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Notes on Violet Sea Snails in Ayeyarwady Intertidal Waters, Myanmar

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Abstract
A total of 5 species of violet sea snails *Janthina exigua*, *J. globosa*, *J. janthina*, *J. pallida*, and *J. umbilicata* were collected from the intertidal shoal of Ayeyarwady coastal waters from January to December 2024. The shell appearance, habitat, buoyancy, feeding system, and local ecological adaptation (bubble raft for buoyancy, dietary specialization, reduced and modified shell and foot, reproduction, pelagic lifestyle) of the genus *Janthina* were studied. Some ecological aspects of the distribution, occurrence, composition, and abundance of violet sea snails in different sampling sites of the Ayeyarwady intertidal waters were also studied with species and station-wise correlation.

Key words
Ayeyarwady Intertidal Waters, genus *Janthina*, Myanmar, notes, violet sea snails

1. Introduction

The family Epitoniidae is commonly found in tropical seas. These marine snails are often called wentletraps or ladder snails, referring to their shell structure. They are known for their parasitic relationship with other marine organisms, such as cnidarians and flatworms. The Epitoniidae are a diverse group, with various species adapted to different habitats within tropical marine environments, including coral reefs and sandy seabeds (Bouchet and Warén 1986). "*Janthina*" primarily refers to a genus of pelagic (open ocean) sea snails, most commonly known as violet snails or purple sea snails. These snails are notable for their distinctive violet-purple coloration and their unique adaptation of floating on the ocean surface using a raft of air bubbles.

The name "*Janthina*" itself is derived from Greek words meaning "violet" and "flower," evoking their appearance (Laursen, 1953). They feed on jellyfish and other floating organisms. Their shells are typically violet or purple, providing them with some camouflage in the open ocean. They are found in tropical and subtropical waters worldwide (Okutani, 1956). Violet sea snails typically inhabit a variety of marine environments, with their preferred habitats including intertidal zones, coral reefs, rocky shores, and sandy or muddy bottoms. These snails often prefer areas where they can find abundant algal growth or detritus to feed on. In particular, in intertidal tropical shoal waters, violet sea snails are usually found browsing on algae, biofilms, or detritus on rocks and coral surfaces. They are well-adapted to survive in areas where they are periodically exposed to air during low tide and submerged during high tide, making intertidal zones especially suitable (Light, 2003). In Ayeyarwady coastal waters, there was no record of pelagic gastropods such as violet snails. The present study mainly emphasizes the basic ecological status of the genus *Janthina* in different study sites along the Ayeyarwady coastal water.

2. Materials and methods

2.1. Description of Study Areas

The Ayeyarwady intertidal water is situated in the southwest part of Myanmar. It's a coastal region bordered by the Bay of Bengal and the Andaman Sea. Its approximate geographical coordinates are between latitudes 15° 40' and 18° 30' north and between longitudes 94° 15' and 96° 15' east, covering an area of approximately 13,566 square miles. This region experiences a tropical monsoon climate, characterized by hot and dry conditions from mid-February to mid-May, followed by the rainy southwest monsoon.

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Table 1. Study areas of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

No	Station	Latitude	Longitude
1	Baw Mi Gyaing	17° 29′ N	94° 33′ E
2	Jade Lett Gyaing	17° 17′ N	94° 30′ E
3	Tapin Maw	17° 16′ N	94° 29′ E
4	Phoe Htaung Gyaing	17° 10′ N	94° 29′ E
5	Wet Thay Gyaing	17° 08′ N	94° 27′ E
6	Kyauk Nagar	17° 04′ N	94° 27′ E
7	Shwe Thaung Yan (Ma Gyi)	17° 04′ N	94° 27′ E
8	Boung Kyun I.	17° 04′ N	94° 26′ E
9	Inn Din Gyi	17° 03′ N	94° 26′ E
10	Thae Phyu Kyun I.	17° 01′ N	94° 18′ E
11	Chaung Tha	16° 57′ N	94° 25′ E
12	Ngwe Saung	16° 52′ N	94° 22′ E
13	Thathanar Dauk	16° 36′ N	94° 19′ E
14	Ngayoke Kaung Aw	16° 32′ N	94° 17′ E
15	Ohn Kyun I.	16° 23′ N	94° 13′ E
16	Cape Negrais	16° 02′ N	94° 11′ E
17	Ngwe Taung Pagoda	16° 01′ N	94° 12′ E
18	Zea Gyaing	16° 01′ N	94° 13′ E
19	Mawtin Point	15° 57′ N	94° 14′ E
20	Kyauk Chaung	15° 59′ N	94° 16′ E
21	Kha Mauk Hmaw	15° 59′ N	94° 16′ E
22	Kyar Kan	15° 59′ N	94° 13′ E
23	Haing Gyi I.	15° 58′ N	94°18′ E

