Obj **1 To study Diversity of marine Molluscs from selected sites of South Saurashtra Coast, Gujarat, India**

INTRODUCTION:

The marine ecosystem, recognized for its extraordinary diversity, hosts a rich array of habitats including mangroves, rocky shores, and other environments, each supporting unique benthic and pelagic communities. This habitat diversity is crucial as it fosters varied floral and faunal populations, which play essential roles in maintaining ecological balance and resilience within the marine ecosystem. Central to this biodiversity are marine molluscs, which play critical roles in marine food webs and ecosystems (Snelgrove, 1998). Notably, the phylum Mollusca includes diverse classes like Aculifera, Monoplacophora, Polyplacophora, Gastropoda, Bivalvia, Scaphopoda, and Cephalopoda, with gastropods being the largest and most prominent class (Arumugam et al., 2010).

Gastropods, such as snails, whelks, cowries, and limpets, thrive particularly well in the challenging conditions of rocky intertidal zones (Satyam & Thiruchitrambalam, 2018). These zones, where dramatic fluctuations in temperature, salinity, and moisture occur, showcase the ecological succession of molluscs from high to low water mark, each species adapted to specific horizontal substrata (Joshi, 2010). This rich distribution allows for detailed ecological studies in the field, correlating the frequency of division, variations in abundance and biomass, growth, mortality, reproductive periods, and the survival of phenotypes under varying environmental conditions (Bacci & Sella, 1970). The ecological roles of gastropods in marine ecosystems are profound. They contribute significantly to the biodiversity and structural complexity of habitats, providing essential services such as the predation of encrusting organisms like barnacles, which helps maintain the health and productivity of marine environments (Kabir et al., 2014). Additionally, many marine gastropods possess nutritional qualities that make them valuable for human consumption, although detailed information on edible species remains limited (Biessy et al., 2019).

In India, studies on the diversity of marine species, particularly molluscs, have historically been sparse, with early contributions by researchers like (Gravely, 1942; Hornell, 1927). More recent studies have continued to explore the diversity and ecological dynamics of molluscs, such as the work by (Ramesh et al., 1996), which recorded 73

species of molluscs related to coral reefs in Palk Bay, highlighting the ecological and economic importance of Gastropods and Bivalves. Further studies, like those by (Jeyabaskaran et al., 1996) on the distribution and abundance of molluscs at Karaichally Island in the Gulf of Mannar, (Rao & Sundaram, 1972) on the ecology of intertidal Molluscs, underscore the need for continuous research and conservation efforts to preserve these critical marine resources.

Studying the diversity of marine molluscs along the South Saurashtra Coast of Gujarat, India, is crucial due to their significant ecological, economic, and conservation importance (Agravat et al., 2022). Ecologically, molluscs play vital roles as primary consumers, predators, and ecosystem engineers, contributing to nutrient cycling, sediment stabilization, and habitat structuring (Vaughn, 2018). Economically, Molluscs such as Oysters, Mussels, and Clams support local fisheries and aquaculture, providing livelihoods to coastal communities, while pearl oysters and turbo shells are harvested for jewellery and handicrafts (Kartika & Mu, 2014). From a conservation perspective, Molluscs serve as sensitive indicators of environmental health, reflecting habitat changes due to pollution, climate change, and human activities (Böhm et al., 2021). Therefore, understanding molluscan diversity along the South Saurashtra Coast provides essential baseline data for sustainable resource management and conservation strategies. Documenting species composition and distribution will guide efforts to preserve marine biodiversity, protect vulnerable species, and ensure the continued availability of economically important ones, ultimately contributing to the sustainable management of marine resources in this unique coastal region.

Intertidal zone of Gujarat state till less explored, but some peculiar investigations were made for diversity and distribution viz., (Apte, 1998) recorded 188 Molluscan species at Gujarat coastline. Saurashtra coast of Gujarat was investigated by number of biologists, (Malli et al., 1982); (Misra & Kundu, 2005); (Bhadja, 2010), (Vaghela, 2010); (Dave, 2011); (Raval et al., 2016); (Khushali, 2015) etc. particularly at the Mangrol coast, work has been done by (Raghunathan et al., 2003); (Bhadja, 2010); (Vaghela, 2010) and (Gohel, 2016). (GOHIL & KUNDU, 2012) studied Diversity of the Intertidal macrofauna at west coast of Gujarat. (Pandya et al., 2013) studied Hydrozoans from the Saurashtra Coast, (Joshi et al., 2015) studied Delayed recovery in Porites spp. following mass coral bleaching. (Parmar & Mankodi, 2017) worked on Sea water quality assessment of

different sites along Saurashtra Coast. (Gohel & Mankodi, 2016) studied population ecology of Cerithiidae family from Mangrol Coast. (Shah et al., 2017) studied diversity of Sea Anemones along Saurashtra Coast. (Solanki et al., 2017) studied ecological status of *Pirenella cingulate* in mangrove habitat of Ghogha coast, Gulf of Khambhat. All these studies were more emphasize population ecology and influence on the intertidal zone and its organisms.

The intertidal zone of Saurashtra coast is well studied for various aspects like ecology of few fauna and flora, biology of few common species, habitat analysis etc (Agravat et al., 2022). But diversity study for phylum with various ecological aspects for larger area is not done. Moreover, diversity account is mainly based on morphology. Therefore, the current research work is aimed to document diversity of marine molluscs for large area with its relation to habitat and micro-habitat level distribution.

Overall, the integrated study of marine molluscs, particularly gastropods, within diverse marine habitats of India, such as the under-researched South Saurashtra Coast, is essential. This objective will not only fill significant gaps in our understanding of molluscan diversity but also enhance our knowledge of their ecological roles and contribute to the sustainable management and conservation of marine biodiversity along south Saurashtra coast.

The detailed methodology for data collection is thoroughly described in the Materials and Methods chapter (pg no.). The following flowchart provides a summary of the methodology used in this chapter.

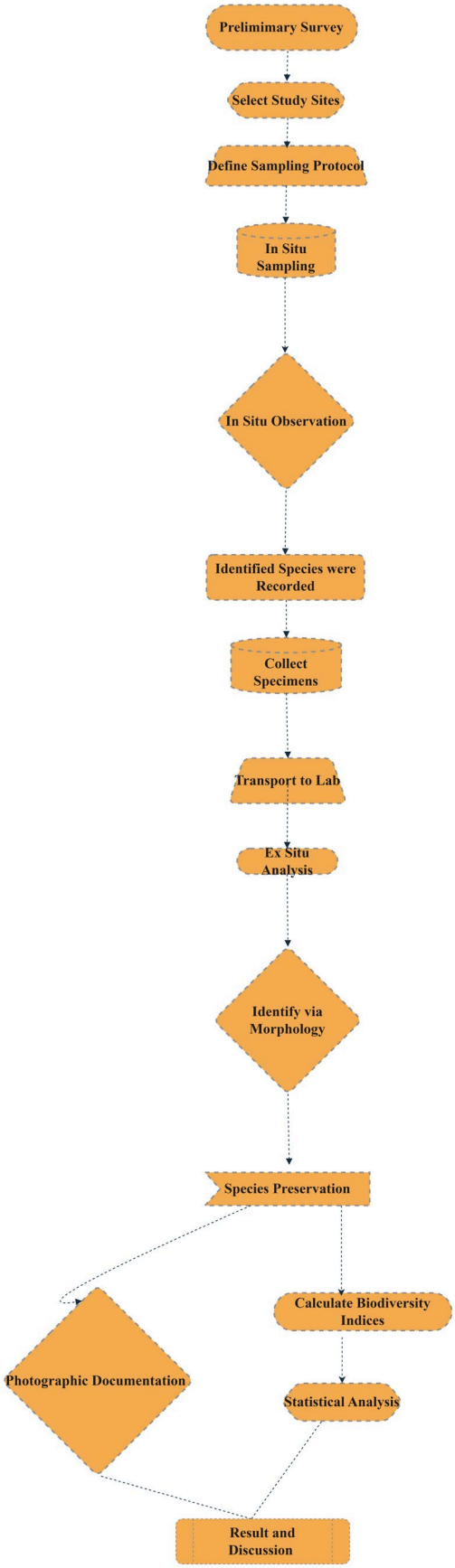


Fig: Methodology for Molluscan diversity study

Results and Discussion

Molluscan Diversity:

A total of 59 molluscs were recorded from three study sites, classified into 4 classes, 14 orders, and 26 families. Among these, the class Gastropoda was the most prevalent, comprising 23 families and 51 species. This was followed by the class Bivalvia, which included 1 family and 4 species; class Polyplacophora, with 1 family and 3 species; and class Cephalopoda, represented by 1 family and 1 species. The higher diversity was observed at the Veraval coast, which hosted 51 species across 4 classes, 13 orders, and 28 families. This was followed by the Mangrol coast, with 37 species from 3 classes, 13 orders, and 26 families, and the Adri coast, which presented the least diversity with 32 species from 3 classes, 10 orders, and 19 families (Table). A detailed description of each observed species is given below:

Table : List of the Molluscan species recorded.

Sr No	Class	Order	Family	Name of Species	Mangrol	Adri	Veraval
1	Polyplacophora	Chitonida	Chitonidae Rafinesque, 1815	*Chiton granoradiatus (*Leloup,1937)	A	A	P
2				*Chiton tuberculatus* (Linnaeus, 1758)	P	P	P
3				*Rhyssoplax peregrina* (Thiele, 19A9)	P	P	P
4	Gastropoda	****	Architectonicidae J. E. Gray, 1850	*Architectonica laevigata* (Lamarck, 1816)	P	P	P
5				*Architectonica arcana* (Roding, 1798)	P	P	P
6		Seguenziida	Chilodontaidae Wenz, 1938	*Euchelus asper* (Gmelin, 1791)	A	P	P

7		Littorinimorpha	Bursidae Thiele, 1925	*Dulcerana granularis* (Röding, 1798)	P	P	P
8				*Bufonaria echinata* (Link, 18A7)	P	P	P
9			Cymatiidae Iredale, 1913	*Gyrineum natator (*Röding, 1798)	P	A	A
10			Cypraeidae Rafinesque, 1815	*Mauritia depressa* (J.E. Gray, 1824)	A	P	P
11				*Mauritia eglantina* (Duclos, 1833)	P	A	A
12				*Mauritia depressa depressa* (J. E. Gray, 1824)	P	A	A
13				*Mauritia maculifera (*F. A. Schilder, 1932)	A	P	P
14				*Naria turdus* (Lamarck, 1810)	A	P	P

15				*Erronea errones* (Linnaeus, 1758)	A	P	P
16				*Austrocypraea reevei* (J. E. Gray, 1832)	A	P	P
17			Rostellariidae Gabb, 1868	*Tibia insulaechorab (*Röding, 1798)	A	P	A
18				*Tibia curta* (G. B. Sowerby II, 1842)	A	A	P
19			Littorinidae Children, 1834	*Littorina sp.*	P	P	P
20		Trochida	Trochidae Rafinesque, 1815	*Umbonium vestiarium (*Linnaeus,1758)	A	A	P
21				*Monodonta australis* (Lamarck, 1822)	A	P	P
22				*Trochus radiatus* (Gmelin, 1791)	P	P	P
23				*Turbo intercostalis* (Menke, 1843)	P	P	P

24			Turbinidae Rafinesque, 1815	*Turbo bruneus* (Röding, 1798)	P	P	P
25				*Astralium semicostatum* (Kiener, 185A)	P	P	P
26		Neogastropoda		*Lunella coronata* (Gmelin, 1791)	P	P	P
27			Columbellidae Swainson, 1840	*Pyrene flava* (Bruguière, 1789)	P	P	P
28			Babyloniidae Kuroda, Habe & Oyama, 1971	*Babylonia spirata (*Linnaeus,1758)	P	A	P
29			Pisaniidae Gray, 1857	*Cantharus spiralis,* (Gray 1839)	P	P	P
30				*Pollia undosa* (Linnaeus, 1758)	A	P	P

31			Conidae J. Fleming, 1822	*Conus capitaneus (*Linnaeus , 1758)	P	A	A
32				*Conus inscriptus* (Reeve, 1843)	P	P	P
33				*Conus miliaris Hwass in (*Bruguière, 1792)	P	P	P
34				*Conus quercinus* (Lightfoot, 1786)	A	A	P
35			Muricidae Rafinesque, 1815	*Purpura bufo* (Lamarck, 1822)	A	A	P
36				*Purpura panama (*Röding, 1798)	P	P	P
37				*Chicoreus brunneus* (Link, 18A7)	P	P	P
38			Mitridae Swainson, 1831	*Strigatella scutulata* (Gmelin, 1791)	P	P	A

39				*Subcancilla sulcata* (Swainson, 1825)	A	P	A
40				*Mitra mitra* (Linnaeus,1758)	A	A	P
41		****	Nacellidae Thiele, 1891	*Cellana karachiensis* (Winck worth, 1930)	P	P	P
42				*Cellana radiate* (Born, 1778)	P	P	P
43		Siphonariida	Patellidae Rafinesque, 1815	*Patella vulgata* (Linnaeus, 1758)	P	P	P
44		Cycloneritida	Neritidae Rafinesque, 1815	*Nerita albicilla (*Linnaeus,1758)	P	A	P
45				*Nerita undata* (Linnaeus, 1758)	P	A	P
46				*Rhinoclavis sinensis* (Gmelin 1791)	P	P	P

