was described by several researchers (Appukuttan, 1979). There is a variety of ornamental gastropods and they are used as raw material for the shellcraft trade. Artistic combinations of gastropods and bivalve shells are shaped into attractive toys and models. Literature is available on trade and economy of ornament shells (Appukuttan, 2008;Mohamed & Venkatesan, 2017; Shyam et. al., 2017a; WWF, 2013). There are only a few literature available describing shell ornament industries in detail (Appukuttan, 2000; WWF, 2013). Earlier identification of ornamental shells was carried out by Appukuttan, & Ramadoss, (2000) in Ramnathpuram, Rameswaram and Kanyakumari; Mohamed & Venkatesan (2017) in Tutikorin, Rameswaram, Ramnathpuram and Keelakarai; Natrajan et. al., (1987) in Ramnathpuram; Ravinesh et. al., (2019) in Rameswaram; Shyam et. al., (2017a) in Kollam; Babu et. al., (2011) in Prangipettai. However, there is no checklist available for ornamental molluscs in India. Utilization and exploitation of the chank shell was studied by Pota & Patel, (1988) in Gujarat. Other than the chank shell, there is no literature available of ornamental mollusc taxonomy, utilization and trade from Gujarat though they are widely used in pilgrimage places like Dwarka and Somnath and in other places all along the sea coast. In this review, we have made an attempt to prepare a checklist of ornamental mollusc of India which includes seashells identified for the first time. Literature review and the seashell trade of ornamentally important molluscs were also carried out to shed some light on the status of exploited species of molluscs in India.

Material and Methods

Study site

Dwarka

Dwarka is a city and a municipality of Devbhumi Dwarka district in the state of Gujarat in Western India. It is located on the western coast of the Okhamandal Peninsula on the right bank of the Gomti River, at the mouth of the Gulf of Kutch facing the Arabian Sea (Figure 1). The city's economy is tourism-based. Dwarka is one of four sacred Hindu pilgrimage sites collectively called the Chardham and is one of the seven-most-ancient religious cities (Sapta Puri) in India. The main festival of Janmashtami is celebrated in Bhadrapada (August–September). Most of the revenue of Dwarka is derived from tourism (Apte, 2012). Tourist population during festival reaches 5-6 thousand daily and the number of visitors reaches 500-600 hundred thousand every year (Kapadia, 2018). As a result, there is a high demand of unique ornaments and souvenirs made from marine molluscs.

Bet Dwarka

Bet Dwarka (also spelled Beyt Dwarka) or Shankhodhar is an inhabited island at the mouth of the Gulf of Kutch situated 3 km off the coast of Okha, Gujarat, India (Fig. 1). Northwest to southeast the island measures 13 km long with an average east-west width of 4 km. It is a strip of sandstone situated 30 km north of the town of Dwarka (Gaur, 2004). Dhwarkadhish Temple and Shri

Keshavraiji Temple are the major temples of Krishna. Hanuman Dandi and Vaishnav Mahaprabhu Bethak and a Gurudwara are also pilgrimage places. Bet Dwarka can be reached by ferry from Okha. There is heavy traffic during the winter and monsoon season and during the festival at Bet Dwarka. In the peak season, 15,000-20,000 tourists visit Bet Dwarka on a daily basis. There is a small market selling mostly ornamental molluscs. Visitors purchase whole shells or ornaments for religious purposes or as a memento of pilgrimage visit.

A local tourist market was surveyed during the month of January and February, 2022. Some common diversified ornaments, gift articles and home decor pieces were collected and identified in the laboratory. Some costly articles were photographed with high resolution using a digital camera (Canon, 1800D, Japan). At the laboratory, mollusc specimens up to species level were identified with standard references (Apte, 2012; Kamboj et. al., 2019; Patel & Patel, 2019). A checklist of identified species was prepared and their taxonomy and scientific names were double-checked via World Register of Marine Species (WoRMS) and Molluscbase.org for the current nomenclature. Different uses of ornamental shells were also examined and classified accordingly. Interviews with local sellers, local people and fishermen were also carried out in order to determine the collection method of molluscs.