The average annual temperature ranges from 25°C to 32°C, with the hottest months being March and April. The annual high temperatures reach 33.0°C, and the annual low temperature is 23.71°C. The average annual precipitation is 72.89 mm (Lindsey, 2008).

2.2. Sampling Procedure

A significant stranding of violet sea snails was observed from January to December 2024 in Ayeyarwady intertidal waters (Fig. 1). Fifty-seven live specimens of snails were collected randomly along the coastal shoal of 23 sampling sites (Table 1). The epifaunas and periostracum (non-calcareous covering that protects the outside of many shells) were removed by soaking the shells in a solution of caustic soda. After all the shells are cleaned, washed, dried, and ready for storage, they are lightly rubbed with a small amount of olive oil applied with a tuft of cotton to make them fresh-looking in a slight luster to the surface, and aid in presenting the delicate colouring. And then, voucher specimens were deposited at the Museum of the Department of Marine Science, Pathein University (PMS).

All collected specimens were preserved in a 10% seawater solution containing formaldehyde and classified according to Beu (2017). The validity of species names was also reviewed from the World Register of Marine Species (WoRMS) database. The correlation analysis was calculated using Microsoft Excel.

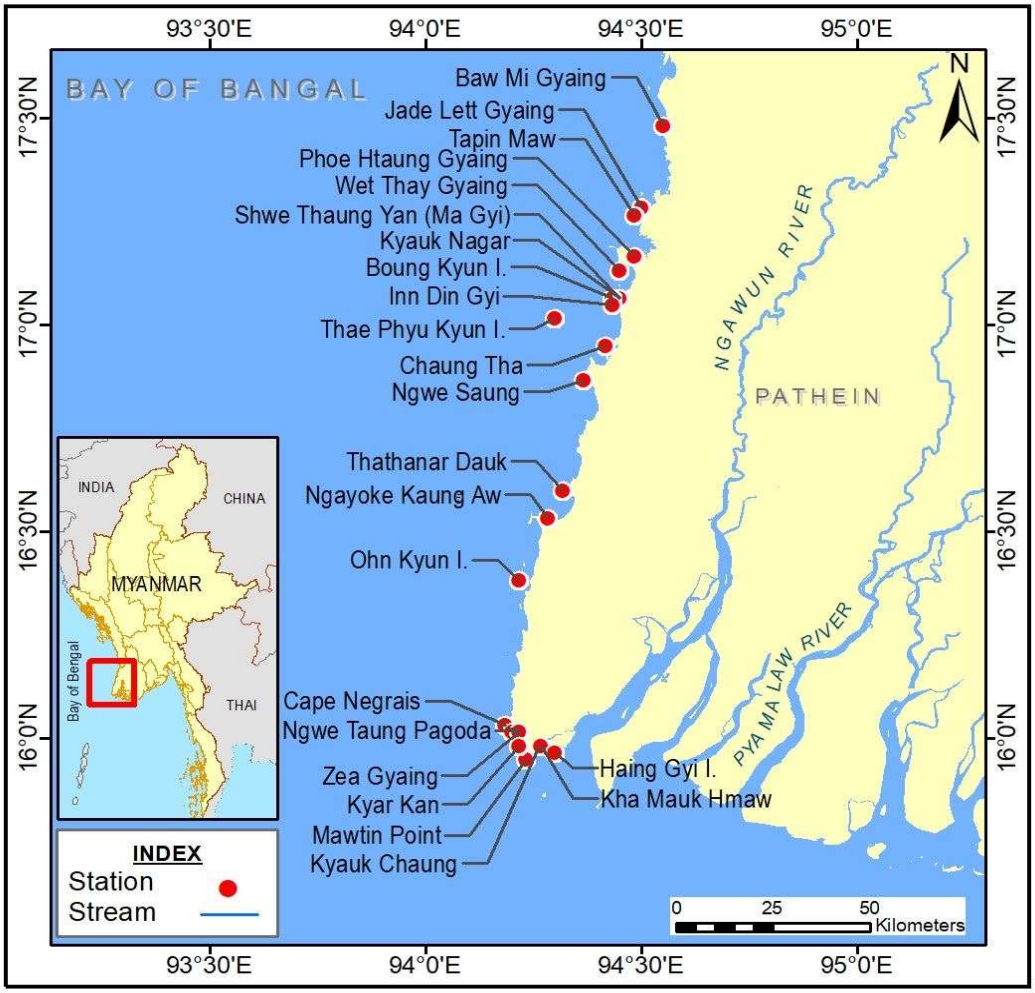

Fig.1. Map showing the collection sites of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

Table 2. Classification of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

Scheme	Taxa	Common name	Shell length (mm)
Phylum	Mollusca (Cuvier, 1795)		
Class	Gastropoda (Cuvier, 1795)		
Order	Mesogastropoda (Thiele, 1929)		
Family	Epitoniidae (Berry, 1910; Berry, 1812)		
Genus	*Janthina* (Röding, 1798)		
Species	*J. exigua* (Lamarck, 1816)	Dwarf Janthina	11-17
	J. globosa (Swainson, 1822)	Glossy Janthina	10-25
	J. janthina (Linnaeus, 1758)	Violet Janthina	07-24
	J. pallida (Thompson, 1840)	Pale Janthina	06-28
	J. umbilicata (d'Orbigny, 1841)	Elongate Janthina	07-14

