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Abundance of obtuse horn shell *Cerithidea obtusa* (Lamarck, 1822) in Mon coastal area of Myanmar

Yin Nwe OO and Naung Naung OO

Abstract
The study on the abundance of obtuse horn shell *Cerithidea obtusa* (Lamarck, 1822) was conducted in estuarine water of Mon coastal area with the aim to get more effective data for shell fishery ecology aspects in this area. Shell samples were collected from Ahlyat coastal water in the north, Zeegone coastal water in the middle portion, and Sitaw coastal water in the south of Mon coastal water during the period of March 2018 to February 2019. A total of 1287 individuals/m^2 of obtuse horn shells were collected in the study areas. Zeegone coastal water has the highest abundance and also the highest average number per station. Sitaw coastal water and Ahlyat coastal water were the second and third ranks. Based on percentage frequency of occurrence, Sitaw coastal water was the highest percentage followed by Zeegone and Ahlyat. The relationships between obtuse horn shells and constancy have not been different due to positive condition of shell abundance in three sampling areas. Regarding to shell assemblage in Mon coastal water, based on transect and quadrat abundance, it illustrated the patchy distribution of the majority of obtuse horn shell because the stations appearing similarity in shell groups and their abundance tended to be located adjacent to each other.

Keywords: Abundance, crustacean larvae, Mon coastal water, Myanmar

Introduction
Gastropods are the largest and most diverse group of molluscs (Some 50, 000 species have been described). They occur at all levels of the sea, in brackish-water, fresh water and on land [1-2]. The molluscan fauna of mangrove ecosystem is relatively poor in species, but the family Potamididae is usually present. Members of this family can be very abundant and are easily found on the trunks and roots of mangroves and on the substrate beneath the trees [3-4]. The mangrove ecosystems are rich in organic matter and nutrients and provide food, substrate and shelter for Potamididae. These snails may serve as bio-indicators of health and ecological changes in the mangrove ecosystem and bio-filters in waste water [5]. Some potamidids are also used as a food source for human [6-8].

Potamidid of the obtuse horn shell *Cerithidea obtusa* Lamarck, 1822 is common intertidal snail, which lead an amphibious existence in muddy, estuarine habitats. Largely confined to tropical and subtropical regions, they are conspicuous members of the fauna of mangrove swamps and salt marshes where they graze on detritus and microalgae [9].

Studies of Potamididae have been done based on taxonomic, behavioural and ecological works in many regions. The taxonomy of all the known Indo-Pacific Potamididae is now well understood as a result of recent morphological and molecular work [10]. In Myanmar especially, this study have been reported by several researchers based on morphological work. In ecological and behavioural works, study about these snails have been done by several researchers from many regions and also Myanmar. However, no study has reported about the obtuse horn shell in mangrove and mudflat of the Mon coastal area. Although taxonomic, behavioural and ecological studies of potamidid snails have been reported in several regions in Myanmar, but that there remains a need for local studies in order to test and explain (for regional workers) the taxonomic characters provided by these monographs, and to study the poorly known ecology of the species. The purpose of this study is to know the ecological aspects of obtuse horn shell in the Mon coastal area.

Materials and Methods

Study area

The southeastern portion of the central deltaic area comprises the coast of Mon state. Here, the Thanlwin River opens into the Gulf of Martaban and Bilukyun (Giant Island) lies at its mouth. Mon coastal area is located between (Lat. 15° 10' N and 17° 30' N; Long. 96° 46' E and 98° 15' E) with a unique ecosystem which extends 320 km from the mouth of Sittaung River in the north to Kyungyi Island, Ye Township in the south. The samples were collected from Ahlyat (Lat. 16° 37' N, Long. 97° 27' E) at Paung Township, Zeegone (Lat. 15° 10' N, Long. 96° 46' E) at Chaungzone Township and Sitaw (Lat. 15° 11' N, Long. 97° 48' E) at Ye Township in Mon coastal area (Fig 1).

