

# Distribution of the genus *Strombus* Linnaeus 1758 (Gastropoda: Strombidae) in some coastal areas of Myanmar

## Abstract

A systematic study on distribution of some marine conchs collected from three coastal regions of Myanmar water was carried out. A total of 325 individuals were collected from the study areas during low tide and were transferred to the laboratory for species identification, labeled specimens were stored and images were taken and recorded. Some marine conch shells on intertidal and subtidal areas in Myanmar coastal water are composed of 20 species belonging to genus *Strombus* Linnaeus 1758 of family Strombidae Rafinesque, 1815 under the order Mesogastropoda Thiele, 1929 collected from field observations during 2005-2017. Species identification had been conducted with emphasis on liquid-preserved materials and living specimens in the field, based on the external shell sculptures such as shape of body whorl, texture, colour, aperture shape, style of siphonal canal and columella, umbilicus formation and operculum type of conchological features. The collected specimens comprised *S. aurisdiane* Linnaeus, 1758; *S. bulla* (Röding, 1798); *S. campbelli* Griffith & Pidgeon, 1834; *S. canarium* Linnaeus, 1758; *S. dentatus* Linnaeus, 1758; *S. erythrinum* Dillwyn, 1817; *S. gibberulus* Linnaeus, 1758; *S. isabella* Lamarck, 1799; *S. japonicus* Reeve, 1844; *S. labiatus* (Röding, 1798); *S. lentiginosus* Linnaeus, 1758; *S. luhuanus* Linnaeus, 1758; *S. marginatus* Linnaeus, 1758; *S. microuceum* Kira, 1959; *S. mutabilis* Swainson, 1821; *S. pulchellus* Reeve, 1851; *S. sinuatus* Humphrey, 1786; *S. thersites* Röding, 1798; *S. urceus* Linnaeus, 1758 and *S. variabilis* Swainson, 1820. In this study provide the habitats, utilization and fishery of these species in brief. Moreover, the local species community similarity and zonal distribution of marine conchs were also presented.

**Keywords:** distribution, conchs, Myanmar, utilization, habitat, community similarity

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## Naung Naung Oo

Department of Marine Science, Mawlamyine University, Myanmar

**Correspondence:** Naung Naung Oo, Assistant Lecturer, Department of Marine Science, Mawlamyine University, Myanmar; Email [naungnaungoomarine@gmail.com](mailto:naungnaungoomarine@gmail.com)

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## Introduction

Myanmar is a large fishing nation in Southeast Asia with a continuous coastline of almost 2832 km extending along the Bay of Bengal and Andaman Sea. The coast of Myanmar can be divided into Rakhine, Ayeyawady Delta and Gulf of Martaban and Taninthayi Coastal Region. Shellfish are found in all regions and are widely distributed across the entire Myanmar coastline.

The genus *Strombus* is one of the economically important seashells and it can also be used as human foods which occurred throughout the tropical and subtropical regions.<sup>1</sup> The variety of seashells in Myanmar is mentioned in even the oldest reports of the first explorers.<sup>2</sup> Some authors have reported significant variations in spatial and temporal distribution and abundance of some species within this genus.<sup>2-13</sup> Much information such as their distribution pattern, habitat preferences and habitat range were still remained unknown.

In Myanmar, 17 species of *Strombus* such as *S. luhuanus* Linnaeus, 1758; *S. aurisdiane* Linnaeus, 1758; *S. canarium* Linnaeus, 1758; *S. urceus* Linnaeus, 1758; *S. dentatus* Linnaeus, 1758; *S. tridentatus* Gmelin, 1791; *S. labiatus* (Röding, 1798); *S. thersites* Röding, 1798; *S. isabella* Lamarck, 1799; *S. mutabilis* Swainson, 1821; *S. japonicus* Reeve, 1844; *S. microuceum* Kira, 1959; *S. gibberulus* Linnaeus, 1758; *S. erythrinum* Dillwyn, 1817; *S. pulchellus* Reeve, 1851; *S. urceus orrae* Abbott, 1960 and *S. campbelli* Griffith & Pidgeon, 1834 had been recorded by Soe Thu.<sup>6</sup> Likewise, 4 species of *Strombus*, namely *S. canarium* Linnaeus, 1758; *S. labiatus* (Röding, 1798); *S. marginatus* Linnaeus, 1758 and *Strombus labiatus olydius*