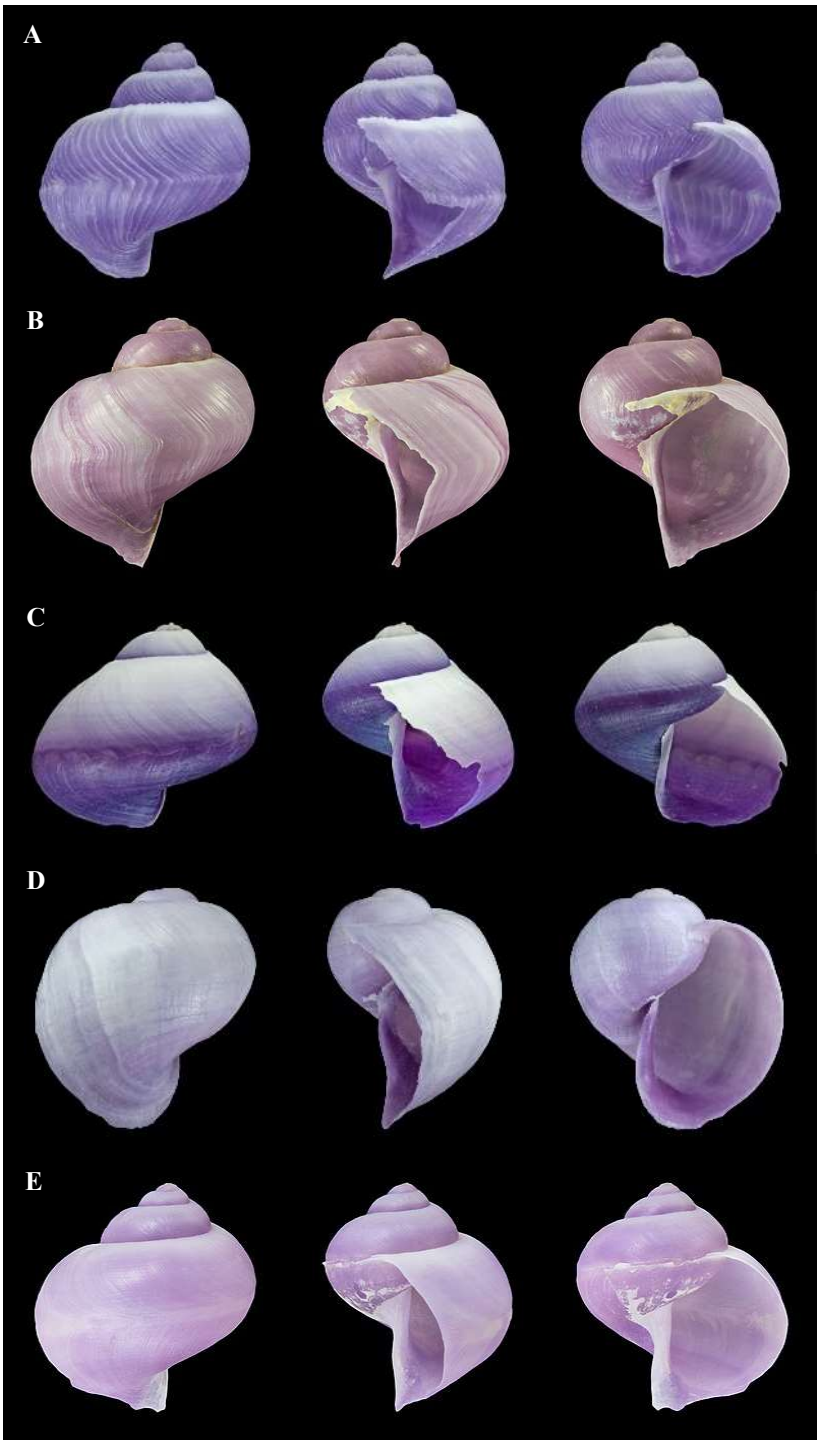

Fig. 2. (A-E) Dorsal, lateral, and ventral views of violet sea snail: A) *Janthina exigua* Lamarck, 1816; B) *J. globosa* Swainson, 1822; C) *J. janthina* (Linnaeus, 1758); D) *J. pallida* W. Thompson, 1840; E) *J. umbilicata* A. d'Orbigny, 1841

3. Results and Discussion

Violet sea snails, specifically *Janthina* species, are marine gastropod molluscs found in the Ayeyarwady intertidal waters of Myanmar. They are holoplanktonic, meaning they spend their entire lives in the water column. These snails belong to the family Epitoniidae (Table 2). They are active marine gastropods that graze on the sandy bottom of the shallow intertidal to deep shelf zone in Myanmar Coastal Water. Research indicates that a variety of gastropods and bivalves are found in these waters, suggesting a diverse marine ecosystem. Key aspects of genus *Janthina* in the Ayeyarwady intertidal waters were shell appearance, habitat, buoyancy, and their feeding system.

