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Community-Led Coastal Management in the Gulf of Mottama Project (CLCMGoMP)

ANALYSIS OF THE MUD CRAB FISHERY IN BILIN TOWNSHIP, MON STATE

MRes (THESIS)

DEPARTMENT OF MARINE SCIENCE

MAWLAMYINEUNIVERSITY

MYANMAR

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MARCH 2017

CLCMGoMP Project Report: GoMP #04/17

Approved Date: June 2017

ANALYSIS OF THE MUD CRAB FISHERY IN BILIN TOWNSHIP, MON STATE

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This Dissertation is submitted to the Board of Examiners in the Department of Marine Science, Mawlamyine University, for the Degree of Master of Research in Marine Science

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March, 2017 **AYE MOE**

MRes MS-

ACKNOWLEDGEMENTS

I am greatly appreciated to Dr. Aung Myat Kyaw Sein, Acting-Rector and Dr. Me Me Sein, Pro-rector, of Mawlamyine University for their administration and giving the research facilities. I would like to greatly acknowledge to my supervisor Professor Dr. San Tha Tun, Head of Department of Marine Science, Mawlamyine University for his valuable guidance, patience and support throughout the course of this thesis and checking my identifications of mud crabs samples. I would like to thanks IUCN through the Community Lead Coastal Management Golf of Mottama Project of the Swiss Agency for Development and Cooperation (SDC) for their financial supporting throughout the research period. I would like to thanks Daw Mi Mi latt and Daw Yin Nwe Oo lecturer of department of Marine Science Mawlamyine University for their help. I would like to thanks Dr. Kenneth MacKay for his advice. I would like to thanks U Myat Thu, Assistant lecturer of department of Marine Science, Mawlamyine University, for his help. I am deeply grateful to my beloved parents for their providing various needs for my project. Finally I am also indebted to all my teachers and colleagues, Department of Marine Science, Mawlamyine University, for their help and encouragement.

ABSTRACT

The study on the fishery of crabs was carried out from Pouk Taw, Thein Chaung, ThaPyayKone, Ywar Tan Shay, Taung Sone, Kyuak Ta Lone in Bilin Township, Mon State. The samples were collected from June, 2016 to February 2017. A total of 1 species of mud crab and 4 mangrove crabs under 3 families and 4 genera were stated, 1 species of Portunidae, 2 species of Grapsidae and 2 species of Ocypodidae were recorded in the present study. There are *Scylla olivacea, Sesarma intermedian, Metaplax elegans, Uca annulipes* and *Tubuca. dessumidri*. *Scylla olivacea* are economically important for local people in this study area. A total of 120 samples of each male and female mud crabs were used for investigate the carapace width and body weight relationship and length frequency distribution described in this study. In all different six stations the collected of the mud crabs (*Scylla olivacea*) are most abundant in October, 2016 (1680 kg) and scarce in January, 2017 (50 kg). The relationship was determined as $W= 0.427 L^{2.64}$ for male and $W= 0.68 L^{2.39}$ for female.

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CHAPTER 1

INTRODUCTION

Myanmar has a long coastline about 2400 km in length which provides many habitats for a variety of Marine organisms. Mud crabs are abundant and one of the predominated species in coastal environment. The crabs depend in all habitats of intertidal regions such as mud flats and mangrove areas. Mud crabs, also known as mangrove crabs, the mud crab of the genus *Scylla* has both ecological and economic importance to the marine environment and to the coastal fishing villages.(Keenan *et al.,* 1998).

Bilin Township is situated at the north-western part of Mon State. The region provides many species of crabs in mud flat areas, inland and offshore fisheries conducted in Bilin Township. Its climatic condition also gives tendency to the abundance of crab fauna. Crabs are of great commercial value and are exported to China and Thailand.

Mud crab *Scylla serrata* and *Scylla olivacea* are important fishery production in Myanmar and Indo-Pacific region. Mud crab, Scylla species have been subjected to increase exploitation during recent years.It is regarded as a valuable commodity, with high quality meat content (Le Vay, 2001). Other crabs such as Grapsidae crabs and Ocypodidae are also found is also serving as food for many countries.