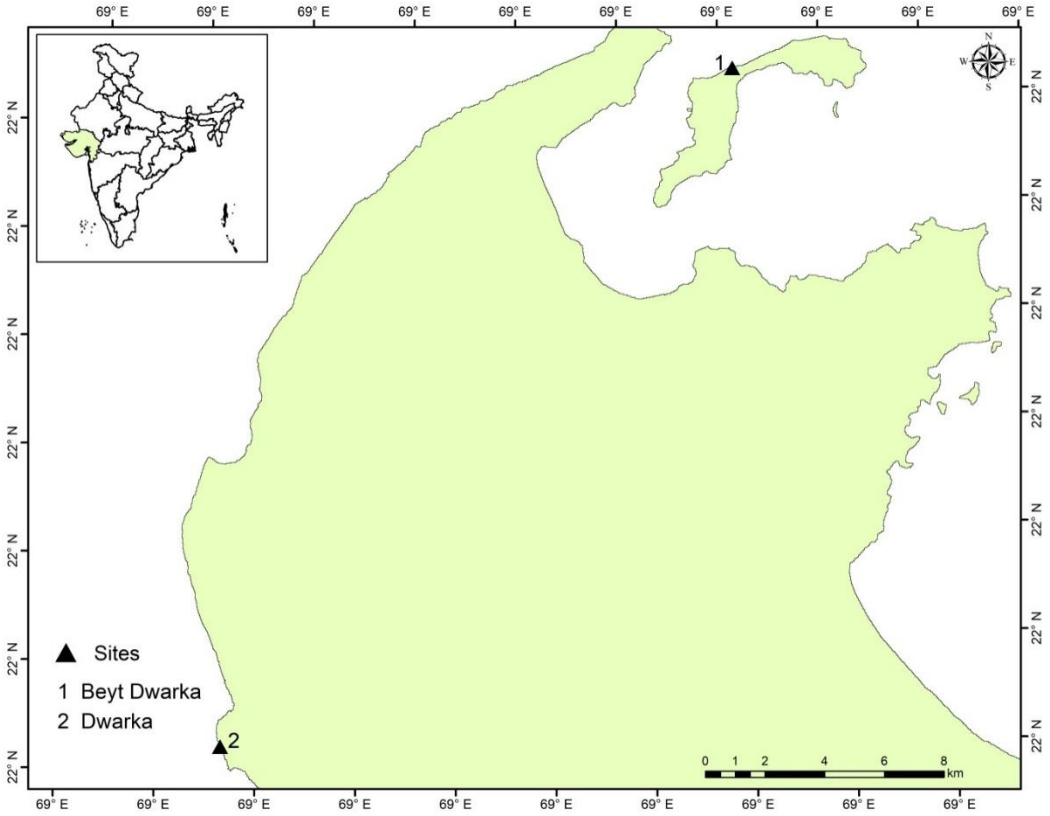

Figure 1. Location of the study site

Results and Discussion

Ornament molluscs from Devbhumi Dwarka district

In the present study, 33 mollusc species were identified and photographed from the ornaments and souvenirs purchased from Dwarka and Bet Dwarka (Figure1-4). These molluscs were classified under 3 classes, 10 orders, 22 families and 29 genera (Table 1). By family, the highest contribution belonged to Cypraeidae (7 species), followed by Muricidae (3 species), Turbinellidae (2 species), Strombidae (2 species) and Cardiidae (2 species). The contribution of the remaining 17 families was 3%. Out of 33 species, 11 species were sold exclusively as a souvenir (only whole shell), 2 species were sold as holy items with religious importance and 8 species were used exclusively in making ornaments while 16 species were used both as a souvenir and used in making ornaments (Table 1).

Table 1. List of ornamental molluscs collected from Dwarka and Bet-Dwarka Market.

Sr.no	Class	Order	Family	Species name	Remarks
1	Gastropoda	Littorinimorpha	Cypraeidae	*Monetaria caputserpentis* (Linnaeus, 1758)	Souvenir Jewellery, Keychain, Toran, Mirror
2				*Monetaria annulus* (Linnaeus, 1758)	
3				*Naria turdus* (Lamarck, 1810)	Souvenir, Toys
4				*Mauritia eglantina* (Duclos, 1833)	
5				*Cribrarula cribraria* (Linnaeus, 1758)	
6				*Cypreae tigris* **(**Linnaeus, 1758	Show –piece
7				*Naria lamarckii* (J. E. Gray, 1825)	Souvenir Jewellery Keychain
8			Ficidae	*Ficus gracilis* (G. B. Sowerby I, 1825)	Souvenir
9			Rostellariidae	*Tibia curta* (G. B. Sowerby II, 1842)	Souvenir
10			Bursidae	Bufonaria echinata (Link, 1807)	Souvenir
11			Strombidae	*Laevistrombus canarium* (Linnaeus, 1758)	Keychain, Shoe-piece
12				*Lambis lambis* (Linnaeus, 1758)	Souvenir
13		Neogastropoda	Turbinellidae	*Turbinella pyrum* (Linnaeus, 1767)	Religious purpose
14				*Turbinella rapa* (Lamarck, 1816)	Religious purpose
15			Melogenidae	*Volegalea cochlidium* (Linnaeus, 1758)	Souvenir
16			Conidae	*Conus araneosus* (Lightfoot, 1786)	Souvenir
17			Muricidae	*Chicoreus capucinus* (Lamarck, 1822)	Souvenir
18				*Chicoreus ramosus* (Linnaeus, 1758)	Souvenir
19				*Murex ternispina* Lamarck, 1822	Souvenir
20			Mitridae	*Mitra sp.* (Lamarck, 1798)	Souvenir, Aquarium decoration
21			Columbellidae	*Euplica scripta* (Lamarck, 1822)	Jhumar, Mirror, Toran
22			Babyloniidae	*Babylonia spirata* (Linnaeus, 1758)	Jhumar, Mirror
23		Caenogastropoda	Cerithiidae	*Cerithium sp.* Bruguière, 1789	Toys
24			Turritellidae	*Turritella radula* (Kiener, 1843)	Aquarium decoration, Souvenir
25		Lepetellida	Haliotidae	*Haliotis varia* Linnaeus, 1758	Souvenir, Aquarium decoration
26		Trochida	Turbinidae	*Turbo bruneus* (Röding, 1798)	Souvenir
27		-	Architectonicidae	*Architectonica perspective* (Lamarck, 1816)	Souvenir
28	Bivalve	Venerida	Veneridae	*Dosinia exoleta* Linnaeus, 1758	Toran, Souvenir
29		Arcida	Arcidae	*Tegillarca granosa* (Linnaeus, 1758)	Toran, Souvenir
30		Cardiida	Cardiidae	*Vasticardium* spp. Iredale, 1927	Table lamp
31				*Vepricardium* spp. Iredale, 1929	Toran
32		Ostreida	Margaritidae	*Pinctada fucata* (A. Gould, 1850)	Jewellery
33	Scaphopoda	Dentaliida	Dentelidae	*Dentalium* spp. Linnaeus, 1758	Jewellery, Souvenir