Table 3. Distribution and occurrence of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

No	Station	*J. exigua*	*J. globosa*	*J. janthina*	*J. pallida*	*J. umbilicata*	Total
1	Baw Mi Gyaing	+	+	+	-	-	3
2	Jade Lett Gyaing	+	+	+	-	-	3
3	Tapin Maw	+	+	+	-	-	3
4	Phoe Htaung Gyaing	+	+	+	+	+	5
5	Wet Thay Gyaing	-	+	-	-	+	2
6	Kyauk Nagar	+	+	+	+	-	4
7	Shwe Thaung Yan (Ma Gyi)	+	-	+	-	-	2
8	Boung Kyun I.	-	+	+	-	-	2
9	Inn Din Gyi	+	+	+	-	-	3
10	Thae Phyu Kyun I.	+	-	+	-	-	2
11	Chaung Tha	+	+	+	-	-	3
12	Ngwe Saung	+	+	+	+	+	5
13	Thathanar Dauk	+	+	+	-	-	3
14	Ngayoke Kaung Aw	+	+	+	+	-	4
15	Ohn Kyun I.	+	-	+	-	-	2
16	Cape Negrais	+	+	+	+	+	5
17	Ngwe Taung Pagoda	+	+	+	-	-	3
18	Zea Gyaing	+	+	+	+	-	4
19	Mawtin Point	+	+	+	-	-	3
20	Kyauk Chaung	+	-	+	-	-	2
21	Kha Mauk Hmaw	+	+	+	-	-	3
22	Kyar Kan	+	+	+	+	+	5
23	Haing Gyi I.	+	+	+	-	+	4
	Total	21	19	22	7	6	75