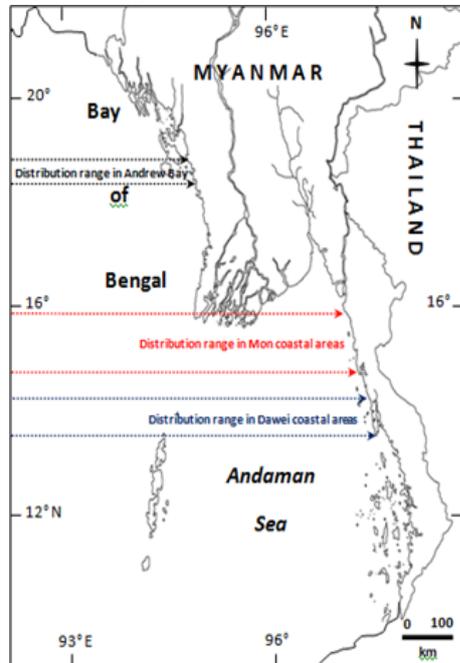
Duclos 1844, had been reported by Naung Naung Oo,<sup>10</sup> based on morphological and some ecological features collected from various coastal areas of Mon State in Myanmar.

In addition, the morphology and zonal distribution of marine gastropods and pelecypods from Kawdut coastal area in Mon State of Myanmar had been reported by Aung Ko Latt.<sup>13</sup> Consequently, composition and distribution of benthic molluscs had been carried out along southern Taninthayi Coastal Region.<sup>12</sup> Soe Thu<sup>6</sup> noted local distribution of *Strombus*, collected from Ngapali and Kyaukphyu in Rakhine Coastal Region, Kyaukkalat and Coco Island in Ayeyarwady Delta and the Gulf of Martaban Coastal Region and Maungmagan and Myeik Archipelago in Taninthayi Coastal Region to the species of the genus *Strombus* from Myanmar. The objectives of current study are 1) to identify the diversified species of conch shells; and 2) to investigate the species distribution of conch shells population in their natural habit. This information is very important for conservation and for better management of conch shell species in Myanmar.

## Materials and methods

Some marine conch shells were collected in the forms of drift and live specimens living in intertidal and shallow subtidal areas of Pearl I., Kathit I., Ponenyat Gyaing and Maung shwe lay Gyaing of Andrew Bay (Lat. 18°25' N, Long. 94°15' E) in Rakhine Coastal Region; Kyaikkhami (Lat. 16°04' N, Long. 97°33' E), Kawdut (Lat. 15° 32' N, Long. 97°45' E) and Kyungyi I. (Lat. 15°04' N, Long. 97°45' E) in Mon coastal areas (Lat. 15°0' N and 16°35' N and Long. 97° 20' E and 97° 48' E) which lie between the Ayeyawady Deltaic coast

and northern part of Taninthayi Coastal Region and Kampani (Lat. 14° 02' N, Long. 98° 04' E), Hmyawyt (Lat. 14°04' N, Long. 98°04' E), Thabawseik (Lat. 14°05' N, Long. 98°05' E), and Maungmagan (Lat. 14° 08' N, Long. 98°06' E) in Dawei coastal areas of Taninthayi Coastal Region (Figure 1) from 2005 to 2017.



**Figure 1** Map showing the species distribution range in some coastal areas of Myanmar.

All collections were preserved in 10 % formalin in seawater. The epifauna were removed by soaking the shells in a solution of caustic soda and then cleaned, washed, dried, and ready for storage, they are lightly rubbed with a small amount of oil applied with a brush to make them fresh-looking in a slight luster to the surface, and aid in presenting the delicate colouring for further study. All voucher specimens were deposited at the Museum of the Department of Marine Science, Mawlmyine University (MLM.MS). Zoogeographical distribution of each species was prepared with the data from the literature available. Ecological notes and associated species of these molluscs were also recorded in the field.