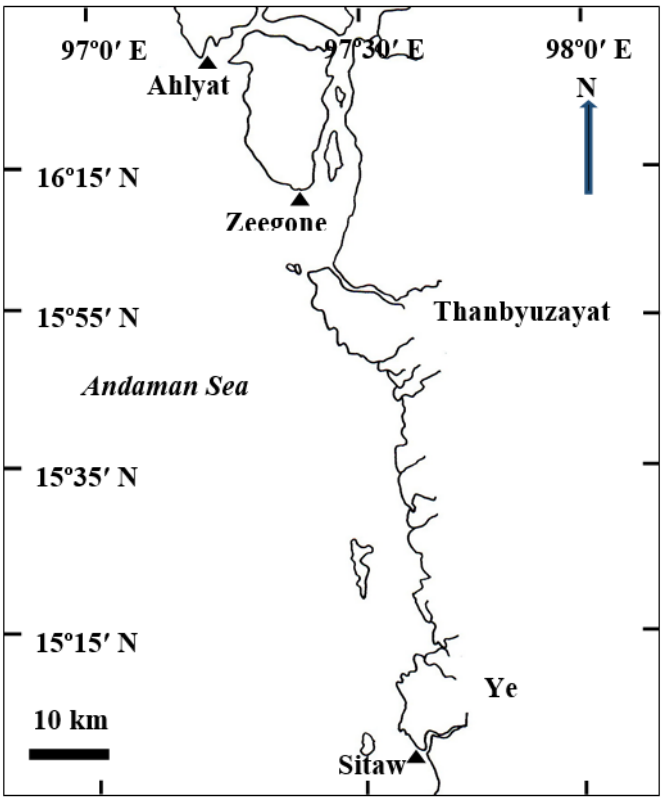

Fig 1: Map showing the sampling sites of obtuse horn shell in Mon coastal water

Field sampling and laboratory study

Samples of the obtuse horn shell were collected from upper tidal level to lower tidal level within the intertidal mudflat along the Ahlyat, Zeegone and Sitaw coastal areas, Mon State during March 2018 to February 2019. In this study was used the quadrat (50 cm × 50 cm) which divided into a (10 cm × 10 cm) grid made of aluminium for light and durable (Fig 2). For each site, at least 10 transects of 20 meters length are lined (Fig 3). Some of the specimens were preserved in 10% formaldehyde-seawater. The epifaunas were removed by soaking the shells in a solution of caustic soda. External morphological structures used as taxonomic criteria of the shell were photographed with a digital camera and processed using Adobe Photoshop CS 7. Local distribution of this shell was arranged from the voucher specimens examined. Zoogeographical distribution of each species was prepared with the data from the literature available. Ecological notes and associated species of these barnacles were also recorded in the field. Determination of the constancy of occurrence was based on the ecological index proposed by Dajoz (1983) cited by Schifino *et al*. [11].

$$C = P/Q \times 100$$

Where: C = Constancy of occurrence of the species (%), P = Number of samples where the species occurred, Q = Total number of samples. The species were then divided into three categories: Constants (When C > 50%), Accessories (When 25% ≤ C ≤ 50%) and Accidental (When C < 25%).