The crabs are easily caught by local populace usually by hooks or hands. Most commercial crab fisheries are small- scale operations and many village dweller conduct crab fishing at inshore areas. The crabs are freshly consumed by the local people as well as exported products. Mud crabs are highly appreciated in wide range of dishes. It is an economically important species of mangrove areas and normally found in coastal regions. In general, crabs are probably edible and rich in protein but low in fats (George *et al* 1987). Mud crab fishery takes place mainly in the intertidal zone along the coast line, estuaries, lagoons and riverbanks

of mangrove and coastal areas. To capture berried females crabs, should have to know the knowledge of their migration route. Most of the female crabs swam out to the sea to breed.

Male mud crabs sometimes exhibit dark sports or abrasion on their underside and first walking legs due to their shell rubbing that of the female while they are coupled together for the days preceding the female moult and subsequent mating. These "mating scars" provide a visual indicator that the male has recently mated, thereby providing information on the health of the fishery. Grubert, *et al*. (2007).

Mud crabs are prized by recreational fishers for their impressive size and delicious taste. Their powerful claws can be dangerous and mud crabs need to be handled with care. Females are often called 'jennies' and males 'bucks'. In Western Australia there are two species of mud crab. Mud crabs prefer sheltered water such as estuaries and mangrove areas (Fisheries Fact sheet 2013). They are highly tolerant of variations in water salinity and temperature. Although many occupy burrows in the intertidal zone (where the land is exposed at low tide), most adults live in areas that are below the low tide mark but are still shallow, where they bury themselves in the mud during the day. (Fisheries Fact sheet 2013)

Mud crabs are mostly found in estuarine and sheltered coastal habitats large population are generally associated with established mangroves are euryhaline (Hill, 1996). Mud crabs can tolerate a wide range of salinities, ranging between 1 and 42 ppt.Habitat of *Scylla* species, *S. serrata* associated with mangrove forests inundated with full salinity oceanic water for the greater part of the year, can tolerate reduced salinity. *S. paramamosain* associated with various habitat including shallow coral rubble; shallows subtidal flats and estuarine ponds; mangrove forests. *S. olivacea*associated with mangrove forests and coastlines inundated with reduced salinity seawater during the wet season. *S. tranguebarica* associated with mangrove forests and coastlines inundated with reduced salinity seawater for part year. (Colin Shelley and Alessandro Lovataelli, 2011).

Naturally, mud crabs are best described as opportunistic feeders; they are carnivores and herbivores scavengers and cannibal. They eat just about anything that they encounter including bivalves, worms, fish, plant material and smaller crabs. When water temperature drops to around 12˚ C mud crabs feeding rate decrease. As water temperature continues to drop to 7˚C they stop feeding and become dormant. During the hot season, as water temperature rises up to 35˚C, they erect their body to keep the abdomen away from the sediment when crawling on our exposed surfaces and, as water temperature increases above 39˚ C they gradually death.

A crab's growth curve is not a continuous, but results from a series of moults that happen when it reaches the size of its current shell. Moulting is triggered by hormones. A new cuticle (hard protective layer) is secreted under the old shell. The crab rapidly absorbs water, splitting its shell along suture lines, then backs out of the old shell. (Fisheries Fact sheet 2013)

At the present, an attempt has been made on the study of mud crabs fishery in Bilin Township. The crab samples were collected from Pouk Taw, TheinChaung, ThaPyayKone, Ywar Tan Shay, TaungSone and Kyuak Ta Lone. The aims of the present study are:

- To know the distribution of mud crabs species in Bilin Township, Mon State.
- to observe their abundance in the study area
- to assess the distribution of size-group in different months, and
- to determine the relationship between carapace width and length weight relationship of mud crab
- to know the biomass of production of mud crabs in Bilin Township

CHAPTER 2

LITERATURE REVIEW

Alcock (1968) recorded materials for Carcinological fauna of India, including the brachyuran oxyrhyncha. Heasman (1980). Found 20-80mm juvenile mud crabs in reed beds associated with macrophytes. He suggested that juveniles seek sheltered conditions and are found in small creeks, under stones, in seagrass and around pneumatophores of mangroves. De Bruin *et.al* (1994) illustrated that the Marine Fishery Resources of Sri Lanka including two species of genus Portunus under family Portunidae such as *Portunus pelagicus* and *Potunus sanguinolentus* and one species of genus Scylla under family such as *Scylla serrata* was described. Each major resources group in introduced by general section technical terms, FAO (English) names, local names commonly used, maximum size habitats and interest to fishery were described.