As with binary similarity coefficient analysis, binary occurrence or non-occurrence of each data set used to compare in the form of community similarity by using the Sorensen similarity index (S<sub>s</sub>).<sup>14</sup>

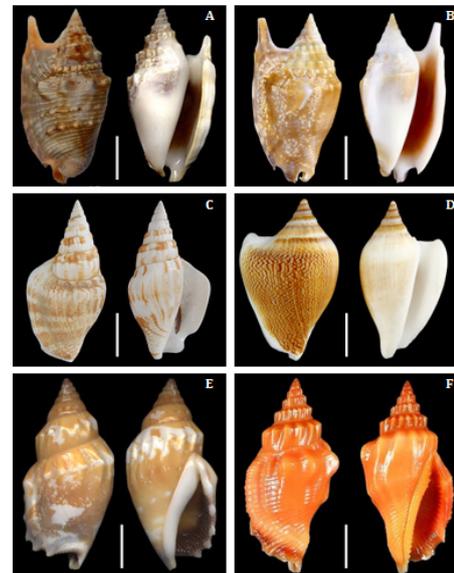
$$S_s = 2C/A + B$$

Where: C = the number of species the two communities have in common, A = the total number of species found in community 1, B = the total number of species found in community 2. For comparing the community structures of shell by station, a cluster analysis was used as shown in the form of a dendrogram. The analysis used Sorensen coefficients of similarity and followed the average linkage method.

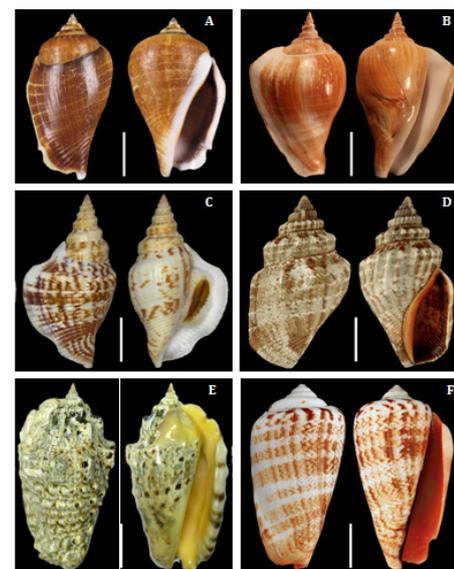
## Results and discussion

Totally 20 species of some marine conch shells from different habitats of coral reef, seagrass and algal bed, coastal lagoon and bay, sandy and muddy patches found along the intertidal and shallow

subtidal zone of Myanmar (Table 2) (Table 3). This systematic account follows the identifying set out by Tantanasiwong et al., in detailed<sup>15-19</sup> (Table 1) (Figure 2-5).



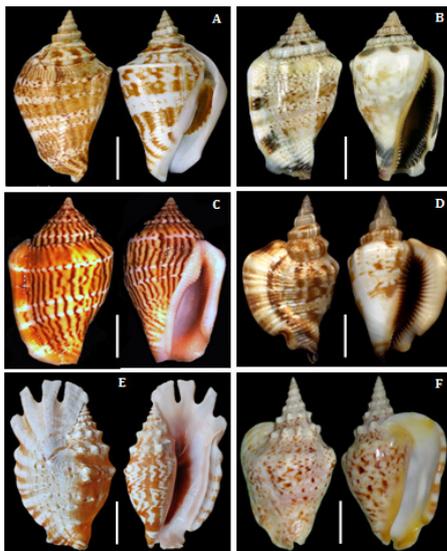
**Figure 2** (A-F) Some marine conchs in Myanmar; (A) *Strombus aurisdiane* Linnaeus, 1758; (B) *S. bulla* (Röding, 1798); (C) *S. campbelli* Griffith & Pidgeon, 1834; (D) *S. canarium* Linnaeus, 1758; (E) *S. dentatus* Linnaeus, 1758; (F) *S. erythrinum* Dillwyn, 1817. Scale bars=7cm.



**Figure 3** (A-F) Some marine conchs in Myanmar; (A) *Strombus gibberulus* Linnaeus, 1758; (B) *S. isabella* Lamarck, 1799; (C) *S. japonicus* Reeve, 1844; (D) *S. labiatus* (Röding, 1798); (E) *S. lentiginosus* Linnaeus, 1758; (F) *S. luhanus* Linnaeus, 1758. Scale bars=7cm.