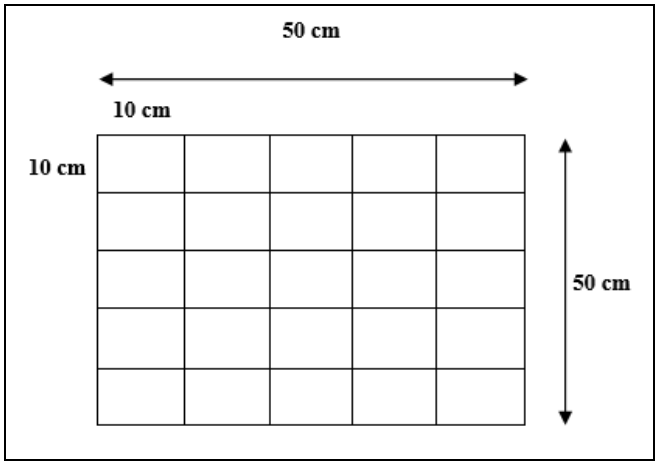

Fig 2: Sampling quadrat (50 cm × 50 cm) with (10 cm × 10 cm) grid

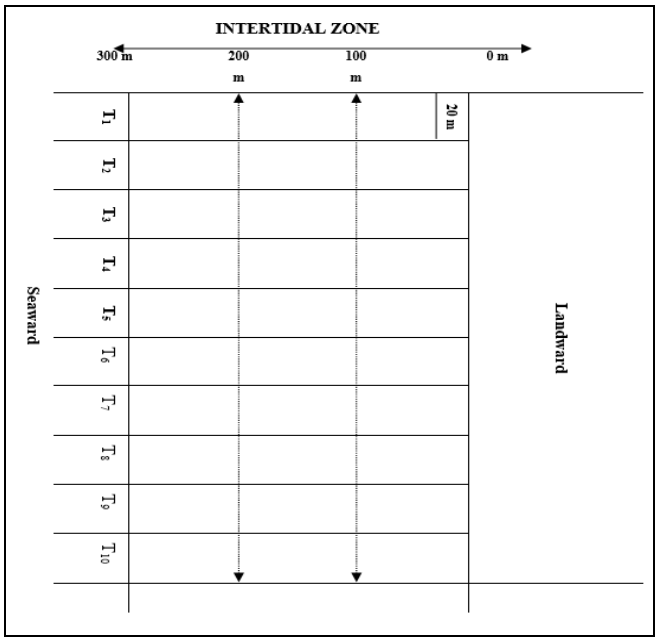

Fig 3: Systematic sampling of obtuse horn shell in Mon coastal area

Results

Systematic of obtuse horn shell in Mon coastal area

Identification of the specimen was done based on several identification books and also from the results of several researchers. The description of species are based on the literatures, which have been modified according to present observations.

Phylum: Mollusca Linnaeus, 1758

Class: Gastropoda Cuvier, 1798
Order: Mesogastropoda Thiele, 1929
Family: Potamididae Adams, 1854
Genus: Cerithidea Swainson, 1840
Species: C. obtusa Lamarck, 1822

Family potamididae adams, 1854
Shell thick and solid, tapering, high-conical, with many flattened or slightly convex spire whorls. Sculpture generally coarse, with spiral grooves or cords and often axial ribs, giving a reticulated to nodular aspect. Axial varices sometimes present. Periostracum usually well developed, brownish to corneous. Aperture relatively small, with a short and deep anterior siphonal canal. Outer lip often thickened and more or less flaring. Operculum rounded, corneous, with many spiral coils and a sub central nucleus. Head with a pair of tentacles, abruptly narrowing distally and bearing eyes at or above their thickened bases. Foot rounded in front and obtuse behind.

Genus *Cerithidea* Swainson, 1840
Shell large (to 61 mm), delicate to solid, elongate, spire decollate; sculpture of axial ribs, one developed as prominent ventrolateral varix on body whorl (rarely weak or absent) and weakening thereafter; varices almost always absent on spire whorls; spiral ridges present on base, present or absent above periphery; aperture circular, peristome flared and thickened in adult, planar or slightly sinuous, with short anterior canal and slight posterior groove; columella straight or slightly twisted, lacking folds; colour often with spiral bands.

References: Tantanasiriwong 1978: 7, fig. 70; Poutiers 1998: 450, fig. 6; Subba Rao 2003: 136, pl. 22, figs. 5 & 6; Naung Naung Oo 2012: 166, fig. 65; Hossain *et.al* 2014: 11, pl. 4; Reid 2014: 27, fig. 6; Yolanda, Asiah and Dharma 2016: 160, fig. 3a. [7, 8, 10, 12-15].

Synonym: *Potamides obtusus* (Lamarck, 1822).

FAO name: Obtuse horn shell.

Common name: Mud whelks, Mud creeper, Blunt creeper.

Local name: Kha-yu-hpin-wine, Ar-ni (Mon State); Kha-yu-osoke (Taninthayi Region).

Shell characters: Shell medium sized, with a moderately high conical spire and broad rounded base. Spire whorls convex, with moderately deep suture, 6 or 7 rounded spiral cords crossed by stronger, relatively broad axial ridges, and forming a pattern of rounded nodules. Apical part of spire always broken off. Body whorl wide, rounded at periphery, with axial ridges fading away and with 12 to 15 fine spiral cords on base. An indistinct ventrolateral varix present on the left ventral side of body whorl. Aperture wide, subcircular in outline, without a wing-like expansion at posterior end. Outer lip thickened and flaring, with a tongue-shaped anterior end produced over the siphonal canal. Columella narrow, without internal spiral ridges. Anterior siphonal canal short, open and oblique. Colour: outside of shell brown or dull purplish brown, with a brighter zone just below the suture; base plain brown or yellowish with a darker brown zone. Aperture brownish, outer lip of mature specimens cream. Animal: head and base of tentacles grey with pale yellow spots; snout dark grey with 3 transverse bands of orange red, the 2 posterior bands wavy or interrupted and with a broad black band between; eyes with black surround and red ring; tentacles pinkish grey, darker at base; sides of foot dark grey with red spots and red margin; mantle cream (red colour fading to dark pink in ethanol preserved specimens) (Fig 4 A).