Figure 2. 1. *Monetaria caputserpentis 2.1 Monetaria annulus 2.2 keychain(Monetaria annulus) 3. Naria turdus 4.1 Mauritia eglantine 4.2 Toy(Mauritia eglantine) 5. Cribrarula cibiaria 6.1 Cypraea tigris 6.2 Showpiece 7.1 Naria lemarckii 7.2 jwellery (Naria lemarckii) 8. Ficus gracilis9.1 Tibia curta 9.2 Showpiece(Tibia curta) 10. Bufonaria echinata 11. Laevistrombus canarium 12. Lambis lambis 13.1 Turbinella pyrum 13.2 Polished shell (Turbinella pyrum) 14. Turbinella rapa 15. Volegalea cochlidium 16. Conus araneosus 17. Chicoreus capucinus 18. Chicoreus ramosus*

Figure 3. *19. Murex ternispina 20. Mitra sp. 21.1 Euplica scripta 21.2 Toran(Euplica scripta) 22.1 Babylonia spirata 22.2 Jhumar(Babylonia spirata) 23. Cerithium sp. 24. Turritella radula 25. Neritodryas dubia 26. Turbo bruneus 27. Architectonica perspectiva 28. Dosinia exoleta* (Photograph 21.1 &22.1 taken from eol.org)

Figure 4. *29.1 Tegillarca granosa 29.2 Toy(Tegillarca granosa) 30. Vesticardium sp. 31. Vepricardiumsp. 32. Pinctada fucata 33. Dentalium sp*

Species like *Ficus gracilis, Tibia insulaechorab, Bufonaria echinata, Laevistrombus canarium, Lambis lambis, Volegalea cochlidium, Conus araneosus, Chicoreus capucinus, chicoreus ramosus, Murex ternispina, Turbo bruneus and Architectonica perspectiva* were used as whole shell for decorative purposes and as souvenirs. Market price for these shells ranged between 10-100 INR (0.1-1.2 USD) based on shape and size. Most of these species are sold by local vendors.

Cypraea tigris, Strombus canarium, Euplica scripta, Babylonia spirata, Cerithium sp. and *Pinctada fucata* were exclusively used in the production of show-pieces (market price 50-200 INR) (0.6-2.5 USD), key chains (market price 10-50 INR) (0.1-0.6 USD), mirrors (market price 300-1000 INR) (4-12 USD), Toran (market price 300-700 INR) (4-9 USD) and Jhumar (market price 1000-5000 INR) (12-60 USD). *Vasticardium sp.* and *Vepricardium sp.* were carved, polished and used in the production of table lamps (market price 500-1000 INR) (6-12 USD). All these ornaments were sold in stores and showrooms. Most of the shells belonging to the family *Cypraeidae* were large and beautiful and used as souvenirs (market price 5-10 INR per piece) (0.1-0.2 USD), jewellery (market price 50-100 INR) (0.5-1 USD), key-chain (market price 20-50 INR) (0.2-0.6 USD), mirror (market price 300-1000 INR) (4-12 USD), Toran (market price 300-700 INR) (4-8 USD) and toys (market price 50-200 INR) (0.5-2.5 USD). The common species of family *Cypraeidae* were *Monetaria caputserpentis, Monetaria annulus, Naria turdus, Mauritia eglantina, Cribrarula cribraria, Erosaria lamarckii.* Species like *Mitra sp., Turritella radula* and *Haliotis varia* were also common. Bivalves like *Dosinia exoleta* and *Tegillarca granosa* were used in making dolls and toys together with gastropods like *Cerithium and Conus.* Market prices of these toys ranged from 50 to 200 INR (0.5-2.5 USD). *Dentalium sp.* was commonly used as pendants and sold in markets in Bet Dwarka under Rs.10 (0.1 USD). On the other hand, since *Turbinella pyrum* and *Turbinella rapa* have high religious values in Hindu belief and considered holy and found in Hindu temples, they receive higher prices ranging from 200 to 4,000 INR (2-50 USD) according to size of the shell.

Interviews with locals and shopkeepers revealed that Devbhumi Dwarka district had no seashell ornament industries and all the ornaments were imported from Tamilnadu and Kerala. However, Ramnathpuram, Keelakarai, Kollam, Rameswaram and Tutikorin had well-established seashell ornament industries (Appukuttan, 1996; Natarajan etal., 1987). Therefore, ornamental shells sold in the markets in Dwarka and Bet Dwarka were imported from south India. Only a few local vendors in Gomti Ghat (Dwarka) and Bet Dwarka were found to sell raw shells (unpolished whole shell) which were bycatches from trawl fishing with the exception of *Turbinella pyrum* and *Turbinella rapa* which were collected by diving. A total of 14 species were identified from local vendors as raw shells which come from the surrounding areas.

Earlier studies on molluscan diversity by Gopalkrishnan, (1970), Sarvaiya, (1977) and Soni & Thakur, (2015) reported a total of 114 species from the intertidal zone of Dwarka, Bet Dwarka, Okha and the surrounding areas. Twelve out of 33 ornamental species identified in this study were recorded from the surrounding intertidal areas by these researchers. Among 14 species which were identified as raw shells sold by local vendors, 7 species were recorded earlier by these researchers from the intertidal areas where as 7 species were deep sea species with no earlier report. There were 7 species sold by local vendors as imports from south India which were recorded earlier by other researchers.