Keenan *et al,* (1998) identified four distinct species in the genus Scylla in Australian waters but *S. paramamosain* and *S. tranquebarica* are not found in Australian waters. *S. olivacea*, the brown mud crab, is found within Queensland waters in the northern part of the Gulf of Carpentaria. Keenan *et al, (*1999) Studied on Crabs of the genus Scylla are strongly associated with mangrove areas throughout the Pacific and Indian Oceans.

Carpenter (2002) reported that the living marine resources of the Western Central Atlantic including the true crab species belonging to only 6 families: Cancridae, Gecarcidae, Ceryonidae, Mennipidae, Ocypodidae occurring in Central Atlantic Ocean including the Gulf of Mexico and Caribbean Sea: these waters collectively comparise FAO fighing Area 31. In this field guide, two species of genus *Cancer* under the family *Cancridae* such as *Cancer borealis Stimpson* and *Cancer irroratus* Say, and one species of the genus *Cardisoma* such as *Cardisoma guanhumi* Latreili under family *Gecarcinidae*. One species of the genus *Chaeon* such as *Chaeon fenneri* Maning under family Geryonidae and Holthuis, one species of the

genus *Ucides* such as *Ucides cordacous* Linnaeus under family *Ocypodidae*, 9 species of the genus *Callinectes* and one species of the genus *Arenaeus* under family Portunidae, such as *C. bocourti* Milne Edwards, *C. danae* Smith, *C. exasperates* Gerstaecker, *C. larvatus* Ordway, *C. maracaiboensis* Taissoun, *C. ornatus* Ordway, *C. rathbunae* Contreras, *C. sapidus* Rathbun, *C. similis* Williams, *A. cribraius* Lamark. Each resources group is introduced by general remarks on the groups, an illustrated section on technical terms and measurements and key or guide to orders or family. Each family diagnostic characters, biological and fisheries information; notes on similar families occurring in the area were also described.

Peter *et al*, (2003) described a new species of Metaplax, *M. gocongensis*, this species is distinguished from congeners by the unique form of the infra orbital stridulatory crest, and the presence of prominent black fixed slender spines on the outer face of the merus of the chelipeds. This species has had a long history of use as food in South Vietnam, and is now potentially threatened by increasing riparian habitat modification. Lavilla-Pitogo, *et al*,(Eds.). (2004) introduced the Diseases in farmed mud crabs *Scylla* spp. They presented the disease problems commonly observed in larvae, juvenile and adults and provided simple diagnostic background for hatchery and farm technicians. They also introduced techniques for disease prevention and increase awareness about hazards of disease to the operation and the environment.

Zannatul Ferdoushi 1a and Zhang Xiangguo, 2.(2009) The present study was conducted in two different location; Paikgachha and Koyra two sub-districts under the Khulna district, from February to April 2009 during dry season by using a structure and pre-tested interview schedule in order to assess their current practice with its profitability analysis. A total of 50 households from Paikgachha and Koyra (25 from each) were randomly selected. Bouchard, *et al*. (2011) investigated 42 species of crabs land, mangrove and fresh water decapods from Mayotte Region. Shelley and Lovatelli, (2011) Aquaculture Officer, Aquaculture Service, FAO Fisheries and Aquaculture Department Rome, Italy.studied four species of mud crab, *Scylla*

serrata, S. tranquebarica, S. paramamosian and S. olivacea. that are the focus of both commercial fisheries and aquaculture production throughout their distribution and they informed on mud crab biology, hatchery and nursery technology, grow-out systems, disease control, processing and packaging has been collated in this manual to provide a holistic approach to mud crab aquaculture production.