Size: Maximum shell length 6 cm, commonly to 5 cm.

Fig 4(A-F): A) External shell structure of obtuse horn shell, B-C) Shell collection from natural ground, D) Shell attached on mangrove bark, E) Shell creeping on mudflat, F) Shell selling for local markets.

Habitat, biology, and fisheries: Common in mangrove swamps, on roots and branches above the substrate, or on mud tidal banks (Fig 4 D). Animals often concentrate in the wettest spots, when the mud bottom is partly dry at low tide (Fig 4 E). This species serves commonly as food in Southeast Asia and Indonesia.

Distribution: Indo-West Pacific, from Madagascar and India to eastern Indonesia; north to the Philippines and south to northern Queensland [7].

Abundance of obtuse horn shell in Mon coastal area
Mon coastal area is rich in brackish water molluscs. In this study, 1287 individuals/m^2 of obtuse horn shell collected from transect sampling lines at mudflat and mangrove swamp of which 394 individuals/m^2 in Ahlyat, 468 individuals/m^2 in Zeegone and 425 individuals/m^2 in Sitaw coastal areas (Tables 1, 2 and 3). *Cerithidea obtusa* lives on muddy-sandy substrata in intertidal and supra-tidal estuarine habitats. Although most obtuse horn shells are immersed in water during very high tides, adults tend to stay above the high

water mark and may be found almost a meter above the high tide zone where they lie beneath or crawl up the vegetation bordering the water.

Zeegone sandy-mudflat (10 transects and 110 quadrats) was highest abundance and Sitaw mudflat and mangrove swamp (10 transects and 80 quadrats) and Ahlyat mudflat (10 transects and 90 quadrats) were the second and third abundance, respectively (Figs 5, 6 and 7). According to frequency of occurrence, the highest and lowest frequency were (88.89% at T_3) and (11.11% at T_2) in Ahlyat, (90.91% at T_8) and (36.36% at T_4 and T_6) in Zeegone and (100% at T_3) and (25.0% at T_7) in Sitaw coastal areas. In constancy of occurrence, transect sampling lines of T_1, T_3, T_5, T_7, T_9 were constant occurrence, T_4, T_6, T_8 were accessories occurrence, and T_2, T_{10} were accidental occurrence at Ahlyat coastal area; T_1, T_2, T_3, T_5, T_8, T_9, T_{10} were constant occurrence, and T_4, T_6, T_7 were accessories occurrence at Zeegone coastal area; and T_1, T_2, T_3, T_5, T_{10} were constant occurrence, and T_4, T_6, T_7, T_8, T_9 were accessories occurrence at Sitaw coastal area. There was no accidental occurrence in Zeegone and Sitaw coastal areas. Quantitative analysis of obtuse horn shells were recorded in the range of 3.29-15.63 in mean population, 0 ± 5.29 in standard deviation, 0-28 in variance at Ahlyat coastal area; 5.40-9.75 in mean population, 2.43 ± 6.18 in standard deviation, 5.90-38.21 in variance at Zeegone coastal area and 5.60-13.50 in mean population, 0.71 ± 6.81 in standard deviation, 0.5-46.40 in variance at Sitaw coastal area, respectively (Table 4 and Fig 8).

In Mon coastal area, *C. obtusa* had a wide tolerance to temperature, salinity and desiccation. Salinity is normally 33‰ but varies considerably during the year due to periods of drought and heavy rainfall. The entire three study sites are rich in detritus and microalgae that form a flocculent mass at the water-substratum interface. When the area is flooded by exceptional high tides, obtuse horn shells disperse everywhere.