Checklist of Indian Ornament Molluscs

A total of 136 species were recorded as ornamental molluscs from the available literature (118 species) and the current work (33 species) (Table 2). Major contributors by family were *Muricidae* (19 species) followed by *Strombidae* (13 species), *Cypraeidae* (12 species), *Conidae* (9 species) and *Naticidae* (5 species). All available literature for identification of ornamental molluscs concentrated on the south and southeast coasts of Ramnathpuram, Rameswaram, Tutikorin, Keelakarai and Prangrpettai in Tamilnadu and of Kollam-Kanyakumari in Kerala (Appukuttan, 2000; Babu et al., 2011; Mohamed & Venkatesan 2017; Natarajan et al., 1987; Ravinesh et al., 2019; Shyam et al., 2017). In this study, ornamental molluscs from Gujarat were identified for the first time and 18 species, which were previously not identified as ornamental molluscs, were added to the checklist of India. Among the 136 species, 5 species falls under Schedule I and 6 species falls under Schedule II of Wildlife Protection Act notification, 2021 (Table 3). There is a long history of mollusc use as ornaments in India and their exploitation continues today. There is no systematic survey carried out to understand the degree of exploitation of ornament molluscs inIndia.

Table 2. Checklist of Ornament molluscs of India

Sr No.	Family	Species Name	References in which species mentioned
1	Architectonicodea	*Architectonica laevigata* (Lamarck, 1816)	WWF 2013, Shyam et al. 2017a, Mohamed & Venkatesan 2017
2		*Architectonica perspectiva* (Lamarck, 1816)	Mohamed & Venkatesan 2017, Babu et al. 2011, Mohamed 2012
3	Babyloniidae	*Babylonia spirata* (Linnaeus, 1758)	WWF 2013, Mohamed &Venkatesan 2017, Venkatesan 2010, Appukuttan 1996, Babu et al.2011, Shyam et al. 2017a&b, Mohamed 2012
4		*Babylonia zeylanica* (Bruguière, 1789)	WWF 2013, Mohamed &Venkatesan 2017 , Venkatesan 2010, Appukuttan 1996, Shyam et al. 2017a&b, Mohamed 2012
5		*Babylonia* spp. Schlüter, 1838	Venkatesan 2010, Narasimham et al.1993, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al.1988
6	Bursidae	Bufonaria echinata (Link, 1807)	WWF 2013,Venkatesan 2010, Shyam et al. 2017a&b, Babu et al. 2011
7		*Bursa margariticula* (Deshayes, 1833)	Shyam et al. 2017b
8	Conidae	*Conus milneedwardsi* (Jousseaume, 1894)	WWF 2013, Mohamed & Venkatesan 2017, Subba Rao 2003, Appukuttan 2008, Natarajan et al.1988
9		*Conus* spp. Linnaeus, 1758	Venkatesan 2010, Appukuttan 1996, Narasimham et al. 1993, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al.1988, Mohamed 2012
10		*Conus amadis* (Gmelin, 1791)	Babu et al.2011, Subba Rao 2003, Salim et al. 2017b
11		*Conus litteratus* (Linnaeus, 1758)	Salim et al. 2017b
12		*Conus bengalensis* (Okutani, 1968)	Alagerswami & Meiyappan 1987
13		*Conus* miles (Linnaeus, 1758)	Appukuttan 2008
14		*Conus striatus* (Linnaeus, 1758)	Appukuttan 2008
15		*Conus geographus* (Linnaeus, 1758)	Appukuttan 2008
16		*Conus araneosus* (Lightfoot, 1786)	Current Study
17	Cymatiidae	*Monoplex pilearis* (Linnaeus, 1758)	WWF 2013, Mahamed & Venkatesan 2017, Natarajan et al.1988, Shyam et al. 2017
18		*Cymatium* spp. Röding, 1798	Venkatesan 2010, Narasimham et al.1993, Alagerswami & Meiyappan 1987, Appukuttan 2008
19		*Septa rubecula* (Linnaeus, 1758)	Shyam et al. 2017b
20	Ficidae	*Ficus gracilis* (G. B. Sowerby I, 1825)	WWF 2013, Mahamed & Venkatesan 2017,Shyam et al. 2017b
21		*Ficus ficus* (Linnaeus, 1758)	Mohamed &Venkatesan 2017, Mohamed 2012
22	Volutidae	*Fulgoraria* spp.Schumacher, 1817	WWF 2013, Mahamed & Venkatesan 2017