3.1. Shell Appearance

The shells are distinctively violet or purple, with the base being darker and the upper parts paler, which helps them blend with their environment when floating upside down in the water column. This reverse countershading is essential for their survival as neustonic (surface-dwelling) organisms. The shell body is generally globular, delicate, fragile, and thin in structure with a smooth appearance, but can have subtle growth lines or spiral grooves, especially near the last whorl.

The shape can be high or low, with the last whorl making up a significant portion of the shell's height. While there are variations among species, *Janthina* shells are generally small to medium-sized, with *Janthina* globosa reaching up to 38.5 mm in length. Unlike many other snails, *Janthina* shells are notable for lacking an operculum, a protective lid that usually covers the aperture. The shells typically consist of four to six whorls. The aperture, or opening of the shell, is often described as large and "D-shaped" (Figs. 2 A-E).

Table 4. Composition and abundance of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

No	Station	*J. exigua*	*J. globosa*	*J. janthina*	*J. pallida*	*J. umbilicata*	Total
1	Baw Mi Gyaing	11	12	17	0	0	40
2	Jade Lett Gyaing	16	10	14	0	0	40
3	Tapin Maw	12	12	17	0	0	41
4	Phoe Htaung Gyaing	12	19	22	18	15	86
5	Wet Thay Gyaing	0	22	0	0	19	41
6	Kyauk Nagar	10	12	17	14	0	53
7	Shwe Thaung Yan (Ma Gyi)	18	0	13	0	0	31
8	Boung Kyun I.	0	15	17	0	0	32
9	Inn Din Gyi	25	16	11	0	0	52
10	Thae Phyu Kyun I.	14	0	27	0	0	41
11	Chaung Tha	13	18	23	0	0	54
12	Ngwe Saung	15	15	12	10	21	73
13	Thathanar Dauk	13	21	17	0	0	51
14	Ngayoke Kaung Aw	10	12	16	14	0	52
15	Ohn Kyun I.	18	0	13	0	0	31
16	Cape Negrais	14	18	16	35	12	95
17	Ngwe Taung Pagoda	33	15	27	0	0	75
18	Zea Gyaing	15	14	14	10	0	53
19	Mawtin Point	16	15	18	0	0	49
20	Kyauk Chaung	24	0	31	0	0	55
21	Kha Mauk Hmaw	15	11	21	0	0	47
22	Kyar Kan	13	12	14	21	20	80
23	Haing Gyi I.	21	11	18	0	26	76
	Total	338	280	395	122	113	1248

3.2. Habitat

Janthina snails primarily inhabit pelagic, or open-ocean, environments in warm seas and tropical waters around the world. They are highly adapted to a life floating on the surface. Their shells and body structures are designed for a life at the water's surface, where they drift with ocean currents. Shells are not found near coastlines or the seabed but float freely in the water column. They prefer warmer waters, often in areas with stable surface conditions. *Janthina* snails attach themselves to particles of floating violet-colored "purple mucus" that they create, which helps them stay afloat. Sometimes, they are seen riding on the backs of other floating debris or even large marine animals. They feed on plankton and smaller organisms at the surface. Their floating habitat makes them vulnerable to surface pollutants but also allows them to travel vast distances with ocean currents.

Table 5. Species-wise correlation of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

Species-wise	*J. exigua*	*J. globosa*	*J. janthina*	*J. pallida*
J. exigua	1.000			
J. globosa	-0.323	1.000		
J. janthina	0.462	-0.339	1.000	
J. pallida	-0.160	0.271	-0.094	1.000

3.3. Buoyancy

The snails produce a float of clear mucus that encases air bubbles, creating a stable raft to which they attach themselves with their foot. This adaptation allows *Janthina* to live a pelagic life at the ocean surface, feeding on other surface-dwelling organisms like hydrozoa (e.g., by-the-wind sailors and Portuguese man o' war).