Table 1: Occurrence and abundance of obtuse horn shell in Ahlyat coastal area

Transect	No. of individuals in each quadrat									Frequency of occurrence (%) And Constance of occurrence
	1	2	3	4	5	6	7	8	9	
T_1		3		2	3	7			13	28 (55.56%)[1]
T_2						6				6 (11.11%)[3]
T_3	15	20	19	8	11	22		14	16	125 (88.89%)[1]
T_4		8		6			3	3		20 (44.44%)[2]
T_5	12	6	1		2	8		3	15	47 (77.78%)[1]
T_6			3			5		13		21 (33.33%)[2]
T_7		11		12	10	8			9	50 (55.56%)[1]
T_8			14		16		6		7	43 (44.44%)[2]
T_9	6	4	1	1		3	4		4	23 (77.78%)[1]
T_{10}		13						18		31 (22.22%)[3]
	33	65	38	29	42	59	13	51	64	394

Symbols: (1) Constants (when C > 50%), (2) Accessories (when 25% ≤ C ≤ 50%) and (3) Accidental (when C < 25%).

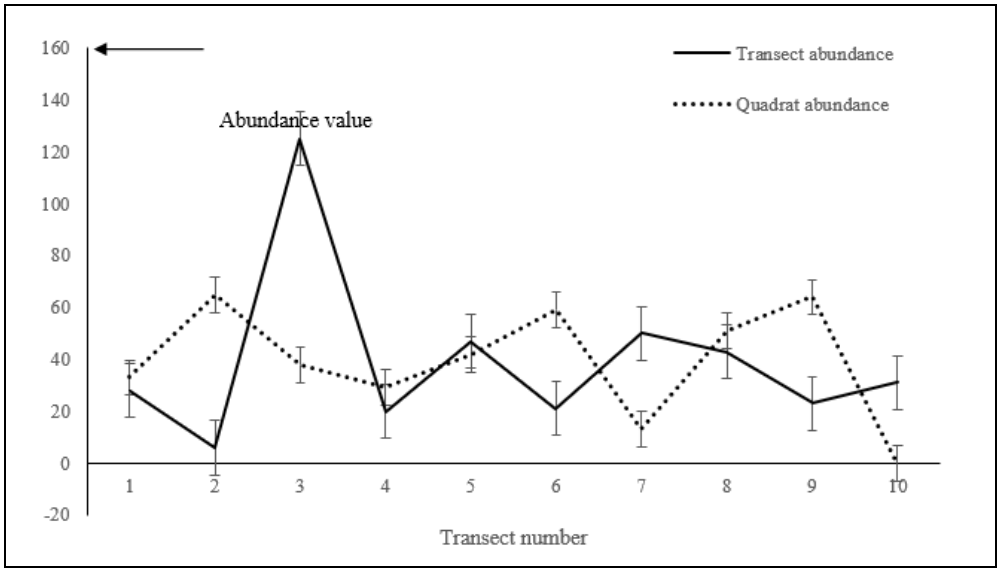

Fig 5: Transect and quadrat abundance of obtuse horn shell in Ahlyat coastal area

Table 2: Occurrence and abundance of obtuse horn shell in Zeegone coastal area

Transect	No. of individuals in each quadrat											Frequency of occurrence (%) And Constance of occurrence
	1	2	3	4	5	6	7	8	9	10	11	
T_1	3	9	3	2	9		11	4	8	10		59 (81.82%)[1]
T_2		8	2		4	3			8	7	5	37 (63.64%)[1]
T_3	4	12		22	7	6	13		11	3		78 (72.73%)[1]
T_4					9	5	8	12				34 (36.36%)[2]
T_5	4	2		7	13			6			11	43 (54.55%)[1]
T_6			6			13		7			4	30 (36.36%)[2]

T_7	5		12	4	7				14			42 (45.45%)[2]
T_8	6	2	3	5		5	3	7	2	9	12	54 (90.91%)[1]
T_9			5	7	16		7	8		8		51 (54.55%)[1]
T_{10}	5		2		9	3	10	4			7	40 (63.64%)[1]
	27	33	33	47	74	35	52	48	43	37	39	468

Symbols: (1) Constants (when C > 50%), (2) Accessories (when 25% ≤ C ≤ 50%) and (3) Accidental (when C < 25%)