47				*Cerithium caeruleum* (G. B. Sowerby II, 1855)	P	P	P
48				*Cerithium coralium* (Kiener, 1841)	P	P	P
49				*Cerithium scabridum* (Philippi, 1848)	P	P	P
50			Turritellidae Lovén, 1847	*Turritella radula* (Kiener, 1843)	P	A	A
51		Aplysiida	Aplysiidae Lamarck, 1809	*Aplysia Oculifera (*A. Adams & Reeve, 1850)	P	P	P
52		Systellommatophora	Onchidiidae Rafinesque, 1815	*Peronia verruculata* (Cuvier, 1830)	P	P	P
53		Cephalaspidea	Haminoeidae Pilsbry, 1895	*Lamprohaminoea ovalis* (Pease, 1868)	P	A	A
54		Nudibranchia	Dendrodoridid ae O'Donoghue, 1924 (1864)	*Dendrodoris fumata [Light brown*	P	A	P

				form] (Rüppell & Leuckart, 1830)			
55	Bivalvia	Venerida	Veneridae Rafinesque, 1815	*Gafrarium dispar* (Holten, 1802)	P	A	P
56				*Gafrarium divaricatum* (Gmelin, 1791)	P	A	P
57				*Sunetta sp.*	A	A	P
58				*Paphia vernicosa* (A. Gould, 1861)	A	A	P
59	Cephalopoda	Octopoda	Octopodidae d'Orbigny, 184A	*Octopus Vulgaris (*Cuvier 1797*)*	A	A	P

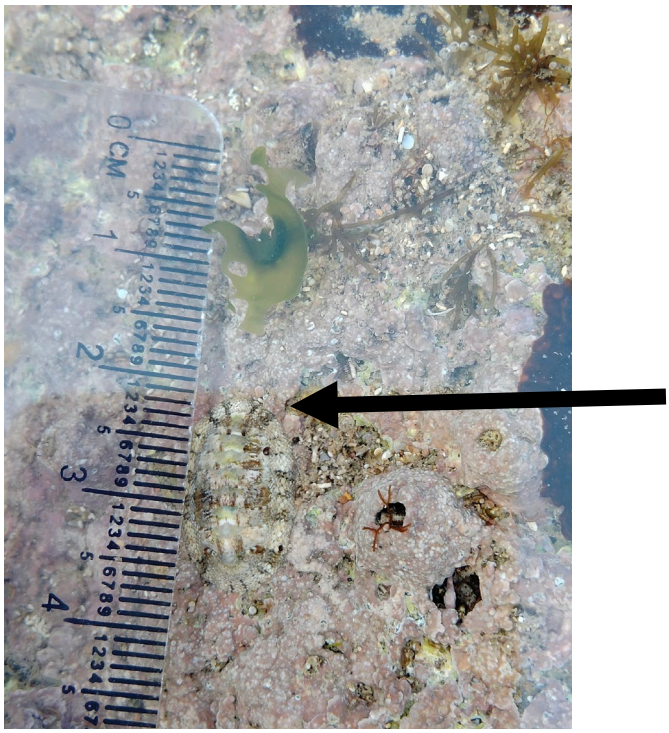
1. *Chiton granoradiatus* (Leloup, 1937)

Common Name	**Chiton**
Description	Small, oval-shaped mollusc with eight articulated shell plates that are granulated and feature radiating lines. These plates are typically brown or green, with a leathery girdle covered in tiny spicules.
Reproduction	It employs external fertilization, releasing eggs and sperm into the water. The planktonic larvae eventually settle and undergo metamorphosis into juvenile chitons.
Ecological Significance	grazer, feeding on algae and biofilm on rocky substrates. This grazing helps control algal growth and contributes to the health and stability of its marine ecosystem.

2. *Chiton tuberculatus (Linnaeus, 1758)*

Common Name	**Chiton**
Description	Small, oval-shaped body. Eight articulated shell plates with granules and radiating lines. Brown or green coloration with a leathery girdle covered in tiny spicules.
Reproduction	External fertilization, with eggs and sperm released into the water. Planktonic larvae undergo several stages before settling on the substrate. Juveniles metamorphose into adult chitons after settling.
Ecological Significance	Functions as a grazer, feeding on algae and microorganisms on rocky surfaces. Plays a role in controlling algal populations. Serves as prey for various marine predators, thus contributing to the coastal food web.

3. *Rhyssoplax peregrina* (Thiele, 1909)



Common Name -	****
Description	Elongated oval body with eight articulating shell plates. Shell plates feature fine sculpturing and may have a range of colours, often brown or greyish. The girdle is smooth or slightly spiny, with varying pigmentation.
Reproduction	Reproduces via external fertilization. Eggs and sperm are released into the water, leading to planktonic larval stages. Larvae settle on substrates and metamorphose into juvenile chitons.
Ecological Significance	Acts as a grazer, consuming algae, and biofilm on rocky surfaces. Helps maintain the balance of the algal community. Provides a food source for a variety of marine predators, contributing to the marine food web.

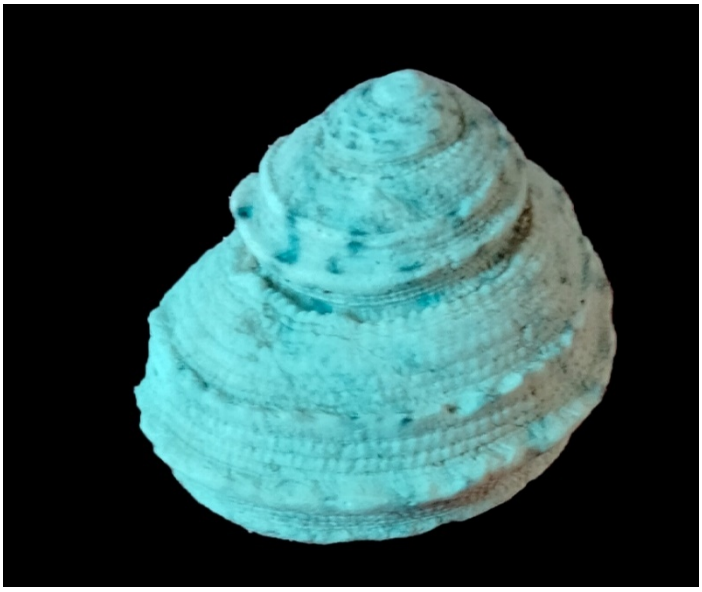
4. *Architectonica laevigata* (Lamarck, 1816)

Common Name -	**Levigated Sundial**
Description	Known for its distinctive, smooth, flat, and spiral-shaped shell. The shell is typically pale, with a glossy surface and fine concentric lines. The body whorl is large and broad, and the aperture is rounded
Reproduction	Likely involves external fertilization, common in marine gastropods. The larvae are planktonic and undergo several developmental stages. Larvae eventually settle on suitable substrates and develop into adult snails.
Ecological Significance	Feeds primarily on microalgae and detritus on sandy and muddy substrates. Plays a role in nutrient cycling and maintaining the cleanliness of the substrate. Serves as prey for various marine predators, integrating into the marine ecosystem.

5. *Architectonica arcana* (Roding, 1798)

Common Name	Aracan sundial
Description	Features a low, conical, and spirally wound shell. The shell surface is smooth and polished, often with intricate patterns or bands. The coloration typically includes shades of cream, brown, or yellow, with a broad, rounded body whorl.
Reproduction	Reproduction occurs via external fertilization. Larvae are planktonic, undergoing multiple stages of development in the water column. They settle on the seabed and metamorphose into juvenile snails, eventually growing into adults.
Ecological Significance	Feeds on detritus and microalgae found on sandy and muddy ocean floors. Contributes to the recycling of nutrients within its habitat. Provides a food source for a variety of marine predators, supporting the local marine food web.

6. *Euchelus asper* (Gmelin, 1791)



Common Name	**four-keeled margarite**
Description	Small, conical shell with a rough, textured surface. Shell surface is covered with prominent, irregular nodules or spines. Typically exhibits a coloration that ranges from grayish to brown.
Reproduction	Likely involves external fertilization. Planktonic larvae are released into the water column and undergo several developmental stages. Larvae eventually settle on substrates and metamorphose into juvenile snails.
Ecological Significance	Acts as a grazer, feeding on algae and detritus on rocky surfaces. Helps control algal populations and maintains the cleanliness of the substrate. Provides a food source for various marine predators, supporting biodiversity and the marine food web.

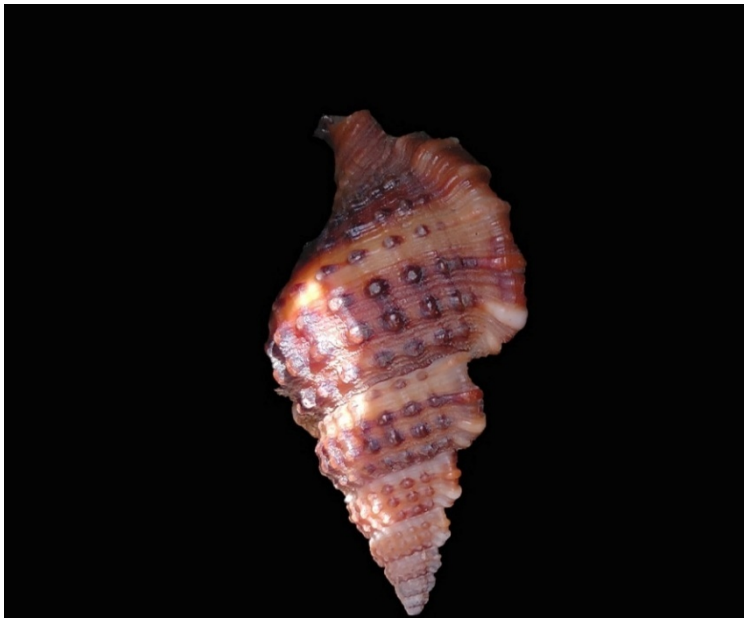
7. *Dulcerana granularis* (Röding, 1798)

Common Name	**Granulated Turban**
Description	Small, conical shell with a granular surface texture. Shell is typically adorned with fine granules, giving it a rough appearance. Coloration ranges from white to light brown, often with banding or speckling.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water. Larvae are planktonic, going through several stages before settling on the substrate. Upon settling, larvae metamorphose into juvenile snails.
Ecological Significance	Grazes on algae and biofilm on rocky and sandy substrates. Plays a role in controlling algal growth and contributing to substrate cleanliness. Serves as prey for various marine predators, integrating into the marine ecosystem and supporting biodiversity.

8. *Bufonaria echinata* (Link, 1807)

Common Name -	**Spiny frogsnail**
Description	Medium-sized, robust shell with a distinctive, spiny surface. The shell has a biconical shape with pronounced, spiky projections along the whorls. Typically, brown or tan in color, often with darker patterns or banding.
Reproduction	Reproduces through external fertilization, releasing eggs and sperm into the water. Larvae are planktonic, undergoing multiple stages of development before settling. After settling, larvae metamorphose into juvenile snails and continue to grow.
Ecological Significance	Predatory snail, feeding on other smaller Molluscs and invertebrates. Helps regulate prey populations within its habitat. Integral part of the marine food web, providing a food source for larger predators.

9. *Gyrineum natator* (Röding, 1798)

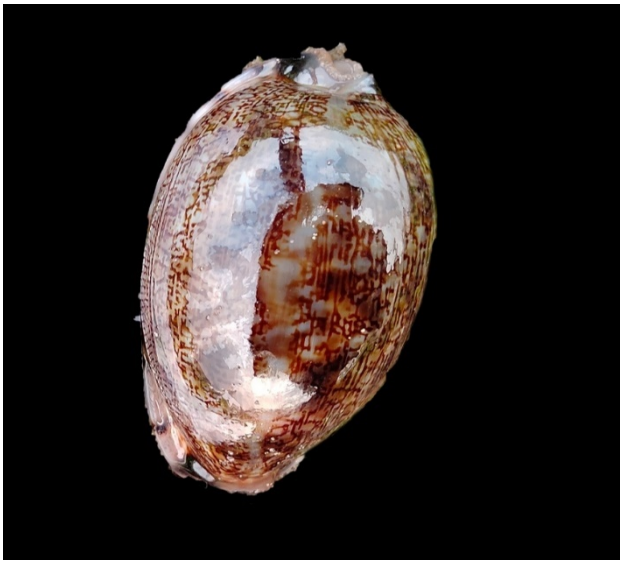


Common Name	**Swimming Frog Shell**
Description	Small to medium-sized, thick shell with a distinct, globular shape. Shell surface is adorned with robust, nodular ridges and has a wide aperture. Typically, pale or cream-colored, often with brown or reddish patterns.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Planktonic larvae develop and undergo several stages before settling. Larvae settle onto suitable substrates and metamorphose into juvenile snails.
Ecological Significance	Predatory species, feeding on other smaller mollusks and marine invertebrates. Plays a role in controlling the population of its prey, maintaining ecological balance. Contributes to the marine food web by serving as prey for larger marine predators.