23		*Melo melo* (Lightfoot, 1786)	WWF 2013, Subba Rao 2003,Shyam et al. 2017b, Venkatesan 2010, Babu et al. 2011, Natarajan et al.1988, Appukuttan 1996, Mohamed 2012
24		*Cymbium* spp. Röding, 1798	Narasimham et al. 1993, Babu et al.2011, Shyam et al. 2017b, Alagerswami & Meiyappan 1987, Appukuttan 2008
25	Fasciolariidae	*Fusinus colus* (Linnaeus, 1758)	WWF 2013,Mahamed & Venkatesan 2017
26		*Fusinus toreuma* (Deshayes, 1843)	Mohamed & Venkatesan 2017, Mohamed 2012, Shyam et al. 2017b
27		*Fusinus* spp. Rafinesque, 1815	Venkatesan 2010, Alagerswami & Meiyappan 1987, Natarajan et al.1988
28		*Plearoploca trapezium* (Linnaeus, 1758)	Ravinesh et al. 2019, Mohamed 2012
29	Harpidae	*Harpa major* (Röding, 1798)	WWF 2013, Mohamed & Venkatesan 2017, Durve 1975, Appukuttan 1996, Babu et al.2011, Mohamed 2012, Shyam et al. 2017b
30		*Harpa* spp. Röding, 1798	Venkatesan 2010, Alagerswami & Meiyappan 1987, Natarajan et al.1988
31	Muricidae	*Murex tribulus* (Linnaeus, 1758)	WWF 2013, Shyam et al. 2017b, Mohamed & Venkatesan 2017
32		*Chichoreus virgineus* (Röding, 1798)	WWF 2013, Appukuttan 1996, Shyam et al. 2017b, Mohamed &Venkatesan 2017, Babu et al. 2011, Mohamed 2012
33		*Purpura bufo* (Lamarck, 1822)	WWF 2013, Appukuttan 1996, Shyam et al. 2017b
34		*Rapana rapiformis* (Born, 1778)	Mohamed & Venkatesan 2017, Mohamed 2012, Shyam et al. 2017b
35		*Murex pectin* (Lightfoot, 1786)	Mohamed & Venkatesan 2017, Mohamed 2012
36		*Murex trapa* (Röding, 1798)	Mohamed & Venkatesan 2017, Mohamed 2012
37		*Orania badia* (Reeve, 1845)	Mohamed & Venkatesan 2017, Mohamed 2012
38		*Murex* spp. Linnaeus, 1758	Mohamed & Venkatesan 2017, Durve 1975, Appukuttan 1996, Narasimham et al.1993, Babu et al.2011, Subba Rao 2003, Alagerswami & Meiyappan 1987, Appukuttan 2008, Mohamed 2012
39		*Chicoreus ramosus* (Linnaeus, 1758)	Venkatesan 2010, Babu et al. 2011, Subba Rao 2003, Shyam et al.2017b, Appukuttan 2008, Mohamed 2012
40		*Haustellum haustellum* (Linnaeus, 1758)	Venkatesan 2010, Natarajan et al.1988
41		*Drupa* spp. Röding, 1798	Narasimham et al. 1993, Appukuttan 2008
42		*Hexaplex kuesterianus* (Tapparone Canefri, 1875)	Babu et al.2011
43		*Nassa* spp. Röding, 1798	Subba Rao 2003, Mohamed 2012
44		*Haustellium* spp. Schumacher, 1817	Shyam et al. 2017b
45		*Chicoreus florifer* (Reeve, 1846)	Natarajan et al.1988

46		*Murex triremis (*Purpurellus Jousseaume, 1880)	Natarajan et al.1988
47		*Thais* spp Röding, 1798	Mohamed 2012
48		*Chicoreus capucinus* (Lamarck, 1822)	Current study
49		*Murex ternispina* Lamarck, 1822	Current study
50	Olividae	Agaronia gibbosa (Born, 1778)	WWF 2013, Mohamed & Venkatesan 2017, Babu et al.2011, Mohamed 2012
51		*Oliva* spp.(Bruguière, 1789)	Mohamed & Venkatesan 2017, Venkatasen 2010, Appukuttan 1996, Narasimham et al.1993, Subba Rao 2003, Shyam et al. 2017b, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al.1988, Mohamed 2012
52	Cassidae	*Phalium glaucum* (Linnaeus, 1758)	WWF 2013, Mohamed & Venkatesan 2017, Shyam et al. 2017b; Babu et al.2011
53		*Cassis conuta* (Linnaeus, 1758)	Ravinesh et al. 2019, Durve 1975, Ramadoss2003, Appukuttan 1996, Narasimham et al. 1993, Alagerswami & Meiyappan 1987, Appukuttan 2008
54		*Cypraecassis rufa* (Linnaeus, 1758)	Ravinesh et al. 2019, Appukuttan 1996, Appukuttan 2008
55		*Cassis madagascarensis(*Lamarck, 1822)	Natarajan et al.1988
56	Naticidae	*Neverita didyma (Röding, 1798)*	WWF 2013, Shyam et al. 2017b
57		*Polinices mammilla (Linnaeus, 1758)*	Mohamed & Venkatesan 2017, Mohamed 2012
58		*Tanea lineate* (Röding, 1798)	Mohamed & Venkatesan 2017, Mohamed 2012
59		*Natica spp.* Scopoli, 1777	Narasimham et al. 1993 ,Shyam et al. 2017b, Appukuttan 2008
60		*Paratectonatica tigrina* (Röding, 1798)	Babu et al.2011
61	Strombidae	*Neodilatilabrum marginatum* (Linnaeus, 1758)	WWF 2013, Venkatesan 2010, Appukuttan 1996, Appukuttan 2008
62		*Lambis truncate* (Lightfoot, 1786)	Mohamed & Venkatesan 2017, Ravinesh et al.2019, Appukuttan 2008, Mohamed 2012
63		*Lambis lambis* (Linnaeus, 1758)	Mohamed &Venkatesan 2017, Venkatasen 2010, Ravinesh et al.2019, Durve 1975, Appukuttan 1996, Narasimham et al. 1993, Babu et al.2011, Subba Rao 2003, Shyam et al. 2017b, Appukuttan 2008, Mohamed 2012
64		*Strombus* spp. Linnaeus, 1758	Venkatesan 2010, Narasimham et al. 1993, Alagerswami & Meiyappan 1987, Natarajan et al.1988, Mohamed 2012
65		*Harpago chiragra* (Linnaeus, 1758)	Ramadoss 2003, Babu et al.2011
66		*Laevistrombus canarium* (Linnaeus, 1758)	Babu et al.2011
67		*Mirabilistrombus listeri* (T. Gray, 1852)	Appukuttan 2008
68		*Lambis crocata* (Link, 1807)	Appukuttan 2008
69		*Lambis* spp. Röding, 1798	Appukuttan 2008
70		*Lambis scropius* (Linnaeus, 1758)	Appukuttan 2008