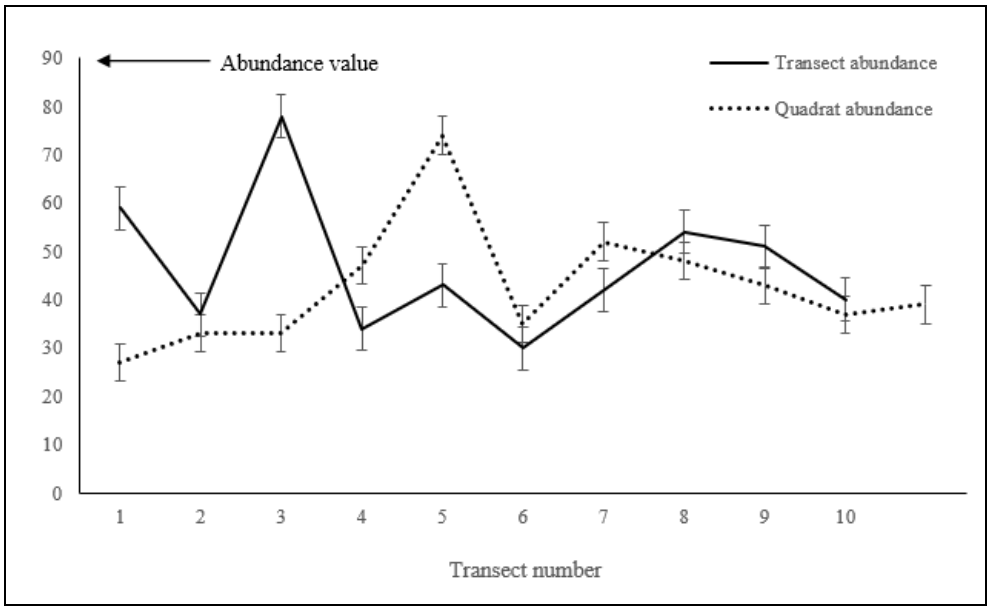

Fig 6: Transect and quadrat abundance of obtuse horn shell in Zeegone coastal area

Table 3: Occurrence and abundance of obtuse horn shell in Sitaw coastal area

Transect	No. of individuals in each quadrat								Frequency of occurrence (%) And Constance of occurrence
	1	2	3	4	5	6	7	8	
T_1	20		5	6	6	4	2	12	55 (87.5%)[1]
T_2	4	3	2	11	8				28 (62.5%)[1]
T_3	8	14	5	5	3	17	13	8	73 (100%)[1]
T_4			3	4	15	6			28 (50.0%)[2]
T_5	2	14		9	5		6	7	43 (75.0%)[1]
T_6		6		5	9		11		31 (50.0%)[2]
T_7			13			14			27 (25.0%)[2]
T_8						11	9	10	30 (37.5%)[2]
T_9	10	10	21		9				50 (50.0%)[2]
T_{10}	12		11	3	5	7		22	60 (75.0%)[1]
	56	47	60	43	60	59	41	59	425

Symbols: (1) Constants (when C > 50%), (2) Accessories (when 25% ≤ C ≤ 50%) and (3) Accidental (when C < 25%)