10.*Mauritia depressa* (J.E. Gray, 1824)

Common Name	**Depressed cowry**
Description	Small, ovate shell with a highly polished, smooth surface. Shell is slightly flattened, with a narrow, slit-like aperture extending the length of the shell. Typically exhibits a rich brown color with white or light spots, giving it a striking appearance.
Reproduction	External fertilization, with eggs and sperm released into the water. Larvae are planktonic, going through several stages before settling. Upon settling, larvae metamorphose into juvenile cowries.
Ecological Significance	Grazes on algae, sponges, and other microorganisms on coral reefs. Helps maintain the health and balance of coral reef ecosystems. Serves as prey for various marine predators, contributing to the biodiversity of its habitat.

11. *Mauritia eglantina* (Duclos, 1833)

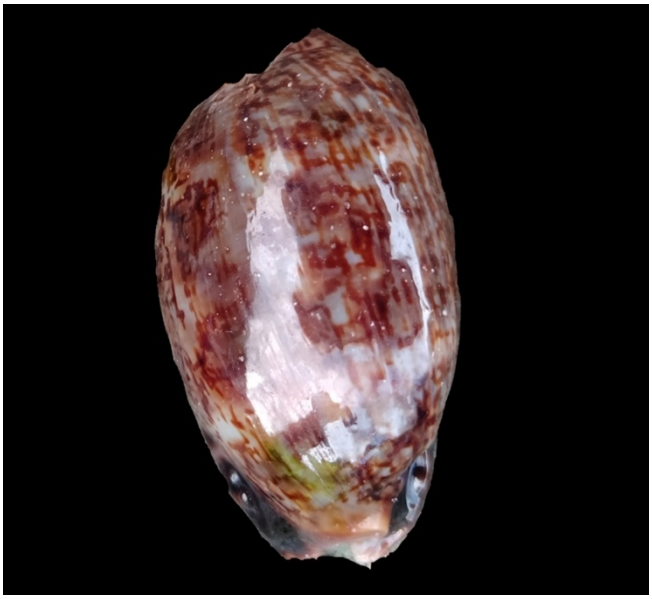


Common Name -	**Eglantine Cowry**
Description	Medium-sized, ovate shell with a glossy, smooth surface. The shell is robust and slightly flattened, with a long, narrow aperture. Typically exhibits a beautiful pattern of brown with lighter spots or bands, often with a golden sheen.
Reproduction	Reproduces through external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic and undergo several developmental stages before settling on the substrate. Settled larvae metamorphose into juvenile cowries and grow into adults.
Ecological Significance	Grazes on algae, sponges, and other microorganisms found on coral reefs. Plays a role in maintaining the health and balance of coral reef ecosystems. Acts as prey for a variety of marine predators, supporting marine biodiversity and food web dynamics.

12. *Mauritia depressa depressa* (J. E. Gray, 1824)

Common Name	****
Description	Small to medium-sized, ovate shell with a highly polished, smooth surface. Slightly flattened shape with a long, narrow aperture. Shell coloration is typically rich brown with white or light spots, often exhibiting a glossy sheen.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water. Larvae are planktonic and undergo several stages of development before settling. Upon settling, larvae metamorphose into juvenile cowries.
Ecological Significance	Feeds on algae, sponges, and other microorganisms on coral reefs. Contributes to the health and balance of coral reef ecosystems. Serves as prey for various marine predators, enhancing biodiversity and supporting the marine food web.

13. *Mauritia maculifera* (F. A. Schilder, 1932)



Common Name -	**Reticulated cowry**
Description	Medium-sized, ovate shell with a smooth, glossy surface Characterized by dark spots or blotches on a lighter background, usually brown or tan. The aperture is long and narrow, extending almost the full length of the shell.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water. Larvae are planktonic, undergoing several developmental stages before settling. Upon settling, larvae metamorphose into juvenile cowries.
Ecological Significance	Grazes on algae, sponges, and microorganisms on coral reefs and rocky substrates. Plays a role in maintaining the health and balance of its ecosystem. Serves as prey for various marine predators, contributing to the marine food web and biodiversity.

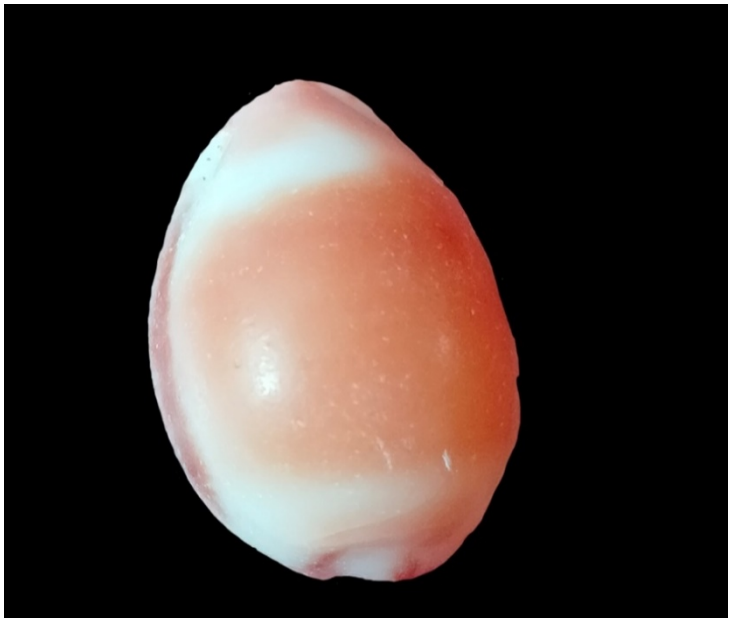
14. *Naria turdus* (Lamarck, 1810)

Common Name	**Thrush cowry**
Description	Medium-sized, cylindrical shell with a glossy and smooth surface. Typically exhibits a pale background with dark brown spots or blotches, often arranged in a pattern. The aperture is long and narrow, extending the length of the shell, with well-developed teeth along the edges.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Planktonic larvae develop through several stages before settling on the substrate. After settling, larvae metamorphose into juvenile cowries and grow into adults.
Ecological Significance	Grazes on algae, sponges, and microorganisms on coral reefs and rocky substrates. Contributes to the health and balance of coral reef ecosystems. Serves as prey for a variety of marine predators, supporting the marine food web and biodiversity.

15.*Erronea errones* (Linnaeus, 1758)

Common Name	**Wandering cowry**
Description	Medium-sized, ovate shell with a glossy, smooth surface. The shell is typically pale with a pattern of dark brown or black spots and streaks. The aperture is long and narrow, running almost the entire length of the shell, with well-developed teeth along the inner edges.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Planktonic larvae undergo multiple stages of development before settling on the substrate. Upon settling, larvae metamorphose into juvenile cowries and continue to grow into adults.
Ecological Significance	Feeds on algae, sponges, and other microorganisms on coral reefs and rocky substrates. Plays a role in controlling algal growth and maintaining the cleanliness of its habitat. Serves as prey for various marine predators, thus contributing to the marine food web and supporting biodiversity.

16. Austrocypraea reevei (J. E. Gray, 1832)



Common Name	**Reeve's cowry**
Description	Medium-sized, ovate shell with a smooth, glossy surface. The shell is typically light brown or tan with darker spots or blotches, often arranged in a pattern. The aperture is long and narrow, with well-defined teeth along the inner edges, extending almost the entire length of the shell.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water. Larvae are planktonic and undergo several developmental stages before settling. Upon settling, larvae metamorphose into juvenile cowries and grow into adults.
Ecological Significance	Grazes on algae, sponges, and other microorganisms found on coral reefs and rocky substrates. Contributes to maintaining the health and balance of coral reef ecosystems. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

17. *Tibia insulaechorab* (Röding, 1798)

Common Name	Arabian tibia
Description	Large, elongated shell with a distinctive, slender, and tapering shape. The shell has a smooth surface with fine, spiral ridges and a prominent, long siphonal canal. Typically light-colored, often white, or pale cream, sometimes with brownish markings.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water. Planktonic larvae undergo several developmental stages before settling on the substrate. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory species, feeding on other smaller molluscs and marine invertebrates. Helps regulate prey populations within its habitat. Integral part of the marine food web, providing a food source for larger marine predators and contributing to the ecosystem's biodiversity.

18. *Tibia curta* (G. B. Sowerby II, 1842)

Common Name	**Short tibia**
Description	Medium to large-sized shell with a distinctive, elongated shape and a short, curved siphonal canal. The shell is smooth with fine, spiral ridges and typically exhibits a light coloration, often white or cream with occasional brown markings. The aperture is elongated, and the overall form is more compact compared to other Tibia species.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on the seabed. Settled larvae metamorphose into juvenile snails and grow into adult forms.
Ecological Significance	Predatory, feeding on smaller mollusks and marine invertebrates. Plays a role in controlling the populations of its prey, maintaining ecological balance. Integral part of the marine food web, serving as prey for larger predators and contributing to the biodiversity of its habitat.

19. Littorina sp.

Common Name	Periwinkle
Description	Small, conical shell with a smooth or slightly rough surface. Typically exhibits a variety of colors and patterns, including shades of brown, gray, and green, often with banding or speckling. The aperture is oval and the operculum is well-developed.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water. Larvae are planktonic, undergoing several developmental stages before settling on the substrate. After settling, larvae metamorphose into juvenile snails.
Ecological Significance	Grazes on algae and biofilm on rocky shores and intertidal zones. Plays a crucial role in controlling algal growth and maintaining the balance of intertidal ecosystems. Serves as prey for a variety of marine predators, contributing to the marine food web and supporting biodiversity.

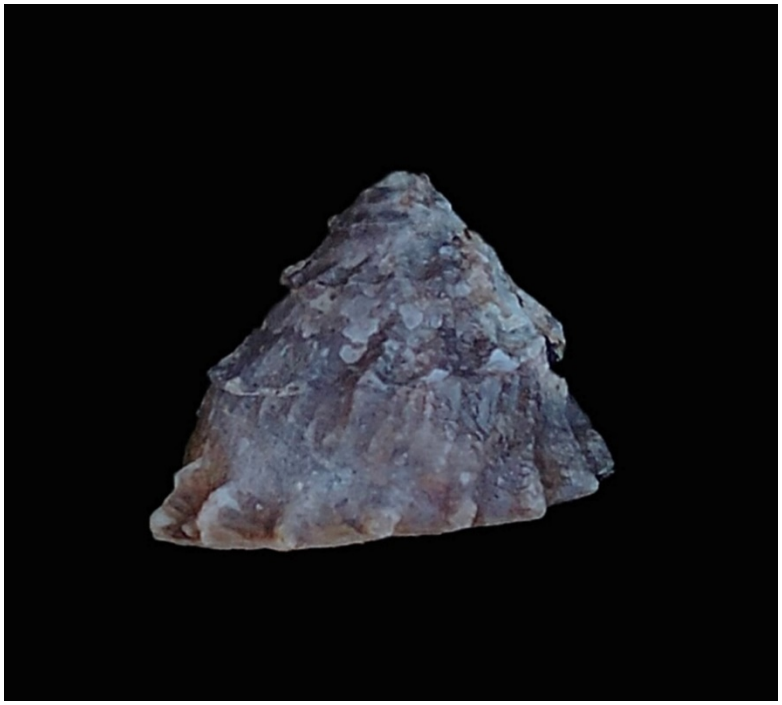
20. *Umbonium vestiarium* (Linnaeus,1758)

Common Name -	**Button snail**
Description	Small, flat, and disk-like shell with a smooth and glossy surface. The shell exhibits a wide range of colors and patterns, including shades of pink, green, yellow, and brown, often with concentric bands or speckles. The aperture is circular and relatively small compared to the overall shell size.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Upon settling, larvae metamorphose into juvenile snails and continue to grow.
Ecological Significance	Feeds on detritus and microalgae on sandy and muddy substrates, playing a role in nutrient recycling and substrate cleaning. Helps maintain the balance of benthic ecosystems by controlling algal growth. Serves as prey for various marine predators, thus contributing to the marine food web and supporting biodiversity.

21.*Monodonta australis* (Lamarck, 1822)

Common Name -	**Toothed topshell**
Description	Medium-sized, conical shell with a robust structure. The shell surface is textured with fine spiral ridges and often exhibits dark bands or mottling on a lighter background, typically greenish or brown. The aperture is rounded, with a pearly interior and a strong, toothed outer lip.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several stages of development before settling on rocky substrates. Settled larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and intertidal zones. Plays a crucial role in controlling algal growth and maintaining the ecological balance of its habitat. Serves as prey for a variety of marine predators, contributing to the marine food web and supporting biodiversity.