In Myanmar there have been a number of thesis projects on marine crabs. The relevant works are summarized here. KhinKhin Thant (1986) worked on the taxonomy and distributionof Myanmar marine crabs (Decapoda : Brachyura). San SanLwin (1968) gave the taxonomic descriptions on the marine crabs of Chaungtha area on the RakhineCoast of Pathein West Township. LwinLwin (1988) carried out the taxonomic study of some crabs from Laung-Lone Township. KhinMar Wai (1995) recorded the taxonomic study of crabs in Gwa area.Sandar Win (1997) studied the taxonomic structure of a total 27 crab species in Mon State. In addition, EiEiHtwe (2007) studied economic importance of marine crabs in Mon State. Nyein Chan (2012) studied on the sand dwelling macro benthic fauna of Zeegone coastal area, Belukyun Island, Mon State. ZinMohMohTun (2014) Studied on the Brachyuran crabs in Ye coastal areas, Mon State. NyuntSandarAung (2016) Studied on mangrove crab fisheries in Mon and Taninthayi Coastal areas. She described a total of 24 species of brachyuran crabs under 4 families, 14 genera have been identified.

CHAPTER 3

MATERIALS AND METHODS

3.1 Study sites

In the present study the crab samples were collected along the mud flats in Bilin Township, Mon State. The Samples were collected from June (2016) and February (2017). The samples were collected in 6 stations including Pouk Taw (Lat. 17˚ 11.4790'N and Long 097˚ 06.7734'E), TheinChaung (Lat 17˚05.8982' and Long 097˚ 06.3472'E), ThapyayKone (Lat17˚05.70'N and Long097˚06.6476'E), Ywar Tan Shay(Lat. 17˚ 08.9560'N and Long 097˚ 05.6104'E), TaungSone (Lat 17˚.196566'N and Long 97˚.135776'E) and Kyuak Ta Lone (Lat 17˚.149275'N and Lone 97˚.093321'E) in Figure (3.1).

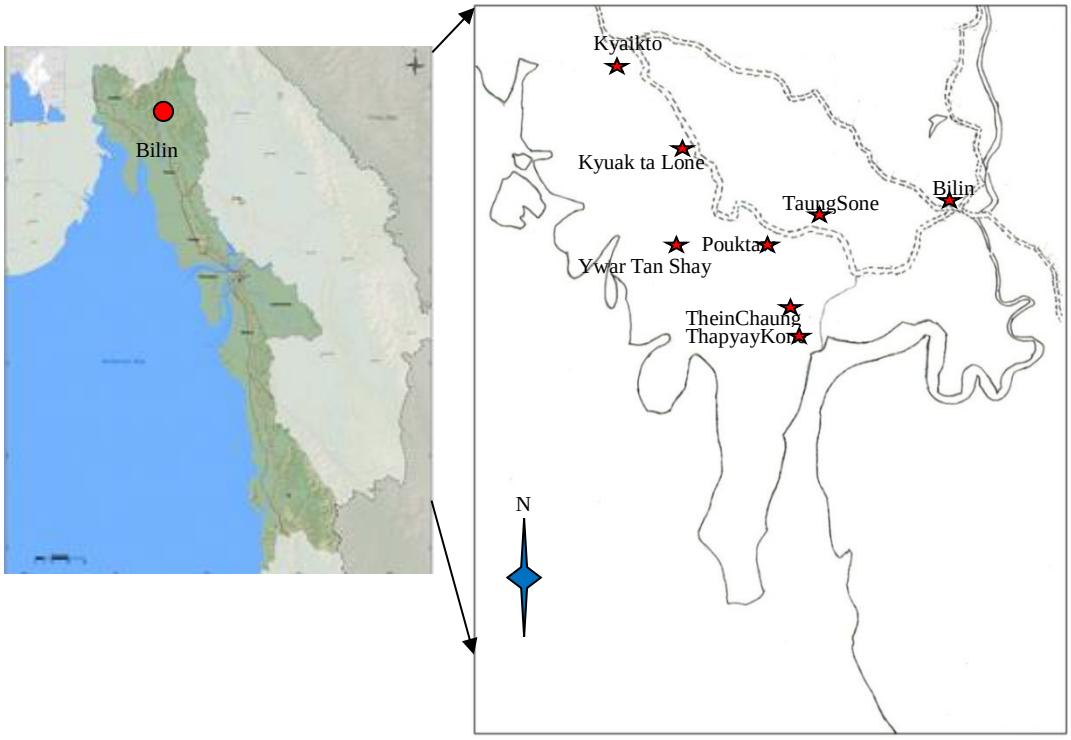

Figure 3.1 Map showing the species collecting sites in Bilin Township. 1) Pouktaw; 2) Ywar Tan Shay; 3) Thein Chaung; 4) Thapyay Kone;5) Kyuak Ta Lone; 6) Toung Sone.