70		*Lambis lambis* (Linnaeus, 1758)	Appukuttan 2008
71		*Harpago chiragra* (Linnaeus, 1758)	Natarajan et al.1988
72		*Lambis crocata* (Link, 1807)	Natarajan et al.1988
73	Rostellariidae	*Tibia curta* (G. B. Sowerby II, 1842)	WWF 2013, Mohamed & Venkatesan 2017, Salim et al. 2017a&b, Mohamed 2012
74		*Tibia* spp. Röding, 1798	Venkatesan 2010, Narasimham et al.1993, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al.1988
75	Tonnidae	*Tonna dolium* (Linnaeus, 1758)	WWF 2013, Narasimham et al. 1993, Babu et al.2011, Shyam et al. 2017ab, Appukuttan 2008
76	Turritellidae	*Turritella duplicate* (Linnaeus, 1758)	WWF 2013, Babu et al. 2011, Shyam et al. 2017b
77		*Turitella terebra* (Linnaeus, 1758)	WWF 2013
78		*Turritella attenuate* Reeve, 1849	Mohamed & Venkatesan 2017
79		*Turritella radula (*Kiener, 1843)	Current study
80	Xenophoridae	*Xenophora corrugate* (Reeve, 1842)	WWF 2013, Shyam et al. 2017b
81		*Xenophora* spp.(Fischer von Waldheim 1807)	Mohamed & Venkatesan 2017, Mohamed 2012
82	Trochidae	*Umbonium vestiarium* (Linnaeus, 1758)	WWF 2013, Mohamed & Venktasen 2017, Venktasen 2010, Ramadoss 2003, Appukuttan 1996, Narasimham et al. 1993, Babu et al.2011, Subba Rao 2003, Shyam et al. 2017b, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al. 1988, Mohamed 2012
83		*Rochia nilotica* (Linnaeus, 1767)	Mohamed & Venkatesan 2017, Venkatesan 2010, Durve 1975, Ramadoss 2003, Appukuttan 1996, Narasimham et al. 1993, Subba Rao 2003, Alagerswami & Meiyappan 1987, Appukuttan 2008, Mohamed 2012
85		*Trochita trochiformis* (Born, 1778)	Venkatesan 2010, Ramadoss 2003, Babu et al.2011
86	Melongenidae	*Volegalea cochlidium* (Linnaeus, 1758)	WWF 2013, Mohamed &Venktasen 2017, Venktasen 2010, Narasimham et al.1993, Appukuttan 2008, Shyam et al. 2017b
87		*Volegalea carnaria* (Röding, 1798)	Babu et al.2011, Subba Rao 2003
88		*Cellana radiate* (Born, 1778)	Mohamed 2012
89	Cypraeidae	*Cypreae tigris* **(**Linnaeus, 1758)	WWF 2013, Mohamed &Venkatesan 2017, Appukuttan 1996, Babu et al.2011, Shyam et al. 2017b, Mohamed 2012
90		*Monetaria moneta* (Linnaeus, 1758)	Mohamed & Venkatesan 2017, Ramadoss 2003, Appukuttan 1996, Subba Rao 2003, Mohamed 2012
91		*Cypraea* spp. Linnaeus, 1758	Venkatesan 2010, Durve 1975, Ramadoss 2003, Narasimham et al. 1993, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al.1988
92		*Talparia talpa* (Linnaeus, 1758)	Venkatesan 2010, Natarajan et al.1988