22. *Trochus radiatus* (Gmelin, 1791)

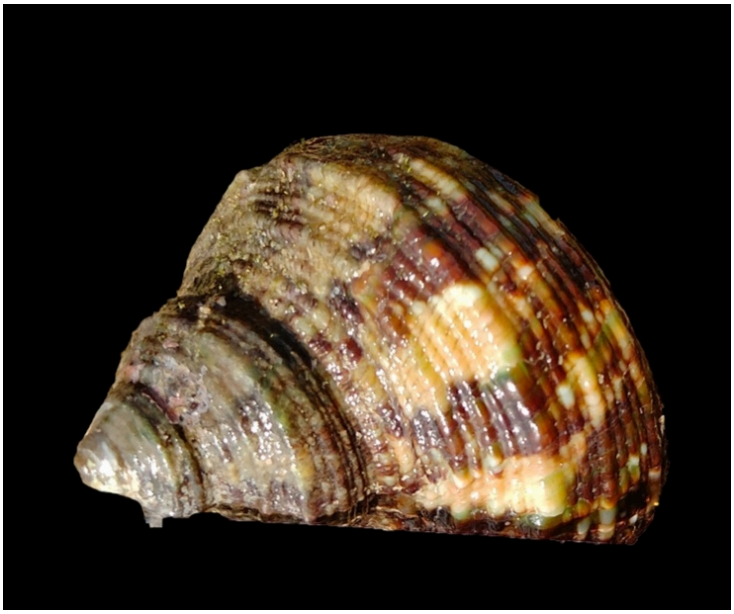


Common Name	**Radiate top shell**
Description	Medium to large-sized, conical shell with a robust structure. The shell surface features radiating stripes or bands, typically in shades of red, brown, or green on a lighter background. The aperture is large and rounded, with a pearly interior and a toothed outer lip.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky or coral substrates. After settling, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky and coral reefs, helping to control algal populations. Contributes to maintaining the health and balance of coral reef ecosystems. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

23. *Turbo intercostalis* (Menke, 1843)

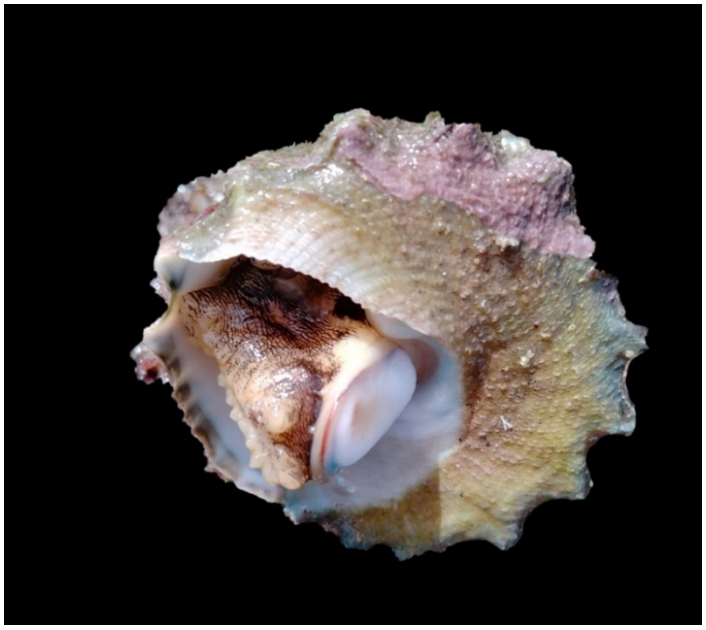
Common Name	**Ribbed turban**
Description	Medium-sized, robust shell with a turban-shaped appearance. The shell surface is marked with prominent, spiral ridges and fine axial growth lines, giving it a textured look. Typically exhibits a range of colours from greenish to brown, often with lighter or darker banding.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several stages of development before settling on rocky or coral substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky and coral reefs, playing a role in controlling algal populations. Contributes to the health and balance of coral reef ecosystems. Serves as prey for various marine predators, supporting biodiversity and the marine food web.

24. *Turbo brunneus* (Röding, 1798)



Common Name -	**Dwarf turban**
Description	Medium-sized, solid, turban-shaped shell. The shell surface is smooth with spiral ridges and often displays a glossy, dark brown or black colour. The aperture is rounded, with a thick, pearly interior and an operculum that is often calcareous and fits tightly.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water. Larvae are planktonic, undergoing several developmental stages before settling on rocky or coral substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky and coral reefs, helping control algal growth. Contributes to the health and balance of coral reef ecosystems. Serves as prey for various marine predators, thus supporting the marine food web and enhancing biodiversity.

25. *Astralium semicostatum* (Kiener, 1850)



Common Name	**Half-ribbed star shell**
Description	Medium-sized, conical shell with a solid structure. The shell surface is adorned with prominent, raised spiral ridges, giving it a ribbed appearance. Typically exhibits a coloration that ranges from grayish to brown, often with lighter or darker bands.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing multiple developmental stages before settling on rocky substrates. After settling, larvae metamorphose into juvenile snails and continue to grow.
Ecological Significance	Grazes on algae and biofilm on rocky substrates and coral reefs. Plays a role in controlling algal growth, contributing to the maintenance of its habitat. Serves as prey for various marine predators, thus supporting the marine food web and biodiversity.

26. *Lunella coronatus* (Gmelin, 1791)

Common Name -	**Crowned turban shell**
Description	Medium-sized, globular shell with a robust structure. The shell surface is adorned with prominent, crown-like spines or nodules along the whorls. Typically exhibits a coloration ranging from greenish to brown, often with lighter or darker patches.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column.Larvae are planktonic, undergoing several developmental stages before settling on rocky or coral . Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and coral reefs. Plays a crucial role in controlling algal populations and maintaining the ecological balance of its habitat. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

27. *Pyrene flava* (Bruguière, 1789)

Common Name -	****
Description	Small, ovate shell with a smooth and glossy surface. The shell is typically yellowish or light brown, often with darker markings or bands. The aperture is elongated, with a well-defined outer lip and a slight indentation near the base.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water. Larvae are planktonic, undergoing several developmental stages before settling on the substrate. After settling, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Feeds on detritus and microorganisms found on sandy and muddy substrates. Plays a role in nutrient recycling and maintaining substrate health. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

28. *Babylonia spirata* (Linnaeus,1758)

Common Name -	**Spiral babylon**
Description	Medium-sized, ovate shell with a robust and smooth structure. The shell surface features distinct, spiral bands of brown or black on a lighter, creamy background. The aperture is large and oval, with a siphonal canal at the base.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory snail, feeding on other smaller molluscs and marine invertebrates. Plays a role in regulating prey populations within its habitat. Integral part of the marine food web, serving as prey for larger predators and contributing to the ecosystem's biodiversity.

29. *Cantharus spiralis,* (Gray 1839)

Common Name -	**Ridged goblet**
Description	Medium-sized, elongated shell with a sturdy structure. The shell surface is marked by distinct, spiral ridges and a pattern of fine lines. Typically exhibits a coloration ranging from light brown to dark brown, sometimes with lighter spiral bands.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky or sandy substrates. After settling, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, feeding on smaller mollusks and marine invertebrates. Helps regulate prey populations and maintain ecological balance within its habitat. Serves as prey for larger marine predators, contributing to the marine food web and supporting biodiversity.

30. *Pollia undosa* (Linnaeus, 1758)

Common Name	**Waved goblet**
Description	Medium-sized, robust shell with an ovate-conical shape. The shell surface is adorned with wavy, undulating ridges and often exhibits a pattern of dark spots or bands on a lighter background. Typically shows a colour palette of white, cream, or light brown with darker brown or black markings.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing multiple stages of development before settling on rocky or sandy substrates. Upon settling, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Predatory, feeding on smaller molluscs and marine invertebrates. Plays a role in regulating prey populations and maintaining ecological balance. Integral part of the marine food web, serving as prey for larger predators and contributing to biodiversity.

31. Conus capitaneus (Linnaeus, 1758)

Common Name -	**Captain cone**
Description	Medium-sized, conical shell with a smooth, glossy surface. The shell exhibits a pattern of intricate, geometric designs often in shades of brown, black, and white. The aperture is narrow and elongated, typical of cone snails.
Reproduction	Medium-sized, conical shell with a smooth, glossy surface. The shell exhibits a pattern of intricate, geometric designs often in shades of brown, black, and white. The aperture is narrow and elongated, typical of cone snails.
Ecological Significance	Predatory, using a venomous harpoon to capture and immobilize prey, primarily small fish, mollusks, and marine worms. Plays a significant role in controlling the population of its prey, thus maintaining ecological balance. Its venom is of scientific interest for research in neuropharmacology and potential medical applications.

32. Conus inscriptus (Reeve, 1843)

Common Name -	**Tiled coneengraved cone**
Description	Medium-sized, conical shell with a smooth and glossy surface. The shell is adorned with intricate, linear patterns or inscriptions, typically in shades of brown on a lighter background. The aperture is narrow and elongated, characteristic of cone snails.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water. Larvae are planktonic, undergoing multiple developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Predatory, using a venomous harpoon to capture and immobilize prey, including small fish, molluscs, and marine worms. Plays a crucial role in regulating prey populations and maintaining ecological balance within its habitat. Its venom is of interest for research in neuropharmacology and potential medical applications, contributing to scientific advancements.

33. Conus miliaris (Hwass in ,Bruguière, 1792)

Common Name	**Thousand-spot cone**
Description	Small to medium-sized, conical shell with a smooth, glossy surface. The shell features a pattern of small, granular spots or dots, typically in shades of brown or yellow on a lighter background. The aperture is narrow and elongated, typical of cone snails.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Upon settling, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, using a venomous harpoon to capture and immobilize prey, primarily small fish, molluscs, and marine worms. Plays a significant role in regulating the population of its prey, maintaining ecological balance. Its venom is of scientific interest for research in neuropharmacology and potential medical applications, contributing to advancements in medicine.

34. *Conus quercinus* (Lightfoot, 1786)

Common Name	Oak cone
Description	Medium to large-sized, conical shell with a smooth and glossy surface. The shell is typically pale yellow to orange, often without distinct patterns, though some specimens may exhibit faint bands or lines. The aperture is narrow and elongated, characteristic of cone snails.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, using a venomous harpoon to capture and immobilize prey, such as small fish, molluscs, and marine worms. Plays a crucial role in controlling prey populations, maintaining ecological balance within its habitat. Its venom is of interest for scientific research, particularly in neuropharmacology, with potential medical applications.

35. ***Purpura bufo*** **(Lamarck, 1822)**

Common Name	**Purpuratoad purple**
Description	Medium-sized, thick, and robust shell with an irregular, rough surface. The shell is typically dark brown or purplish, with prominent ridges and knobs. The aperture is large and oval, often with a thickened outer lip and a dark interior.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing multiple developmental stages before settling on rocky substrates. After settling, larvae metamorphose into juvenile snails and continue to grow.
Ecological Significance	Predatory, feeding on other molluscs and marine invertebrates. Plays a role in regulating prey populations and maintaining ecological balance in rocky shore environments. Serves as prey for larger marine predators, contributing to the marine food web and supporting biodiversity.

36. Purpura panama (Röding, 1798)

Common Name -	**Rudolph's purpura**
Description	Medium-sized, thick shell with a robust and irregular surface. The shell is usually dark brown to purplish, with strong, nodular ridges and spines. The aperture is large and oval, often with a thickened, dark-coloured lip.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky or coral substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, feeding on other molluscs and marine invertebrates. Helps regulate prey populations, maintaining ecological balance in its habitat. Serves as prey for various larger marine predators, supporting the marine food web and contributing to biodiversity.

37. Chicoreus brunneus (Link, 1807)

Common Name -	**Brown murex**
Description	Medium-sized, robust shell with an elongated, spiny structure. The shell surface is dark brown or black with prominent, sharp spines and ridges. The aperture is oval and smooth, often with a lighter-colored interior.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky substrates. Upon settling, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, feeding on other molluscs and marine invertebrates. Plays a role in controlling prey populations, thus maintaining ecological balance. Serves as prey for larger marine predators, contributing to the marine food web and supporting biodiversity.

38. Strigatella scutulata (Gmelin, 1791)

Common Name	****
Description	Small to medium-sized, elongated shell with a glossy and smooth surface. The shell is often adorned with intricate, wavy patterns in shades of brown or black on a lighter background. The aperture is narrow and elongated, with fine teeth along the inner edge.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Predatory, feeding on small marine invertebrates. Plays a role in controlling prey populations and maintaining ecological balance within its habitat. Serves as prey for various larger marine predators, contributing to the marine food web and supporting biodiversity.

39. Subcancilla sulcata (Swainson, 1825)

Common Name -	****
Description	Small to medium-sized, elongated shell with a sturdy structure. The shell surface is marked by distinct, spiral grooves or sulcations, giving it a textured appearance. Typically exhibits a color palette of creamy white to light brown, often with darker bands or markings.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, feeding on smaller marine invertebrates. Plays a role in regulating prey populations and maintaining ecological balance within its habitat. Serves as prey for various larger marine predators, contributing to the marine food web and supporting biodiversity.