**Characteristics:** Shell is solid and small to large. It exhibits different shapes but has an enlarged body whorl and a low conical to turreiform spire. Aperture is long and narrow, with anterior and posterior canals. The most distinguishing features of the shell are the development of a large, flaring and thickened outer lip and the presence of a U-shaped notch or indentation on the edge of the lip near the end. It is referred

as a 'stromboid notch' and facilitates the protrusion of right eye. Outer lip may be digitate and sometimes with inner plications. Umbilicus is lacking. Shell surface may be smooth or may have axial and spiral threads, and varices. Operculum is long, sharp, strong, chitinous and claw-like with a terminal nucleus. It assists in the leaping and jumping locomotion and serves as a defensive weapon to ward off predators. Head bears long and muscular eye peduncles, each one of which gives rise to a small short tentacle a little below its distal end. Eyes are well developed and have colourful irises. Foot is narrow, very muscular and is divided into an anterior prepedial sole and an elongate posterior metapodium bearing the operculum. Mantle bears pallial tentacles and its cavity consists of a long narrow osphradium. Proboscis is long and thin.



**Figure 4** (A-F) Some marine conchs in Myanmar: (A) *Strombus marginatus* Linnaeus, 1758; (B) *S. microunceum* Kira, 1959; (C) *S. mutabilis* Swainson, 1821; (D) *S. pulchellus* Reeve, 1851; (E) *S. sinuatus* Humphrey, 1786; (F) *S. thersites* Röding, 1798. Scale bars=7 cm.



**Figure 5** (A-B): Some marine conchs in Myanmar: (A) *Strombus urceus* Linnaeus, 1758; (B) *S. variabilis* Swainson, 1820. Scale bars=7 cm.

**Habitat, biology, and fisheries:** Tropical to subtropical and often gregarious animals, mainly living in shallow water, on sandy, muddy or rubble bottoms or on marine grassflats. Very active, using their narrow foot and strong operculum in a leaping locomotion and as a defensive weapon. Mostly herbivores, browsing on delicate algae, or swallowing sand and detritus to digest the decomposing plant matter. Sexes separate, the male frequently smaller than the female. Fertilization internal. Eggs numerous, laid in gelatinous, tubular, tangled masses, and hatching as planktonic larvae. Strombidae are commonly collected for food in the area, and may be of economic importance locally.

**Distribution:** Widespread in the Indian Ocean, Andaman and Nicobar Islands, from Gulf of Oman to Myanmar and Thailand; Indo-

West Pacific, from central East Africa, including Madagascar and the southern Red Sea, but not in the northwestern Indian Ocean, to Melanesia; north to southern Japan, and south to northern Queensland and New Caledonia. 17 In Myanmar, Rakhine Coastal Region: Andrew Bay (Pearl I., Kathit I., Ponenyat Gyaing and Maung shwe lay Gyaing); Ayeyawady Delta and Gulf of Martaban Coastal Region: Mon coastal areas (Kyaikkhami, Kawdut and Kyungyi I.); Taninthayi Coastal Region: Dawei coastal areas (Kampani, Hmyawyt, Thabawseik and Maungmagan).

**Utilization:** Commercially fished for food in many parts of South East Asia. In the Philippines, shells are traditionally used by fishermen as sinkers for nets. Locally collected for food and shell used in shellcraft. 17 In Myanmar, mainly collected for shellcraft, especially in Rakhine and Taninthayi coastal regions. Locally collected for food, conch species is not rare in the local markets of the coastal populations. Some islanders in Myeik Archipelago also utilized conch shells for preparing indigenous medicine and decorative materials for earthenware (Table 1).

In Myanmar, the Strombidae is the second largest gastropod family is well represented by four genera with many species. Although the family is rich in species variety, the number of population is not much, or even rather scarce. For example many species belonging to the genus *Strombus* occur singly and they are solely recorded from their localities. The common species with high frequency are *S. luhuanus*, *S. canarium*, *S. japonicus* and *S. campbelli*. *S. labiatus* and *S. urceus* are inhabitants of Rakhine Coastal Region occurring abundantly there. But they are also found in Maungmagan and fewer in number. The other species occur relatively rare. However, the family on the whole has its relatives occurring in Indian Ocean, Indo-West Pacific region. A single species *Strombus latus* Gmelin, 1791 occurring in the Eastern Central Atlantic region.<sup>20</sup>

The substance of conch shells, being composed almost entirely of calcium carbonate, has led to yet another series of uses. Calcined shells make the finest and purest lime and this has been used in making a very fine glaze for pottery. Especially fine glaze for making an enamel for clock faces was obtained from conch shells.