93		*Mauritia Arabica* (Linnaeus, 1758)	Appukuttan 1996, Mohamed 2012
94		*Mauritia eglantina* (Duclos, 1833)	Current study
95		*Mauritia histrio* (Gmelin, 1791)	Natarajan et al.1988
96		*Monetaria caputserpentis* (Linnaeus, 1758)	Current study
97		*Monetaria annulus* (Linnaeus, 1758)	Current study
98		*Naria lamarckii* (J. E. Gray, 1825)	Current study
99		*Naria turdus* (Lamarck, 1810)	Current study
100		*Cribrarula cribraria* (Linnaeus, 1758)	Current study
101	Turbinellidae	*Turbinella pyrum* (Linnaeus, 1767)	WWF 2013, Mohamed & Venkatesan 2017, Venkatasen 2017 ,Ravinesh et al. 2019, Ramadoss 2003, Appukuttan 1996, Narasimham et al.1993, Babu et al.2011, Subba Rao 2003, Shyam et al. 2017b, Alagerswami & Meiyappan 1987, Appukuttan 2008, Natarajan et al 1988, Mohamed 2012
102		*Turbinella rapa*(Lamarck, 1816)	Current study
103	Pseudonelatomidae	*Crassispira* spp. **(**Swainson, 1840)	Mohamed & Venkatesan 2017, Mohamed 2012
104	Epitoniidae	*Epitonium scalaris* (Linnaeus, 1758)	Mohamed & Venkatesan 2017, Mohamed 2012
105	Turbinidae	*Turbo marmoratus* (Linnaeus, 1758)	Mohamed & Venkatesan 2017, Ravinesh et al.2019, Durve 1975, Ramadoss 2003, Appukuttan 1996, Narasimham et al. 1993, Babu et al.2011, Subba Rao 2003, Alagerswami & Meiyappan 1987, Appukuttan 2008, Mohamed 2012
106		*Turbo intercostalis* (Menke, 1846)	Venkatesan 2010, Mohamed 2012
107		*Turbo bruneus* (Röding, 1798)	Current study
108	Charoniidae	*Charonia tritonis* (Linnaeus, 1758)	Mohamed & Venkatesan 2017, Ravinesh et al.2019, Appukuttan 2008, Mohamed 2012
109	Arcidae	*Arca* spp. Linnaeus, 1758	Mohamed & Venkatesan 2017, Venkatasen 2010, Natarajan et al.1988
110		*Anadara* spp. Gray, 1847	Babu et al.2011
111		*Tegillarca granosa* (Linnaeus, 1758)	Current study
112		*Tegillarca rhombea* (Born, 1778)	Babu et al.2011
113	Dentelidae	*Dentalium* spp. Linnaeus, 1758	Venkatesan 2010, Appukuttan 1996, Appukuttan 2008, Natarajan et al.1988, Mohamed 2012
114	Haliotidae	*Haliotis varia* (Linnaeus, 1758)	Venkatesan 2010

Table 3. List of scheduled ornament molluscs

Sr No	Species	WPA 2021
1	*Conus milneedwardsi* (Jousseaume, 1894)	Schedule-1
2	*Turbo marmoratus* (Linnaeus, 1758)	Schedule-1
3	*Charonia tritonis* (Linnaeus, 1758)	Schedule-1
4	*Cassis conuta* (Linnaeus, 1758)	Schedule-1
5	*Cypraecassis rufa* (Linnaeus, 1758)	Schedule-1
6	*Rochia nilotica* (Linnaeus, 1767)	Schedule-2
7	*Lambis truncate* (Lightfoot, 1786)	Schedule-2
8	*Talparia talpa* (Linnaeus, 1758)	Schedule-2
9	*Placuna placenta* (Linnaeus, 1758)	Schedule-2
10	*Harpago chiragra* (Linnaeus, 1758)	Schedule-2
11	*Lambis scropius* (Linnaeus, 1758)	Schedule-2

Conclusion

This is the first comprehensive checklist of ornamental molluscs of India. We have recorded 136 ornamental molluscs from India with 18 species recorded for the first time being used in the making of seashell ornaments in India. Most of the seashell ornamental industries are concentrated in the south and south east coasts of India with corresponding exploitation of molluscs recorded from the south coast, Gulf of Mannar and Andaman Nicobar Islands.

We have recorded 33 species being used as ornamental molluscs from Gujarat. Although seashell ornaments are extensively imported from south India, there are as much as 14 species used as souvenirs collected from the nearby coasts of Dwarka and Bet Dwarka. There is already high exploitation pressure on *Turbinella pyrum* from the Gulf of Kachchh and there is a need to track the exploitation of ornamental molluscs from Gujarat. Since Dwarka and Bet Dwarka are pilgrimage sites with 5-6 hundred thousand people visiting annually, demand for ornamental molluscs as holy objects or as souvenirs is very high. However, there is no study available on the market demand and exploitation of ornamental molluscs. Therefore, there is a need to study the ornamental shell market quantitatively in order to better understand the rate of exploitation on ornamental molluscs. Well-managed exploitation of ornamental shells with regulations towards limiting the harvest of species with high demand will help sustainable business opportunities for the local people and help thrive this age old ornamental seashell trade for future generations. In a further study, we are planning to survey the ornamental seashell market to quantify the trade of ornamental molluscs exploited from Dwarka & Bet Dwarka and assess the economical importance of ornamental seashell trade on local people.

Acknowledgement

We would like to thank all the local vendors and shopkeepers of dwarka and bet dwarka for the cooperation in our survey. We would like to thank Dr. Hitesh Kardani, Fisheries Research Institute, Junagadh Agriculture University for guiding us during study and identification of the specimen.

Conflict of Interest

No conflict of interest.

Author Contributions

MKG: correspondence, methodology, literature review, data analysis, field work, and writing- review & editing, MZ: conceptualization, literature review, field work, data analysis, and writing- original draft, review & editing. DDM: field work, literature review, data analysis, and writing- original draft, review & editing. SJV: field work and literature review, and writing- review, SS: methodology and supervision, data analysis, and writing- original draft, review & editing.

Ethics Approval

Ethics committee approval is not required for this study.

References

Alagerswami, K., & Maiyappan, M., M. (1987). Prospects and Problems of Management and Development of The Marine Molluscan Resources (Other than Cephalopods) in India. Central Marine Fisheries Research Institute, 44(1), 250-261.

Appukuttan, K., K. (1979). Trochus and Turbo Fishery in Andamans. Seafood Export Journal, 11(1), 41-44.