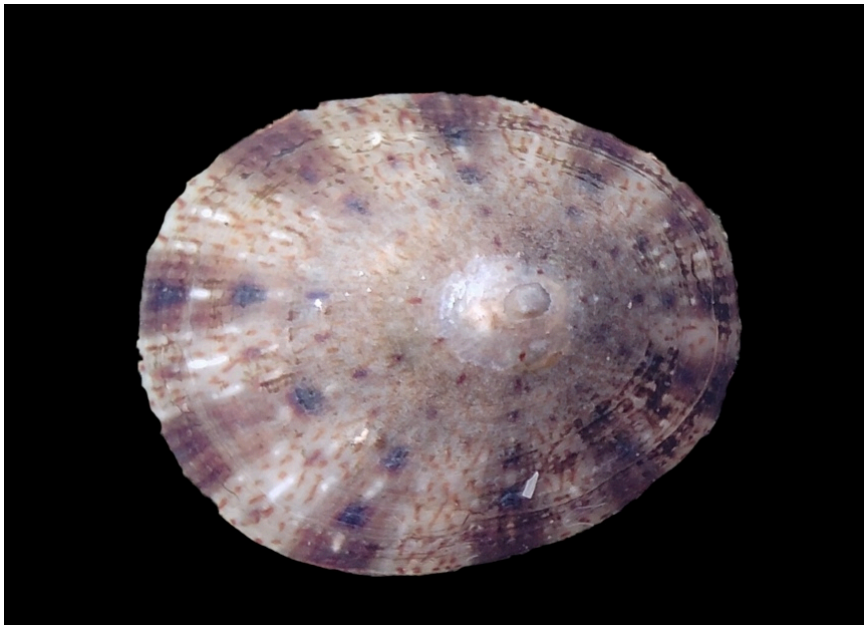
40. Mitra mitra (Linnaeus,1758)

Common Name -	**Episcopal miter**
Description	Medium to large-sized, elongated shell with a smooth and glossy surface. The shell is characterized by its vibrant coloration, often red or orange with white or yellow banding. The aperture is narrow and elongated, extending nearly the length of the shell.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Predatory, feeding on smaller marine invertebrates. Plays a role in regulating prey populations and maintaining ecological balance within its habitat. Serves as prey for various larger marine predators, contributing to the marine food web and supporting biodiversity.

41. Cellana karachiensis (Winckworth, 1930)

Common Name	**Common limpet**
Description	Small to medium-sized, oval, limpet-like shell with a low profile. The shell surface is smooth with concentric growth lines and often displays a greyish or brownish colour with radiating darker lines. The interior of the shell is typically glossy and white with a muscle scar.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky substrates. Once settled, larvae metamorphose into juvenile limpets and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and intertidal zones. Plays a crucial role in controlling algal growth and maintaining the ecological balance of its habitat. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

42. Cellana radiata (Born, 1778)



Common Name -	**Rayed wheel limpet**
Description	Medium-sized, oval shell with a low, limpet-like profile. The shell surface features distinct radial ribs that extend from the apex to the edges, often with a pattern of alternating dark and light bands. The interior of the shell is smooth and glossy, usually white, or light-colored with a prominent muscle scar.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky substrates. Once settled, larvae metamorphose into juvenile limpets and continue to grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and intertidal zones. Plays a significant role in controlling algal growth, contributing to the maintenance of ecological balance in its habitat. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

43. Patella vulgata (Linnaeus, 1758)

Common Name -	**Common limpet**
Description	Medium-sized, conical shell with a rough, textured surface. The shell is often greyish or brownish, with radial ribs and concentric growth lines. The interior is smooth and glossy, typically white, or light-colored, with a central muscle scar.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing multiple developmental stages before settling on rocky substrates. Upon settling, larvae metamorphose into juvenile limpets and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and intertidal zones. Plays a critical role in controlling algal growth and maintaining the ecological balance of its habitat. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

44. Nerita albicilla (Linnaeus,1758)

Common Name	**Blotched nerite**
Description	Medium-sized, robust shell with a globular shape. The shell surface is smooth and glossy, often displaying a variety of colours and patterns, including black, white, and red markings. The aperture is rounded and slightly flattened, with a strong, toothed outer lip and a calcareous operculum.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on rocky or coral substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and coral reefs. Plays a significant role in controlling algal growth and maintaining the ecological balance of its habitat. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

45. Nerita undata (Linnaeus, 1758)

Common Name -	**Waved nerite**
Description	Medium-sized, robust shell with a globular shape. The shell surface is smooth and glossy, often decorated with wavy, undulating patterns in black, white, and sometimes brown. The aperture is rounded, with a toothed outer lip and a thick, calcareous operculum that fits tightly.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing multiple developmental stages before settling on rocky or coral substrates. Upon settling, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Grazes on algae and biofilm on rocky shores and coral reefs. Plays a crucial role in controlling algal growth and maintaining the ecological balance of its habitat. Serves as prey for various marine predators, thus supporting the marine food web and contributing to biodiversity.

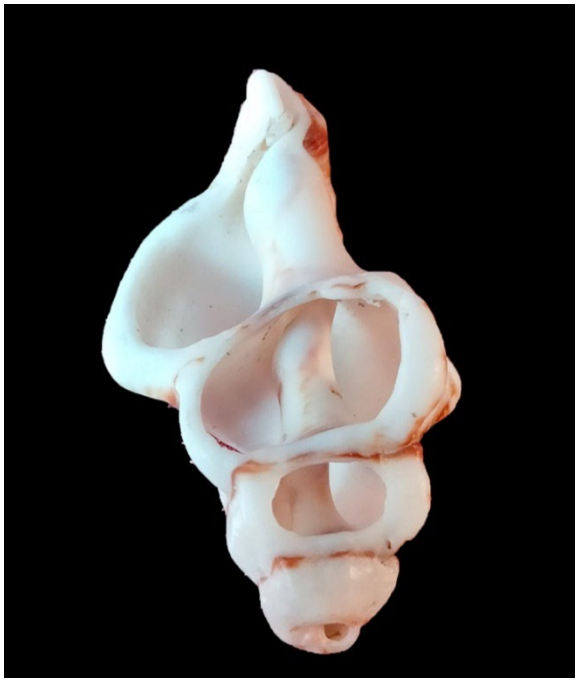
46. Rhinoclavis sinensis (Gmelin 1791)

Common Name -	****
Description	Medium-sized, elongated shell with a high spire. The shell surface is sculpted with fine, spiral ridges and often features a color pattern of light and dark bands. The aperture is elongated, and the outer lip is smooth, with a siphonal canal at the base.
Reproduction	Reproduces via external fertilization, with eggs and sperm released into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Upon settling, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Feeds on detritus and algae on sandy and muddy substrates. Plays a role in nutrient recycling and maintaining the cleanliness of the substrate. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

47. Cerithium caeruleum (G. B. Sowerby II, 1855)

Common Name -	**Cerith sand snail**
Description	Medium-sized, elongated shell with a high spire. The shell surface is adorned with numerous spiral ridges and fine axial lines, often exhibiting a bluish or greyish coloration with darker bands. The aperture is oval and the outer lip is slightly flared, with a short siphonal canal at the base.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae, detritus, and biofilm on sandy and rocky substrates. Plays a role in maintaining the cleanliness of the substrate and controlling algal growth. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

48. Cerithium coralium (Kiener, 1841)



Common Name	**Coral Cerith**
Description	Medium-sized, elongated shell with a high spire and a narrow, conical shape. The shell surface features prominent spiral ridges and fine axial growth lines, often exhibiting a coloration that ranges from light brown to gray with darker bands or spots. The aperture is oval, and the outer lip is slightly flared, with a short siphonal canal at the base.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing multiple developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and continue to grow into adults.
Ecological Significance	Grazes on algae, detritus, and biofilm on coral reefs and rocky substrates. Plays a role in maintaining the cleanliness of the substrate and controlling algal growth. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

49. Cerithium scabridum (Philippi, 1848)

Common Name -	**Yellow Cerith**
Description	Medium-sized, elongated shell with a high spire and robust structure. The shell surface is rough with prominent, irregular spiral ridges and fine axial growth lines, typically exhibiting a greyish or brownish coloration. The aperture is oval, and the outer lip is slightly flared, with a short siphonal canal at the base.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or rocky substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on algae, detritus, and biofilm on rocky and sandy substrates. Plays a role in maintaining the cleanliness of the substrate and controlling algal growth. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

50. Turritella radula (Kiener, 1843)

Common Name	**Radula Tower Shell**
Description	Medium-sized, elongated shell with a high, turreted spire. The shell surface features fine spiral ridges and growth lines, often displaying a pattern of alternating light and dark bands. Typically exhibits a color palette of brown, tan, or cream.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Once settled, larvae metamorphose into juvenile snails and grow into adults.
Ecological Significance	Grazes on detritus and microorganisms on sandy and muddy substrates. Plays a role in nutrient recycling and maintaining substrate health. Serves as prey for various marine predators, contributing to the marine food web and supporting biodiversity.

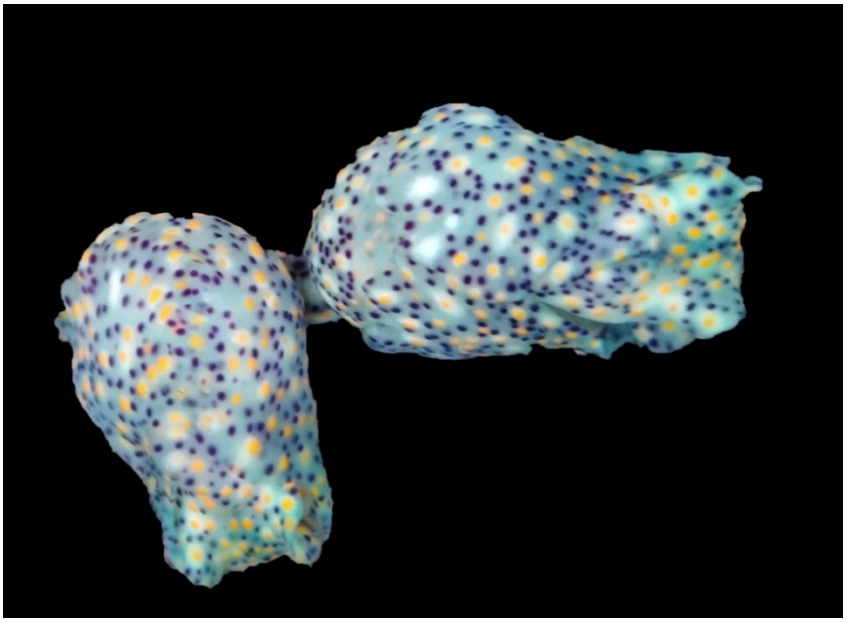
51. Aplysia Oculifera (A. Adams & Reeve, 1850)

Common Name	**Spotted sea hare**
Description	Medium-sized Sea slug with a soft, elongated body. The body is typically brownish to reddish, with distinctive eye-like spots or ocelli on the parapodia (side flaps). The head has a pair of large, folded rhinophores (sensory organs) and a pair of oral tentacles.
Reproduction	Hermaphroditic, capable of both self-fertilization and cross-fertilization. Lays eggs in long, spaghetti-like strings attached to substrates. Larvae are planktonic, undergoing several developmental stages before metamorphosing into juvenile sea slugs.
Ecological Significance	Feeds on algae, particularly red and green algae, contributing to the control of algal populations. Plays a role in nutrient cycling within its habitat. Serves as prey for various marine predators, including fish and crustaceans, supporting the marine food web and enhancing biodiversity.

52. Peronia verruculata (Cuvier, 1830)

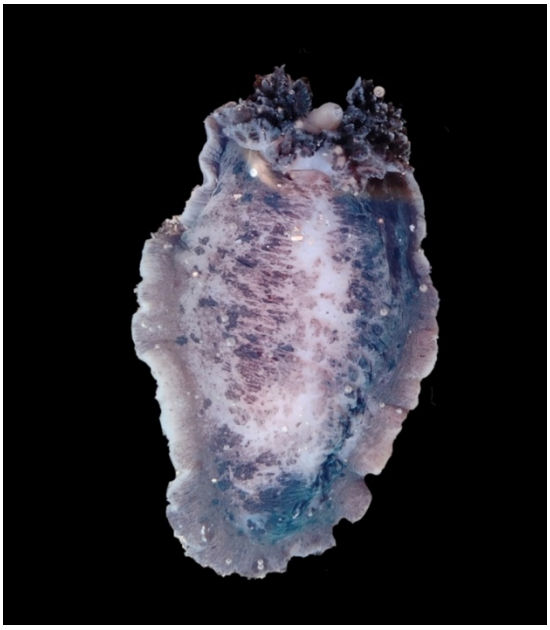
Common Name -	**Onch slugs/ Onchidium**
Description	Medium-sized sea slug with an elongated, soft body covered in small, wart-like tubercles. The body is typically greyish to brownish, sometimes with darker spots or patches. The dorsal side features parapodia (side flaps) that can be raised or flattened against the body.
Reproduction	Hermaphroditic, capable of both self-fertilization and cross-fertilization. Lays eggs in gelatinous strings or masses attached to substrates. Larvae are planktonic, undergoing several developmental stages before settling and metamorphosing into juvenile sea slugs.
Ecological Significance	Feeds on algae, particularly those found on rocky substrates in intertidal zones. Contributes to controlling algal populations and maintaining the ecological balance of its habitat. Serves as prey for various marine predators, including fish and invertebrates, supporting the marine food web and enhancing biodiversity.