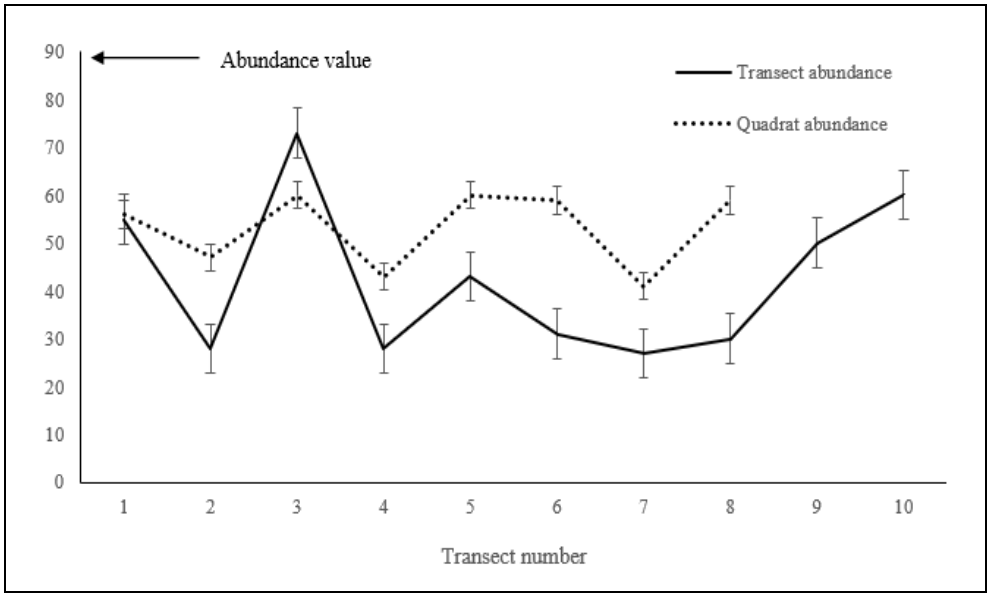

Fig 7: Transect and quadrat abundance of obtuse horn shell in Sitaw coastal area

Table 4: Quantitative analysis of obtuse horn shell in Mon coastal area

Transect	Ahlyat				Zeegone				Sitaw			
	N	Mean	SD	S^2	N	Mean	SD	S^2	N	Mean	SD	S^2
T_1	5	5.60	4.56	20.80	9	6.56	3.50	12.28	7	7.86	6.18	38.14
T_2	1	6.00	0	0	7	5.29	2.43	5.90	5	5.60	3.78	14.30
T_3	8	15.63	4.69	21.98	8	9.75	6.18	38.21	8	9.13	4.99	24.98
T_4	4	5.00	2.45	6.00	4	8.50	2.89	8.33	4	7.00	5.48	30.00
T_5	7	6.71	5.28	27.90	6	7.17	4.17	17.37	6	7.17	4.07	16.57
T_6	3	7.00	5.29	28.00	4	7.50	3.87	15.00	4	7.75	2.75	7.58
T_7	5	10.00	1.58	2.50	5	8.40	4.39	19.30	2	13.50	0.71	0.50
T_8	4	10.75	4.99	24.92	10	5.40	3.24	10.49	3	10.00	1.00	1.00
T_9	7	3.29	1.80	3.24	6	8.50	3.83	14.70	4	12.50	5.69	32.33
T_{10}	2	15.50	3.54	12.50	7	5.71	3.04	9.24	6	10.00	6.81	46.40

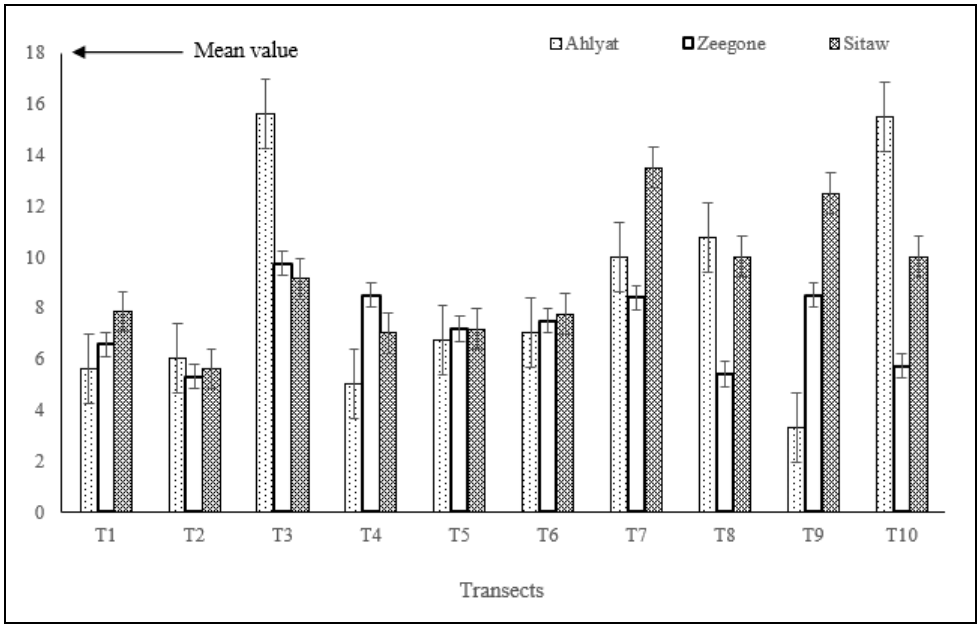

Fig 8: Mean population of obtuse horn shell in Mon coastal area

Discussion

Mon coastal environments are high biologically diverse of marine and estuarine ecosystems in Myanmar but are being degraded region-wide by human activities potentially leading to numerous extinctions. Potamididae is most common of the molluscan fauna of mangrove forests in the Indo-West Pacific area and in the past their identification has been problematic [15]. These shells play important role in mangrove and mudflat ecosystem. In general, the molluscan fauna of Myanmar is not well known and so a study of this kind is necessary. All obtuse horn shells are surface animals that occur in dense aggregations and are easily collected because of their high intertidal habitat.