Classification of conch shells assemblage by using dendrogram was shown in figure 6. The similarity cluster indicated the presence of 1-3 major groups based on shell number in species with roughly similar abundance and constructed with 19 clades and 20 leaves. The binary similarity coefficient analysis of Sorensen similarity index (Ss) values comparing distribution range between species were recorded and they ranged from 18 (minimum similarity) to 78 (maximum similarity). Regarding to shell assemblage in Myanmar coastal water, based on a cluster analysis, it illustrated the widely distribution of the majority of conch shells because the sampling sites appearing similarity in shell groups and their abundance tended to be located adjacent to each other.

The conch shells have an extensive range and inhabits most of the relatively shallow water and sheltered bay from Rakhine to Taninthayi Coastal Regions. The commercial fishery is centered on suitable areas from Andrew Bay to Maungmagan, with small local fisheries existing to the north and south. The bulk of the catch is from Maung shwe lay Gyaing and Kyungyi Island waters. Kampani at Dawei coastal area, Taninthayi Coastal Region, is an especially prolific source of conch shells. The less important conch shell, *S. gibberulus*, ranges from Kyaikkhami to Hmyawyt area. This species tends to be almost entirely oceanic, whereas this shell thrives best in estuarines where salinities range from oceanic to mid-brackish.

**Table 1** Systematic of conch shells in some coastal areas of Myanmar

Symbols: F, Food; Sc, Shellcraft; S, Sinkers for net; M, Medicine; D, Decorative items

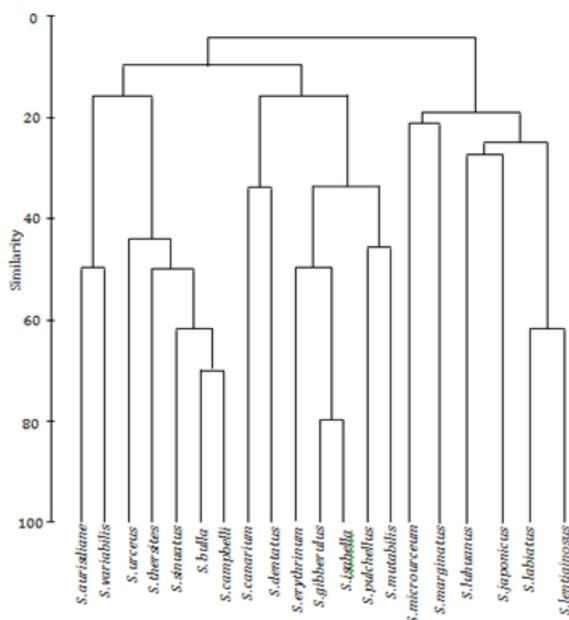
<b>Phylum:</b> Mollusca Linnaeus, 1758	
<b>Class:</b> Gastropoda Cuvier, 1795	
<b>Order:</b> Mesogastropoda Thiele, 1929	
<b>Family:</b> Strombidae Rafinesque, 1815	
<b>Genus:</b> <i>Strombus</i> Linnaeus, 1758	
<b>Species:</b>	<b>Local utilization</b>
<i>S. aurisdiane</i> Linnaeus, 1758	F, Sc, S, M, D
<i>S. bulla</i> (Röding, 1798)	F, Sc, S, M, D
<i>S. campbelli</i> Griffith & Pidgeon, 1834	F, Sc, D
<i>S. canarium</i> Linnaeus, 1758	F, Sc, S, M, D
<i>S. dentatus</i> Linnaeus, 1758	F, Sc, D
<i>S. erythrinum</i> Dillwyn, 1817	F, Sc, D
<i>S. gibberulus</i> Linnaeus, 1758	F, Sc, D
<i>S. isabella</i> Lamarck, 1799	F, Sc, D
<i>S. japonicus</i> Reeve, 1844	F, Sc, D
<i>S. labiatus</i> (Röding, 1798)	F, Sc, D
<i>S. lentiginosus</i> Linnaeus, 1758	F, Sc, S, M, D
<i>S. luhuanus</i> Linnaeus, 1758	F, Sc, D
<i>S. marginatus</i> Linnaeus, 1758	F, Sc, D
<i>S. microunceum</i> Kira, 1959	F, Sc, D
<i>S. mutabilis</i> Swainson, 1821	F, Sc, D
<i>S. pulchellus</i> Reeve, 1851	F, Sc, S, M, D
<i>S. sinuatus</i> Humphrey, 1786	F, Sc, S, M, D
<i>S. thersites</i> Röding, 1798	F, Sc, S, M, D
<i>S. urceus</i> Linnaeus, 1758	F, Sc, D
<i>S. variabilis</i> Swainson, 1820	F, Sc, D