53. Lamprohaminoea ovalis (Pease, 1868)



Common Name -	****
Description	Small, oval-shaped sea slug with a smooth, glossy body. The body color ranges from translucent white to pale yellow, often with scattered darker spots or patches. The head has a pair of small, pointed rhinophores and the mantle covers the shell, which is thin and fragile.
Reproduction	Hermaphroditic, capable of both self-fertilization and cross-fertilization. Lays eggs in gelatinous ribbons or masses attached to substrates. Larvae are planktonic, undergoing several developmental stages before settling and metamorphosing into juvenile sea slugs.
Ecological Significance	Feeds on small algae and detritus, contributing to the control of algal growth and nutrient cycling. Plays a role in maintaining the cleanliness and ecological balance of its habitat. Serves as prey for various marine predators, supporting the marine food web and enhancing biodiversity.

54. Dendrodoris fumata [Light brown form] (Rüppell & Leuckart, 1830)

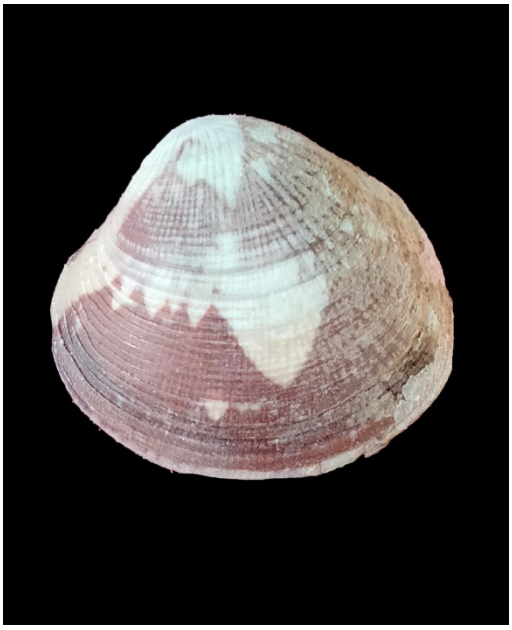


Common Name -	**Black (Brown) dorid**
Description	Medium to large-sized sea slug with a soft, oval, and flattened body. The body is light brown in color, often with darker mottling or speckling. The mantle is smooth and lacks tubercles, with the gills and rhinophores being retractable.
Reproduction	Hermaphroditic, capable of both self-fertilization and cross-fertilization. Lays eggs in ribbon-like gelatinous masses attached to substrates. Larvae are planktonic, undergoing several developmental stages before settling and metamorphosing into juvenile sea slugs.
Ecological Significance	Feeds on sponges, playing a role in controlling sponge populations and maintaining ecological balance. Contributes to the nutrient cycling within its habitat. Serves as prey for various marine predators, including fish and other invertebrates, supporting the marine food web and enhancing biodiversity.

55. Gafrarium dispar (Holten, 1802)

Common Name	**Discrepant venus**
Description	Medium-sized, thick, and robust bivalve shell. The shell is nearly oval with concentric ridges and radiating lines, providing a textured surface. Typically, the shell is light brown or greyish with darker concentric bands.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Once settled, larvae metamorphose into juvenile bivalves and continue to grow into adults.
Ecological Significance	Filter feeder, feeding on plankton and organic particles suspended in the water. Plays a crucial role in maintaining water quality and clarity by filtering out suspended particles. Serves as prey for various marine predators, including fish and birds, contributing to the marine food web and supporting biodiversity.

56. Gafrarium divaricatum (Gmelin, 1791)



Common Name	**Forked venus**
Description	Medium-sized, thick, and robust bivalve shell. The shell is nearly oval with prominent concentric ridges and radiating lines, creating a textured surface. Typically, light brown or grayish, often with darker concentric bands or spots.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Once settled, larvae metamorphose into juvenile bivalves and grow into adults.
Ecological Significance	Filter feeder, consuming plankton and organic particles suspended in the water. Plays a crucial role in maintaining water quality and clarity by filtering out suspended particles. Serves as prey for various marine predators, including fish and birds, contributing to the marine food web and supporting biodiversity.

57. Sunetta sp.

Common Name -	****
Description	Medium-sized, oval to slightly rounded bivalve shell. The shell surface is smooth to slightly textured, often with concentric growth lines. Coloration can vary, but typically ranges from cream to light brown, sometimes with darker radial markings or bands.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing multiple developmental stages before settling on sandy or muddy substrates. Once settled, larvae metamorphose into juvenile bivalves and grow into adults.
Ecological Significance	Filter feeder, consuming plankton and organic particles suspended in the water. Plays an essential role in maintaining water quality and clarity by filtering out suspended particles. Serves as prey for various marine predators, including fish and birds, contributing to the marine food web and supporting biodiversity.

58. Paphia vernicosa (A. Gould, 1861)

Common Name	**Varnished venus**
Description	Medium-sized, elongated bivalve shell with an oval shape. The shell surface is smooth and glossy, often with concentric growth lines and sometimes subtle radial lines. Typically exhibits a coloration ranging from white to light brown, with possible darker streaks or patches.
Reproduction	Reproduces via external fertilization, releasing eggs and sperm into the water column. Larvae are planktonic, undergoing several developmental stages before settling on sandy or muddy substrates. Once settled, larvae metamorphose into juvenile bivalves and grow into adults.
Ecological Significance	Filter feeder, consuming plankton and organic particles suspended in the water. Plays a crucial role in maintaining water quality and clarity by filtering out suspended particles. Serves as prey for various marine predators, including fish and birds, contributing to the marine food web and supporting biodiversity.

59. Octopus Vulgaris (Cuvier 1797)

Common Name	**Octopus**
Description	Medium to large-sized octopus with a soft, rounded body and long, flexible arms. The skin is highly textured with numerous chromatophores that allow for rapid color changes, providing excellent camouflage. Typically exhibits a color range from reddish-brown to gray, with the ability to display complex patterns.
Reproduction	Reproduces via internal fertilization; males use a specialized arm (hectocotylus) to transfer spermatophores to the female. Females lay thousands of eggs in protected crevices and tend to them until they hatch. Larvae are planktonic, undergoing several developmental stages before settling on the seafloor and growing into juvenile octopuses.
Ecological Significance	Predatory, feeding on a variety of marine organisms such as crabs, molluscs, and small fish. Plays a critical role in controlling prey populations and maintaining the ecological balance of its habitat. Serves as prey for larger marine predators, including sharks and large fish, contributing to the marine food web and supporting biodiversity.

The high occurrence of gastropods on the intertidal belt of the Saurashtra coastal region has been previously documented by Joshi (2007), Bhadja (2010), and Vaghela (2010), and our observations confirm these findings. The study of (Kardani et al., 2014) further supports this, documenting 36 gastropod species from 18 families in the Northern Gulf of Kachchh. Among the sites studied, Mandvi exhibited the highest diversity with 25 species, followed by Sanghi with 17 species, and Mundra with 13 species. Dominant species included *Cerithidea cingulata* and *Umbonium vestarium*, with seasonal variations and habitat characteristics significantly influencing species distribution and density. Similarly, the study conducted by Vaghela, Bhadja, and Kundu (2013) at Mangrol coast identified 28 molluscan species from 19 families. Gastropods like *Turbo coronatus* and *Turbo intercostalis* were dominant, particularly in the middle and lower littoral zones. Seasonal fluctuations were observed, with maximum abundance post-monsoon, likely influenced by human activities and specific habitat characteristics such as substrate type and availability of food resources.

In the more recent study by (Gadhvi et al., 2023), 56 molluscan species from 31 families were recorded across four sites in Devbhumi Dwarka. Bet Dwarka exhibited the highest species richness with 26 species, followed by Okha and Poshitra with 15 species each, and Dwarka with 12 species. The diverse habitats, including sandy, rocky, and reef substrates, played a crucial role in influencing species distribution. These substrates provide a variety of niches that support different molluscan species, contributing to the observed biodiversity.

Overall, the distribution of gastropods and other molluscs in these coastal regions is heavily influenced by the complex interplay of habitat characteristics, seasonal variations, and human activities (Vahidi et al., 2021). The presence of diverse substrates such as rocky shores, sandy flats, and muddy patches creates numerous microhabitats that support a wide range of species (Naderloo et al., 2013). Seasonal changes, particularly the post-monsoon period, lead to fluctuations in species abundance due to changes in environmental conditions and resource availability (Saraf & Vijaykumar, 2021). Human activities, including coastal development and pollution, also impact molluscan populations by altering their habitats and affecting their survival and distribution (Gallmetzer et al., 2017).

Molluscan Species Composition

The species composition of Mollusca across three different study sites on the South Saurashtra coast Mangrol, Adri, and Veraval provides insightful data into the ecological diversity and habitat specificity of Molluscan classes in this region (Fig).

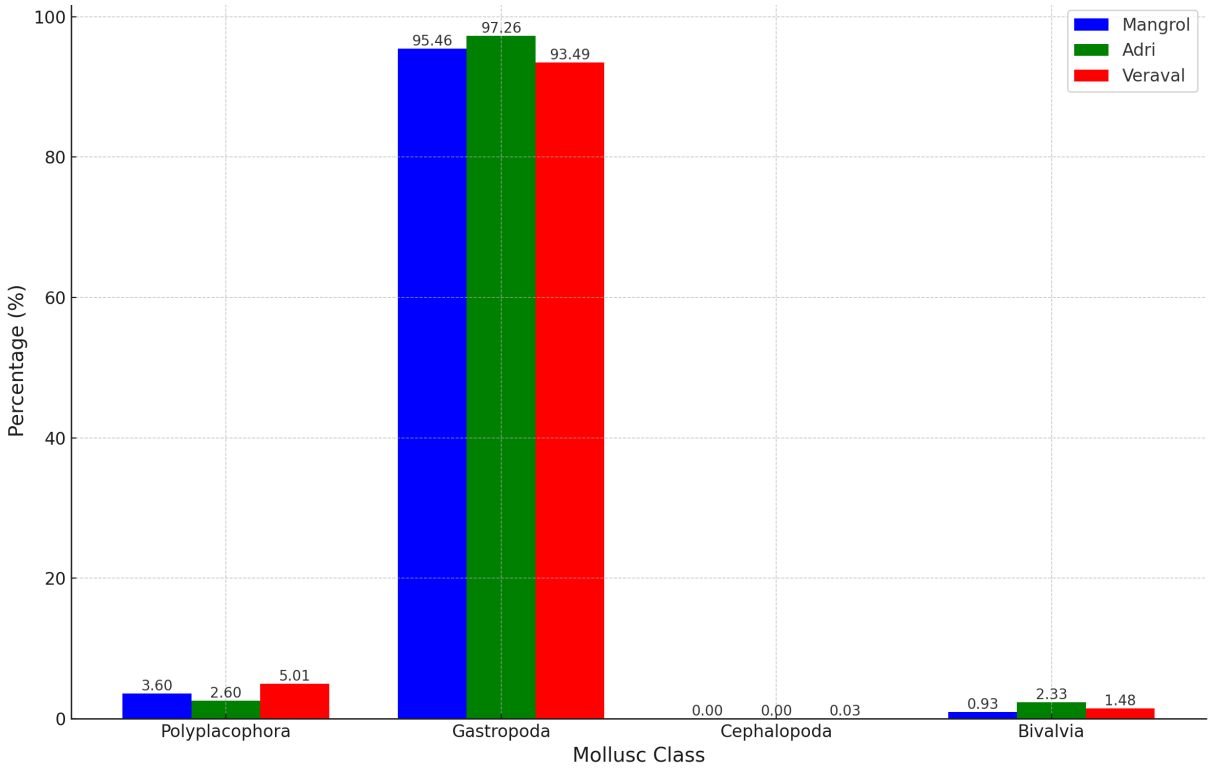


Fig – Molluscan species composition

A dominant observation is the overwhelming prevalence of the Gastropoda class in all three regions. In Mangrol, gastropods account for approximately 95.46% of the mollusc population, indicating highly favourable conditions for their survival. Adri exhibits an even higher dominance, with gastropods constituting about 97.26% of the total molluscs, suggesting similar environmental suitability. Veraval, while still showing a significant presence of gastropods at 93.49%, has a slightly lower percentage, possibly indicating some variation in habitat or resources. Polyplacophora shows a notable but varying presence across the locations. In Mangrol, Polyplacophora makes up about 3.60% of the population. This percentage drops to 2.6% in Adri but rises to 5.01% in Veraval, suggesting that Veraval might offer more suitable niches or fewer competitive pressures for this class. Cephalopoda are virtually absent in Mangrol and Adri, indicating these

environments may not favour cephalopod survival or their population is too sparse to be detected. Veraval, however, shows a minimal presence of Cephalopoda at 0.03%, implying some level of environmental support for this class, albeit limited. Bivalvia exhibits a minor presence across all three locations, constituting 0.93% of the population in Mangrol, increasing to 2.33% in Adri, and 1.48% in Veraval. This distribution suggests slightly better conditions for bivalves in Adri compared to the other two locations.