Table 6. Station-wise correlation of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

No	St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7	St. 8	St. 9	St. 10	St. 11	St. 12	St. 13	St. 14	St. 15	St. 16	St. 17	St. 18	St. 19	St. 20	St. 21	St. 22	St. 23
St. 1	1.000																						
St. 2	0.918	1.000																					
St. 3	0.998	0.939	1.000																				
St. 4	0.392	0.017	0.343	1.000																			
St. 5	-0.185	-0.314	-0.206	-0.013	1.000																		
St. 6	0.602	0.477	0.590	0.629	-0.585	1.000																	
St. 7	0.645	0.840	0.679	-0.235	-0.650	0.323	1.000																
St. 8	0.792	0.493	0.757	0.805	0.170	0.571	0.074	1.000															
St. 9	0.724	0.911	0.758	-0.294	-0.154	0.280	0.727	0.249	1.000														
St. 10	0.768	0.741	0.772	0.305	-0.614	0.524	0.829	0.461	0.423	1.000													
St. 11	0.992	0.871	0.985	0.468	-0.099	0.608	0.546	0.856	0.677	0.709	1.000												
St. 12	-0.275	-0.205	-0.268	-0.495	0.695	-0.928	-0.184	-0.261	-0.068	-0.320	-0.272	1.000											
St. 13	0.927	0.837	0.923	0.347	0.100	0.518	0.411	0.811	0.760	0.472	0.950	-0.189	1.000										
St. 14	0.577	0.464	0.567	0.603	-0.578	0.998	0.304	0.544	0.289	0.482	0.584	-0.938	0.510	1.000									
St. 15	0.645	0.840	0.679	-0.235	-0.650	0.323	1.000	0.074	0.727	0.829	0.546	-0.184	0.411	0.304	1.000								
St. 16	-0.418	-0.470	-0.430	0.269	-0.373	0.466	-0.403	-0.204	-0.439	-0.337	-0.394	-0.737	-0.382	0.496	-0.403	1.000							
St. 17	0.867	0.988	0.893	-0.065	-0.417	0.444	0.913	0.383	0.894	0.783	0.804	-0.202	0.743	0.429	0.913	-0.467	1.000						
St. 18	0.771	0.801	0.783	0.234	-0.451	0.833	0.571	0.497	0.754	0.507	0.753	-0.683	0.769	0.843	0.571	0.126	0.763	1.000					
St. 19	0.979	0.969	0.988	0.219	-0.177	0.543	0.698	0.686	0.848	0.705	0.961	-0.229	0.939	0.527	0.698	-0.448	0.923	0.813	1.000				
St. 20	0.752	0.813	0.768	0.103	-0.655	0.466	0.933	0.326	0.563	0.975	0.674	-0.280	0.468	0.431	0.933	-0.378	0.869	0.555	0.732	1.000			
St. 21	0.978	0.947	0.984	0.299	-0.342	0.586	0.781	0.677	0.735	0.869	0.947	-0.286	0.840	0.558	0.781	-0.435	0.927	0.755	0.963	0.871	1.000		
St. 22	-0.899	-0.910	-0.909	-0.094	-0.064	-0.388	-0.551	-0.639	-0.896	-0.473	-0.896	0.072	-0.964	-0.384	-0.551	0.499	-0.840	-0.758	-0.955	-0.525	-0.843	1.000	
St. 23	0.198	0.293	0.213	-0.389	0.248	-0.604	0.403	-0.043	0.251	0.320	0.152	0.789	0.089	-0.638	0.403	-0.946	0.334	-0.337	0.221	0.367	0.266	-0.231	1.000

St. 1: Baw Mi Gyaing, St. 2: Jade Lett Gyaing, St. 3: Tapin Maw, St. 4: Phoe Htaung Gyaing, St. 5: Wet Thay Gyaing, St. 6: Kyauk Nagar, St. 7: Shwe Thaung Yan (Ma Gyi), St. 8: Boung Kyun I., St. 9: Inn Din Gyi, St. 10: Thae Phyu Kyun I., St. 11: Chaung Tha, St. 12: Ngwe Saung, St. 13: Thathunar Dauk, St. 14: Ngayoke Kaung Aw, St. 15: Ohn Kyun I., St. 16: Cape Negrais, St. 17: Ngwe Taung Pagoda, St. 18: Zea Gyaing, St. 19: Mawtin Point, St. 20: Kyauk Chaung, St. 21: Kha Mauk Hmaw, St. 22: Kyar Kan, St. 23: Haing Gyi I.