Appukuttan, K., K. (1996). Marine Molluscs and Their Conservation. Marine Biodiversity Conservation and Management.

Appukuttan, K., K. (2008). Molluscan Resources and Management Strategies. National Seminar on Environmental Management for Sustainable Livelihood, 6-12.

Appukuttan, K., K., & Ramadoss, K. (2000) Edible and Ornamental Gastropod Resource. Marine Fisheries Research and Management, 525-535.

Apte, D. (2012). Field Guide to The Marine Life of India. First addition.

Apte, P., M. (2012). The Building of Gandhinagar: New Capital of Gujarat, India.

Arjunan, Babu., Venkatesan, V., & Rajagopal, S. (2011). Contribution to the knowledge of ornamental molluscs of Parangipettai, Southeast Coast of India. Advances in Applied Science Research, 2(5), 290-296.

Durvey, V. S. (1975) .Commercial Marine Mollusc of India and The Need for Their Survey. Record of the Zoologycal Survey of India, (68) 421-429. http://faunaofindia.nic.in/PDFVolumes/records/068/01-04/0421-0429.pdf eol.org/pages/46462476

Gaur, A. S. (2004). A unique Late Bronze Age copper fish-hook from Bet Dwarka Island, Gujarat, west coast of India: Evidence on the advanced fishing technology in ancient India. *Current Science*, 86 (4), 512-514.

Gopalkrishnan, P. (1970). Some Observations of The Shore Ecology of The Okha Coast. Journal of Marine Biologycal Association of India, 12 (1&2), 15-34.

Hornell, J.(1914) . The Sacret Chank of India: A Monograph of The Indian Conch (*Turbinella pyrum*). Madras Fisheries' Bureau (7).

Kamboj, R. D., Joshi, D. M., & Parmar, H. (2019). Common Marine Mollusc of Gujarat. Gujarat Ecological Education and Research Foundation.

Kapadia, K. (2018). Pilgrim tourism proposals in Dwarka, Gujrat, India. International research journal of Engineering and Technology (IRJET), 5(10), 889-892.

Mohamed, K. S. (2012). Marine Molluscan Diversity in India –Exploitation and Conservation Challengesin The 21th Century. Marine Biodiversity Status, opportunities and Challenges, pp. 37-64, 2012.

Mohamed, K. S., & Venkatesan, V. (2017) Marine Molluscan Diversity in India- Exploitation, Conservation. Summer School on Advance Methods for Fish Stock Assessment and Fisheries Management, 56-81.

Narasimham, K., Kripa, V., & Balan, K .(1993). Molluscan Shellfish Resource of India- An overview. Indian Journal of Fisheries, 40 (1 & 2), 112-114.

Natarajan, P., Ramadoss, K., Sivalingam, D., & Thillairajan, P. (1987) Ornamental Shell Industry of Ramanathpuram Coast. Central Marine Fisheries Research Institute, 42(1), 106-110.

Patel, M., & Patel, H. (2019). Shell's Field Guide. A Seashell Conchology a Samll Introduction of sea world. (E-book)

Pillai K., M. & Devadoss, P. (1947). On the occurance of the sacred chank, *Xancus pyrum* of Porto Novo. Indian Jouranal of Fisheries, 21(1), 279-281.

Pota K. A., & Patel, M., I. (1988). Exploitation and Marketing of Chanks from The Gulf of Kutch. Central Marine Fisheries Research Institute, 42(2), 445-450.

Ramadoss, K. (2003). Gastropods, In: Status of Exploited Marine Fishery Resources of India. CMFRI, Cochin, 203-210.

Ravinesh, R., Kumar, B., & Samuel, V., D. (2019) .Status of Marine Mollusc in illegal wildlife trade in India. TRAFFIC Post-December 2018, 2019.

Sarvaiya, R., T. (1977). Studies on Mollusca of Saurashtra Coast-3 Composition. Fisheries Technology, 14 (2).

Shyam, S. S., Jagadis, I., Venkatesan, V., Rahman, M., R., & Nashad, M. (2017a). "Gastropod landing, utilization and trade in India: A case study from Kollam, India," The Marine Biological Association of India, 59(1).

Shyam, S. S., Jagadis, I., Venkatesan, V., Kavitha, M., & Mohamed, K. S. (2017b). Ornamental gastropod shell trade in India: A macroeconomic assessment. Marine Fisheries Information Service Technical and Extension Series, 231.

Soni H. B., & Thakur, K. (2015). Preliminary Checklist of Marine Mollusks from Beyt Dwarka, Gulf of Kutch(Eco-Sensitive Zone), Gujrat, India. International Journal of Environment ,4 (2) .

Subba Rao, N. V. (2003). Indian seashell (part-1) Polyplacophora and Gastropoda. Records of The Zoological Survey of India, 20-34.

WPA (2021). The Wild Life (Protection) Amendment Bill, 2021.

WWF (2013). Commercially Important Gastropod Shell Resource and Trade in India: Distribution, Status and Conservation Strategies," WWF Final Report, 2013.

Vanhaeren, M., & Perle`s, C. (2010) .Black Cyclope neritea Marine Shell Ornaments in the Upper Palaeolithic and Mesolithic of Franchthi Cave, Greece: Arguments for Intentional Heat Treatment. Journal of Field Archaeology, 35(3), 298-310.

Venkatesan, V. (2010). Marine Ornamental Molluscs. National Training Programme on Marine Ornamental Fish Culture-2010 at Mandapam CMFRI.