External characters of obtuse horn shell are shell thick and solid, tapering, high-conical, with many flattened or slightly convex spire whorls. Sculpture generally coarse, with spiral grooves or cords and often axial ribs, giving a reticulated to nodular aspect. Axial varices sometimes present. Periostracum usually well developed, brownish to corneous. Aperture relatively small, with a short and deep anterior siphonal canal. Outer lip often thickened and more or less flaring. Operculum rounded, corneous, with many spiral coils and a sub-central nucleus. Head with a pair of tentacles, abruptly narrowing distally and bearing eyes at or above their thickened bases. Foot rounded in front and obtuse behind.

Systematic study of 280 quadrats lined by 30 transects at Ahlyat, Zeegone and Sitaw in Mon coastal area during March 2018 to February 2019. The highest densities in present observation in a population of *Cerithidea obtusa* was 468 individuals/m^2 in Zeegone coastal area. According to frequency of occurrence, the highest frequency was (100% at T_3) in Sitaw coastal area and the lowest frequency was (11.11% at T_2) in Ahlyat coastal area. Based on constancy of occurrence, Ahlyat coastal area has constant occurrence, accessories occurrence, and accidental occurrence but accidental occurrence was not found at Zeegone and Sitaw coastal areas. In quantitative analysis of shell mean population, standard deviation and variance values were related between the quadrats and transects along the sandy-mudflat and mangrove swamp.

All *Cerithidea* species are surface animals that occur in dense aggregations and are easily collected because of their high intertidal habitat. Obtuse horn shell of *Cerithidea obtusa* was high abundant in brackish-water environments, on mud flats of estuaries and in mangrove swamps near high tide line. Some *Cerithidea* species appear to comprise a tree dwelling group. Brown [16] found that *C. obtusa* formed dense aggregations on mangrove tree trunks, between 1-2 meters from the ground, but that it fed for short periods on the mud surface of the substratum. He observed a general movement of the snails from the bases of trees to the mud after spring tides. This species, when not feeding, is attached to tree trunks at its aperture by dried mucus.

Cockcroft and Forbes [17] showed that descent of *C. obtusa* to the substratum was associated with feeding. They found that snails descended at low tide periods and ascended the trees

before the following high tide and suggested that tree-climbing was a predator avoidance response. Berry [18] also suggested that this species was primarily a tree-dweller that feeds on epiphytic algae and descends to browse on the mud when the mangrove is not flooded for several days. In Ahlyat and Zeegone coastal area, *C. obtusa* lives on mangrove roots but also occurs on the mud surface. According to Brandt [19], this species feeds on algae growing at the roots and stems of mangroves. Likewise, *C. obtusa* occurs mainly on trees from 50-175 cm above the substratum but is occasionally found on the substratum of Sitaw coastal area.

Feeds on algae or detritus, which are scraped with a powerful radula. Potamididae are extensively used as food in the area, and their shell is mainly utilized for making lime. In the Philippines, they appear quite often in local markets. They are consumed steamed or boiled, and a somewhat piquant taste increases the desire for drinking [7]. In Mon coastal area, inner fleshy parts of obtuse horn shell are used as food and the outer shells are utilized for local road construction.

Conclusion

The obtuse horn shell *Cerithidea obtusa* (Lamarck, 1822) were abundantly collected from mudflat areas of Ahlyat, Zeegone and Sitaw. Many bottom dwelling shell have value as food for shore birds and local people in study areas. The abundance of obtuse horn shell in mudflat area is comparable to or even greater than in mangrove swamp. The shell community within the sampling substrate is thus considered high, but it is still not a real justification as it based on one year data collection. Many more comparative sampling truly remain to be added.

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