The distribution patterns reveal significant ecological insights about the three coastal regions. The dominance of gastropods underscores favourable environmental conditions, while the varied presence of Polyplacophora and the minimal presence of Cephalopoda and Bivalvia suggest specific ecological constraints. These findings can guide further ecological studies and conservation efforts, highlighting areas that might need focused environmental management to support broader mollusc biodiversity.

Diversity Indices

Various diversity indices provide insights into the ecological health and richness of a specific area, as assessed through these biodiversity measures. To evaluate the molluscan diversity along the South Saurashtra coastline, a range of diversity indices were employed including the Shannon-Wiener diversity index (H), Simpson's Index (D), Margalef Index (d), and Menhinick's Index (Dmn). These indices were utilized to analyze the diversity of Molluscs at selected study sites. The collected diversity data were tabulated and analyzed using the Past 4.03 software to create diversity indices graphs. (Fig)

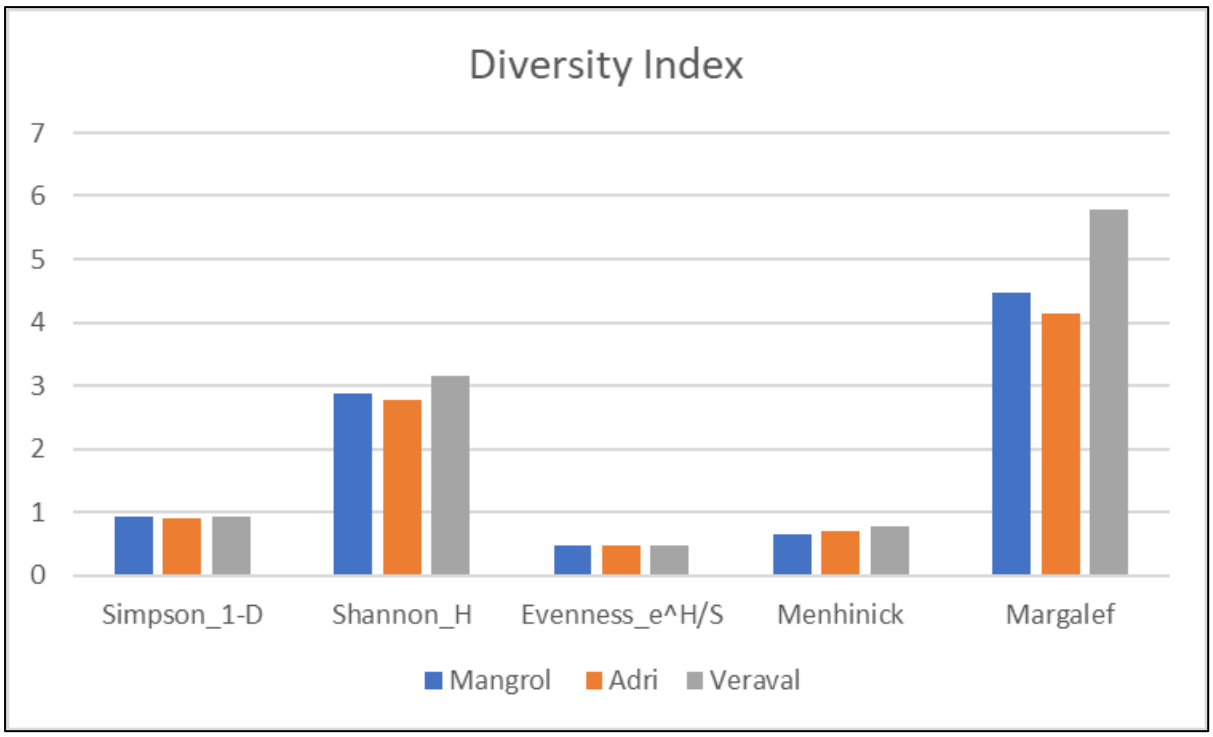


Fig: Diversity Indices of Mollusca along different study sites

Simpson's 1-D Index: which measures the probability that two randomly selected individuals from a sample belong to different species, highlights Veraval as the most diverse location with a score of 0.9393. This represents approximately 1.95% and 2.98% higher diversity compared to Mangrol (0.9214) and Adri (0.9121) respectively. Such high values indicate a robust and varied molluscan community at Veraval due to its diverse habitat that supports a broad range of species. (Fig)

Shannon's H Index: quantifying the entropy in the community by considering both the abundance and evenness of species, is highest in Veraval at 3.153. This score is about 9.83% and 14.08% higher than Mangrol (2.871) and Adri (2.764), respectively, reinforcing the status of Veraval as the most ecologically diverse site. The high value of Shannon's Index at Veraval correlates with a habitat that supports a balanced ecological distribution, with minimal dominance by any single species. (Fig)

Evenness (e^H/S): shows similar values across all sites: Mangrol at 0.4773, Adri at 0.4808, and Veraval at 0.4776, suggesting a moderate level of species evenness at each location. This evenness is crucial for maintaining ecological stability, as it implies that no single species disproportionately dominates the community. (Fig)

Menhinick's Index: indicating species richness relative to the number of individuals, is highest in Veraval (0.777). This index is about 19.00% and 11.59% higher than Mangrol (0.6529) and Adri (0.6963), respectively. A higher Menhinick's Index at Veraval suggests that despite possibly larger sample sizes, the diversity remains significantly high, indicative of a rich biological environment. (Fig)

Margalef's Index: which calculates species richness for a given number of individuals, also shows Veraval leading with a value of 5.791, nearly 30.03% and 39.62% higher than Mangrol (4.458) and Adri (4.147), respectively. This substantial difference highlights superior species richness along Veraval and suggests that its habitat conditions such as nutrient availability, habitat complexity, and lesser anthropogenic disturbances are particularly conducive to supporting a diverse array of molluscan life. (Fig)

The dominance of Gastropoda across all studied sites (FIG OF SP. COMPOSITION), as revealed by our diversity indices, underscores their significant ecological roles in nutrient cycling and food web dynamics. Comparative analysis of the diversity indices, Shannon-Wiener Index, Simpson's Index, Margalef Index, and Menhinick's Index across three distinct study sites (Mangrol, Adri, and Veraval) indicates varying levels of molluscan diversity. Veraval exhibits the highest biodiversity, as evident by the highest scores in both Margalef and Menhinick indices, suggesting a complex habitat that supports a broad range of species. This high biodiversity is attributed to optimal environmental conditions that foster not only a high species richness but also a balanced ecological distribution among the molluscan community (Venkataraman et al., 2020).

Historical studies on the Gujarat coastline, such as those by Hornell (1927) and Ramesh et al. (1996), have documented the presence and general distribution patterns of Molluscs but lacked the detailed analysis provided by modern diversity indices. These earlier studies provided a foundational understanding of species diversity but did not delve into the ecological interactions and health of habitats. The current research enhances this foundational knowledge by applying detailed diversity indices that reflect both the richness and evenness of the communities, providing deeper insights into ecological dynamics and the health of the ecosystems.

The findings from Veraval, supported by quantitative diversity metrics, spotlight it as a crucial area for conservation efforts and further ecological research. This enhanced

understanding of Molluscan diversity and their ecological roles contributes to broader conservation strategies aimed at sustaining marine biodiversity, emphasizing the need for continued monitoring and tailored conservation efforts across the South Saurashtra coast.

Length Weight relationship (LWR) of selected species

The analysis of the length-weight relationship (LWR) of *Cerithium caeruleum* (Figure3.4), *Lunella Coronatus* (Figure3.5), *Peronia verruculata* (Figure3.6) *Trochus radiatus* (Figure3.7) from three different sites Adri, Mangrol, and Veraval revealed significant variations in the correlation and strength of the relationship between log length and log weight.

Cerithium Caeruleum

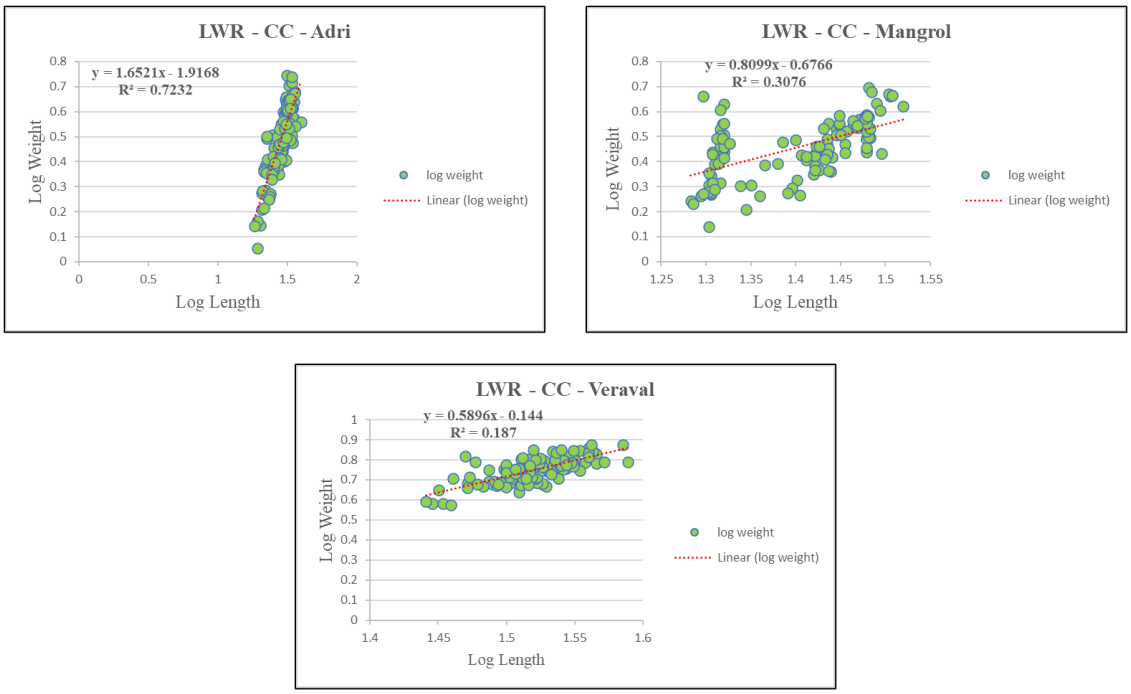


Figure 3.1: LWR of *Cerithium Caeruleum*

At the Adri site, the LWR shows a strong positive correlation, with an R^2 value of 0.7232, indicating that approximately 72.32% of the variability in log weight can be explained by log length. The equation (y = 1.6521x - 1.9168) and the slope of 1.6521 suggest a robust positive relationship between these variables. This high degree of correlation suggests favourable environmental conditions or less variability in the size and weight of the species at this site, making log length a reliable predictor of log weight. In contrast, the Mangrol site demonstrates a moderate positive correlation, with an R^2 value of 0.3076, indicating that only 30.76% of the variability in log weight can be attributed to log length. The equation (y = 0.8099x - 0.6766) and the slope of 0.8099 point to a moderate relationship between log length and log weight. The lower R^2 value suggests greater variability, possibly due to environmental heterogeneity, differences in food availability, or other ecological factors influencing the species at this site. The Veraval site shows the weakest correlation among the three sites, with an R^2 value of 0.187, meaning that only 18.7% of the variability in log weight is explained by log length. The equation (y = 0.5896x - 0.144) and the slope of 0.5896 indicate a relatively weak positive relationship.

The low R^2 value implies that much of the variability in log weight is not accounted for by log length, potentially due to higher environmental stress, greater ecological diversity, or differences in growth patterns of *Cerithium caeruleum* at this site.

Overall, the varying strength of the LWR across different sites underscores the impact of local environmental conditions on the growth patterns of *Cerithium caeruleum*. These site-specific relationships provide valuable insights into the ecology and biology of the species, which can inform conservation and management strategies.