Their shells are typically thin and fragile, and they lack an operculum (a protective flap found in many other gastropods), enabling them to float upside down with their raft. This passive flotation method is considered a particularly resource-efficient form of locomotion.

3.4. Feeding System

Their diet mainly consists of pelagic hydrozoans like *Velella* and *Physalia*. While *Velella* appears to be a favored prey, studies suggest *Janthina* species will consume other available food sources, even exhibiting cannibalistic behavior. When feeding, *Janthina* snails may either abandon their mucus-covered bubble raft to directly attach to and consume the prey, especially if the prey is large relative to the snail, or they may maintain their float and simply hold onto the prey while feeding. *Janthina* species are known to be resistant to the toxins found in the nematocysts of their prey, which allows them to effectively prey on these cnidarians. Unlike many other marine animals, the diet of *Janthina globosa* doesn't significantly change as it matures. The presence of large populations of *Janthina* snails can often indicate a significant abundance of their prey, particularly *Velella*.

3.5. Ecological Adaptation of the Genus Janthina

3.5.1. Bubble Raft for Buoyancy

The most significant adaptation is the creation of a raft of air bubbles, stabilized by a thin, transparent sheet of glycoproteins and mucus, which allows the snail to float upside down at the surface of the ocean. This raft is essential for their survival as they cannot swim.

3.5.2. Dietary Specialization

Janthina species are specialized predators of pleustonic hydrozoans, such as "Blue Bottles" (*Physalia physalis*) and "By-the-wind Sailors" (*Velella velella*).

3.5.3, Reduced and Modified Shell and Foot

Adult *Janthina* have a paper-thin shell and lack an operculum (a trapdoor-like structure found in many snails), both adaptations to their floating existence. They use their foot to anchor themselves to their bubble raft.

3.5.4. Reproduction

Janthina globosa is a hermaphrodite that begins life as a male and later becomes female (protandry), laying eggs on the underside of its bubble raft, where they hatch and attach.

3.5.5. Pelagic Lifestyle

The genus is holoplanktonic, meaning they spend their entire lives in the open water column, living at the ocean's surface. Their dispersal is heavily influenced by sea surface currents, allowing them to colonize vast areas of the world's oceans.

The data suggests a varying distribution of these species across the different locations. Some stations have a high diversity of species, such as Phoe Htaung Gyaing, Ngwe Saung, Cape Negrais, and Kyar Kan, while others have a lower diversity (Table 3).

The total count for each species and the total count across all species at each location is also provided (Table 4). The most

abundant species is *J. janthina* with a total count of 395 (Fig. 4). Cape Negrais had the highest total count of 95, while Shwe Thaung Yan (Ma Gyi) and Ohn Kyun I. had the lowest total counts of 31 (Fig. 3). The stations Phoe Htaung Gyaing, Ngwe Saung, Cape Negrais, and Kyar Kan each have 5 species present, which is the highest number, indicating they have the highest species diversity.

The provided data appears to represent a correlation matrix among four species: *J. exigua*, *J. globosa*, *J. janthina*, and *J. pallida*. The diagonal elements (1.000) indicate perfect correlation within each species. The off-diagonal values represent the correlation between different species. For instance, *J. exigua* and *J. globosa* correlate at -0.323, suggesting a negative correlation. *J. exigua* and *J. janthina* have a correlation of 0.462, which implies a positive correlation. *J. pallida* shows varied correlations, with negative correlations to *J. exigua* and *J. janthina* but a positive correlation with J. globosa (Table 5).