**Table 2** Habitat of sampling site in some coastal areas of Myanmar

Sampling site	Habitat
Andrew Bay area (Rakhine Coastal Region)	
Pearl I.	Sandy bottoms of coral rubble and seagrass areas.
Kathit I.	Coral reef areas.
Ponenyat Gyaing	Coral-sand bottoms in clear water, with rocks and seaweeds.
Maung shwe lay Gyaing	Algal bottoms, coastal lagoon and protected bay.
Mon coastal area (Between the Deltaic and northern Taninthayi coast)	
Kyaikkhami	Muddy shallow water and sandy patches.
Kawdut	Sandy patches of hard substrate and algal bed.
Kyungyi I.	Clear muddy sand and shallow water.
Dawei coastal area (Taninthayi Coastal Region)	
Kampani	Clean sandy bottoms, algal bottoms, near coral reefs and sublittoral.
Hmyawyt	Shallow water bottoms of coral reef areas such as sand flats, coral sand, or dead coral.
Thabawseik	Sandy lagoons or in muddy sand bottoms.
Maungmagan	Clean sandy bottoms.

**Table 3** Distribution of conch shells in some coastal areas of Myanmar

Species	Zonal distribution			
	Upper tide	Mid tide	Low tide	Subtide
<i>S. aurisdiane</i>			—————→	
<i>S. bulla</i>			—————→	
<i>S. campbelli</i>	—————→			
<i>S. canarium</i>		—————→		
<i>S. dentatus</i>	—————→			
<i>S. erythrinum</i>			—————→	
<i>S. gibberulus</i>	—————→			
<i>S. isabella</i>		—————→		
<i>S. japonicus</i>	—————→			
<i>S. labiatus</i>	—————→			
<i>S. lentiginosus</i>		—————→		
<i>S. luhanus</i>		—————→		
<i>S. marginatus</i>	—————→			
<i>S. microureum</i>		—————→		
<i>S. mutabilis</i>	—————→			
<i>S. pulchellus</i>			—————→	
<i>S. sinuatus</i>			—————→	
<i>S. thersites</i>			—————→	
<i>S. urceus</i>		—————→		
<i>S. variabilis</i>	—————→			



**Figure 6** Dendrogram of similarity of marine conchs collected at 11 survey sites in Myanmar.

### Conclusion

There were 20 species of conch shells collected from some coastal

areas of Myanmar from 2005 to 2017. The identification is done on the basis of external morphological characters. Outer surface of shell sometimes with Vermetid and Hipponicid gastropods, or more or less covered with green algae, bryozoans, and other marine growths. The Strawberry conch *S. luhanus* is highest species frequency and the Gibbose conch *S. gibberulus* is lowest populated in study areas. During the study, the distribution of conch shells widely disperses along the intertidal and shallow sublittoral to a depth of about 55 m. In some places, a distinct form, often considered as *S. aurisdiane*, occurs nearer to the mainland and in muddier environments. The species distribution and study areas were correlated with minimum and maximum similarity of shell assemblages. Taninthayi Coastal Region is highest distribution and followed by Rakhine Coastal Region and Ayeyawady and Gulf of Martaban Coastal Region, respectively. This study contributes a baseline data for the observation of seashells in Myanmar waters.

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## Conflict of interest

None.

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