Lunella coronatus

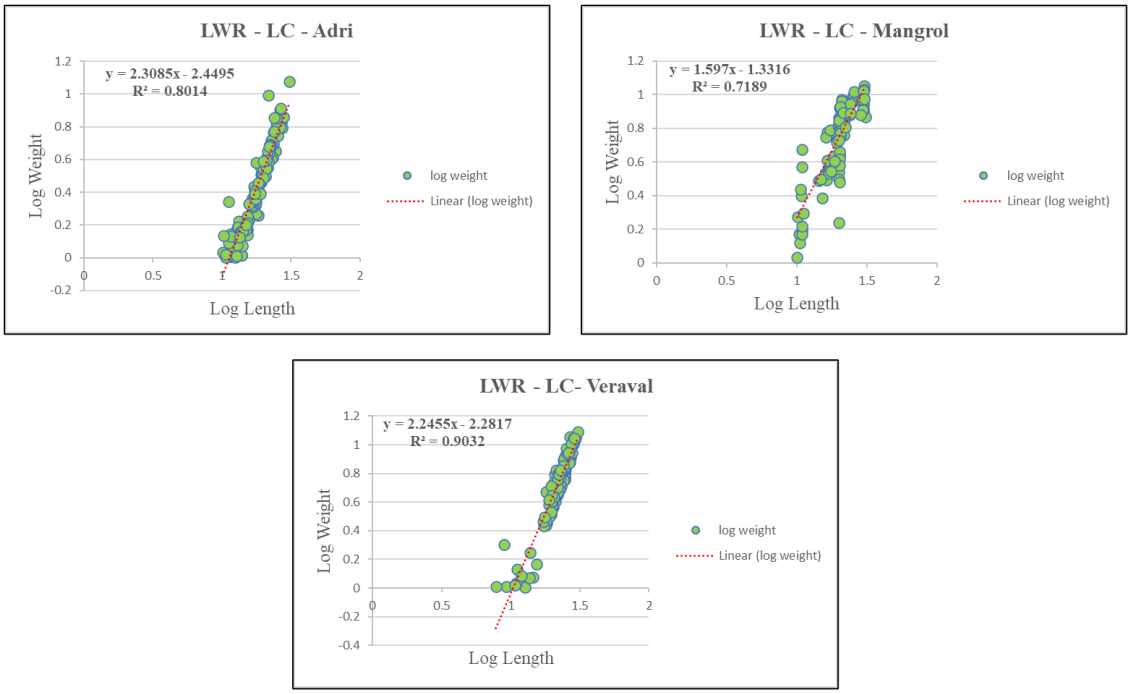


Figure 3.2: LWR of *Lunella coronatus*

At the Adri site, the LWR displays a strong positive correlation, with an R^2 value of 0.8014, indicating that 80.14% of the variability in log weight can be explained by log length. The regression equation (y = 2.3085x - 2.4495) with a slope of 2.3085 suggests a robust and significant relationship between these variables. This high degree of correlation implies that log length is a reliable predictor of log weight for *Lunella coronatus* at this site, likely due to stable environmental conditions and less variability in the size and weight of the individuals. For the Mangrol site, the LWR also shows a strong positive correlation, with an R^2 value of 0.7189, meaning that 71.89% of the variability in log weight is explained by log length. The equation (y = 1.597x - 1.3316) and the slope of 1.597 indicate a significant relationship, though slightly weaker than that of Adri. The lower R^2 value compared to Adri suggests some variability in the growth conditions or ecological factors influencing *Lunella coronatus* at this site. At the Veraval site, the LWR indicates the strongest correlation among the three sites, with an R^2 value of 0.9032, suggesting that 90.32% of the variability in log weight is attribuTable to log length. The equation (y = 2.2455x - 2.2817) with a slope of 2.2455 reflects a highly significant and reliable relationship between log length and log weight. This exceptionally high R^2 value indicates minimal variability in the size and weight relationship, suggesting very favourable or consistent environmental conditions for *Lunella coronatus* at Veraval.

The analysis of the LWR for *Lunella coronatus* across the three sites reveals site-specific variations in the strength of the relationship between log length and log weight. The strong correlations observed, particularly at Veraval and Adri, indicate that log length is a reliable predictor of log weight in these regions. These results underscore the importance of considering local environmental conditions and ecological factors when assessing the growth patterns of aquatic species.

Peronia verruculata

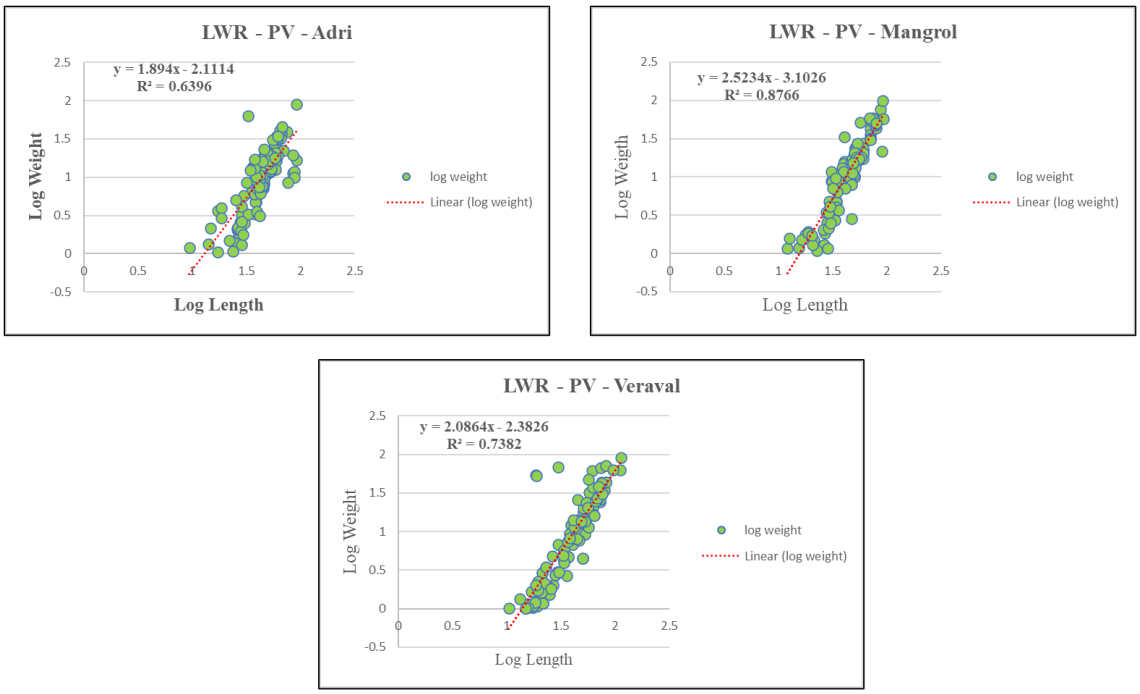


Figure 3.3: LWR of *Peronia Verruculata*

At the Adri site, the LWR demonstrates a moderately strong positive correlation, with an R^2 value of 0.6396. This indicates that 63.96% of the variability in log weight can be explained by log length. The regression equation (y = 1.894x - 2.1114) suggests a significant relationship between log length and log weight, with a slope of 1.894. Despite the moderate strength of this relationship, it highlights that environmental or biological factors might be causing some variability in the growth patterns of *Peronia verruculata* at Adri. For the Mangrol site, the LWR shows a very strong positive correlation, with an R^2 value of 0.8766.

This high R^2 value indicates that 87.66% of the variability in log weight is explained by log length. The regression equation (y = 2.5234x - 3.1026) with a slope of 2.5234 reflects a robust and significant relationship, suggesting consistent growth conditions and less variability in the size and weight of individuals at this site. The strong correlation implies that log length is a reliable predictor of log weight for *Peronia verruculata* at Mangrol. At the Veraval site, the LWR indicates a strong positive correlation, with an R^2 value of 0.7382. This suggests that 73.82% of the variability in log weight is attribuTable to log length. The equation (y = 2.0864x - 2.3826) with a slope of 2.0864 indicates a significant and reliable relationship between log length and log weight. The strong correlation at Veraval suggests favourable or consistent environmental

conditions for the growth of *Peronia verruculata*, though there is slightly more variability compared to Mangrol.

The analysis of the LWR for *Peronia verruculata* across the three sites reveals site-specific variations in the strength of the relationship between log length and log weight. The strong correlations observed, particularly at Mangrol, indicate that log length is a reliable predictor of log weight in these regions. The moderate correlation at Adri suggests that additional environmental or biological factors may be influencing growth patterns at this site. These results highlight the importance of considering local environmental conditions and ecological factors when assessing the growth patterns of intertidal species.

Trochus radiatus

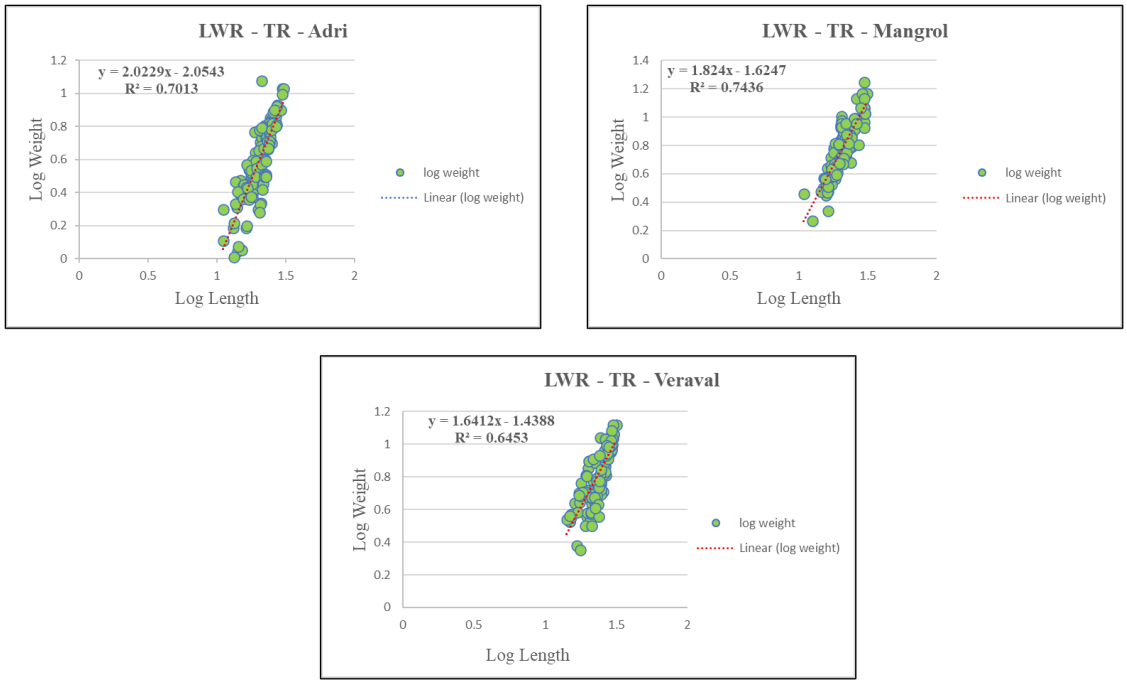


Figure 3.4: LWR of *Trochus radiatus*

At the Adri site, the LWR exhibits a strong positive correlation, with an R^2 value of 0.7013. This indicates that 70.13% of the variability in log weight can be explained by log length. The regression equation (y = 2.0229x - 2.0543) with a slope of 2.0229 suggests a significant relationship between log length and log weight, reflecting consistent growth patterns at this site. For the Mangrol site, the LWR shows a slightly stronger positive correlation, with an R^2 value of 0.7436. This high R^2 value indicates that 74.36% of the variability in log weight is explained by log length. The regression equation (y = 1.824x - 1.6247) with a slope of 1.824 reflects a robust relationship, suggesting favourable growth conditions and less variability in the size and weight of individuals at this site. At the Veraval site, the LWR demonstrates a moderate positive correlation, with an R^2 value of 0.6453. This suggests that 64.53% of the variability in log weight is attributable to log length. The equation (y = 1.6412x - 1.4388) with a slope of 1.6412 indicates a significant relationship between log length and log weight, though there is more variability compared to Adri and Mangrol. This could imply that additional environmental or biological factors are influencing growth patterns at Veraval.

The analysis of the LWR for *Trochus radiatus* across the three sites reveals site-specific variations in the strength of the relationship between log length and log weight. The strong

correlations observed, particularly at Mangrol, indicate that log length is a reliable predictor of log weight in these regions. The moderate correlation at Veraval suggests that other factors may be affecting growth patterns at this site. These results underscore the importance of considering local environmental conditions and ecological factors when assessing the growth patterns of aquatic species. Further research incorporating additional environmental and biological variables could provide deeper insights into the factors influencing the LWR and enhance the effectiveness of conservation and management strategies for *Trochus radiatus*.

Mating Behaviour of different Molluscan Species

The figure showcases the intricate and diverse mating behaviors of Molluscan species along the Saurashtra coast. Understanding these behaviors is essential for comprehending the ecological dynamics and reproductive strategies of these fascinating marine organisms.

Fig: Mating behaviour of different Molluscan Species

During field visits, observations of various molluscan species engaged in mating behaviours were documented (fig), revealing distinct temporal patterns and ecological implications. *Peronia verruculata* exhibited peak mating activity in winter, indicating an adaptation to specific climatic conditions that may enhance reproductive success. Similarly, *Lunella coronatus* engaged in mating from early to late winter, a strategy that could be driven by the need to align reproductive cycles with favourable environmental conditions that ensure the successful development of offspring. *Aplysia oculifera* were observed mating in groups during December, suggesting a synchronized reproductive strategy likely influenced by environmental factors such as water temperature and food availability, which optimize larval survival rates. In contrast, *Purpura panama* was noted to mate predominantly in the late monsoon, a period characterized by increased nutrient influx and optimal conditions for larval dispersal. These temporal variations in mating behaviours across different species highlight the intricate interplay between reproductive strategies and environmental cues, underscoring the adaptive mechanisms that these Molluscs employ to maximize their reproductive fitness in varying ecological contexts (Baur & Baur, 2021).