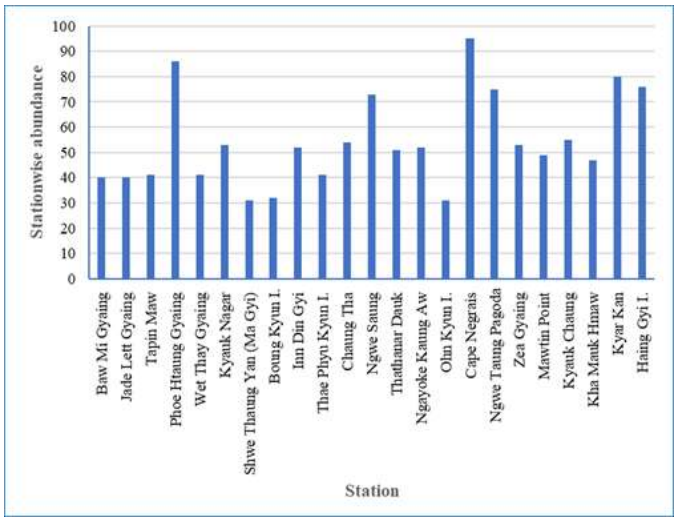

Fig. 3. Station-wise abundance of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

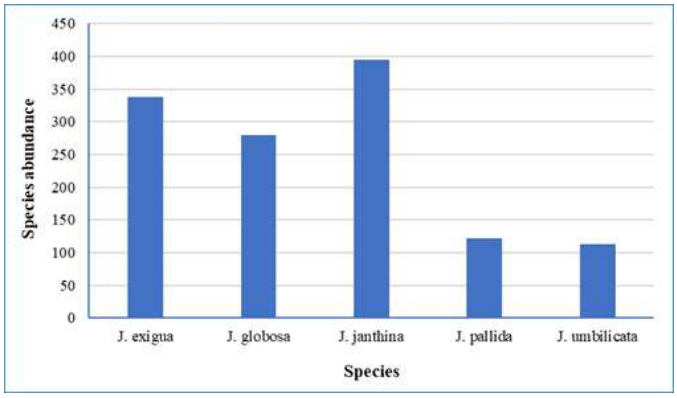

Fig. 4. Species-wise abundance of violet sea snails in the Ayeyarwady intertidal waters, Myanmar

Species that coexist in similar habitats are more likely to show positive correlations because their populations tend to fluctuate in tandem due to shared environmental conditions such as temperature, humidity, or availability of resources. From this result, a positive correlation between *J. globosa* and *J. janthina* might suggest they prefer similar habitats or ecological niches. A negative correlation between *J. exigua* and *J. globosa* (-0.323) could indicate that when one species is abundant, the other tends to be less so, possibly due to competition for similar resources.

The provided data presents a correlation matrix for violet sea snail populations across 23 stations in the Ayeyarwady intertidal waters (Table 6). High positive correlations (values close to 1) indicate similar population trends between stations, while negative correlations (values close to -1) suggest inverse relationships. Stations 1, 2, and 3 show strong positive correlations, implying similar environmental influences or snail distributions. Station 12 (Ngwe Saung) shows negative correlations with many stations, suggesting it has distinct characteristics from the others. The data could be used to identify potential habitat similarities, understand the factors affecting snail populations, and inform conservation efforts.

4. Conclusion

Violet sea snails are holoplanktonic gastropods found floating on the surface. They are characterized by a fragile, smooth, purple shell. These snails rely on wind and water currents for movement and feed on jellyfish. Their presence in Ayeyarwady intertidal waters suggests a marine environment with suitable currents and a jellyfish population to sustain them. The snails' distribution is therefore highly dependent on these environmental factors. Positive correlations (*J. globosa* and *J. pallida* at 0.271): These species might share similar habitat preferences or coexist within similar environmental conditions. They could be competing or cooperating in the same ecological niches. Negative correlations (*J. exigua* and *J. globosa* at -0.323): These species might prefer different habitats or conditions, leading to less overlap in their distributions. They might be occupying mutually exclusive or contrasting environments. Moderate positive correlation (*J. janthina* and *J. exigua* at 0.462): Indicates a potential partial overlap in habitat preferences or an indirect association, such as shared resources or similar environmental tolerances.

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