3.2 Sample collection

The samples were collected from the market of villages and monthly length-weight relationship; length frequency distribution was conducted, samples were collected (randomly) in fresh condition in whole sale market of Kyuak Ta Lone village in Bilin Township. The photograph were taken in fresh condition and the carapace length (cm) were measured (for *Scylla olivacea*) by Vernier caliper. The collected samples were grouped as the seven size groups according length ranging from 5cm to 17 cm such as 3-5; 5-7; 7-9; 9-11; 11-13; 13-15; 15-17; respectively.

The weight of individual crabs was determined by the nearest gram using kilo-balance. The samples were then preserved with the 10% formaldehyde with sea-water solution, put in the plastic bottles and then carried to the laboratory of Marine Science Department, Mawlamyine University for further identification work.

3.3 Identification

Species identification up to species level was carried out using the FAO identification sheets and other identification books (Heasman, 1980; Keenan, P *et al*, 1998; Le, 2001; Grubert, *et al*, 2007; Peter, 2008; and Fisheries fact sheet mud crab 2013).

3.4 Carapace Length-weight relationship

Measurements of carapace width and body weight were carefully done for individual crabs. The carapace width was measured across the widest part of the carapace from the left to the right lateral spines by using vernier caliper. The weights (g) were taken by using kilo-balance.

The carapace width and weight relationship was calculated by the method of least squares using the parabolic equation:

$$W = \alpha L^{b}$$

W is the weight of crab

"α" is the antilogarithm of intercept

"L" is the carapace width and

"b" is the slope

CHAPTER 4

RESULTS

4.1 Identification of crabs in Bilin Township Mon State.

In the present study a total of 5 species under 4 genera, 3 families belonging to Order Decapoda under Phylum Arthropoda. The recorded species are *Scylla olivacea*, *Sesarmaintermedian, Metaplaxelegans*, *Ucaannulipes*, and *Tubucadussumieri*. The general classification of the recorded species was also presented in Table4.1.

Species identification was based on the F.A.O species identification sheets and Alcock (1985, 1900), Carpenter and Niem (1980), De Man (1988). FAO species name, local name, common name, morphological description, identification keys and some ecological aspects of each of the species were presented in the present study.

Table 4.1 Classification list of crabs in Bilin Township, Mon State.

Phylum	Class	Order	Family	Genus	No.	Species
Arthropoda	Crustacean	Decapoda	Portunidae	*Scylla*	1.	*Scylla olivacea*
			Grapsidae	*Sesarma*	2.	*Sesarmaintermedian*
				Metaplax	3.	*Metaplaxelegans*
			Ocypodidaea	*Gelesimus*	4.	*Ucaannulipes*
					5.	*Tubucadussumieri*

Gear used in crab fisheries

The mud crabs fishing in Bilin Township, Mon State areas such as Pouktaw, Thein Chaung, Thapyay Kone, Ywar Tan Shay, Taung Sone and Kyuak Ta Lone are conducted with simple gear design. There are only one type gear used in the study area is crab hook.

Fishing hook locally call ka-nan-jaid is widely used at the edge of the mudflats in the intertidal area at low tide. The hook is made of iron and rod1.8 m. The hook is lifted into a wooden handle, which is pushed into crevices and burrows along the shores of estuaries, and intertidal flats of mangrove areas to detect and capture. The crab hook cornered the crab until it grips the rod with its powerful claws. The crab could be easily drawn out from its carapace width of 8 cm and above usually caught with this gear. They are captured only during low tides. A few people engaged in this type of fishing. The imformation get by interviewing both from men and women.

Fishery status

In the study period, the collection of mud crabs is carried out 12 days per month, the working duration is 6 to 8 hours a day, caches rate is 2.4 to 12.8 (kg) per day in the study area. They walk for about 4 hours to reach fishing ground. To collect crabs, the crab fishers by using iron crab hook,5 to 10 minutes for a burrow. From a burrow, 1 or 2 crabs may be caught. They sell the collected crabs to the buyers. The information for CPUE such as fishing hour per day and total catch weight are recorded monthly from the fishermen for each village by interviewing with them.

Socioeconomic status

There are 142 to 150fishermen in all villages about 70 households and 8 of wholesale crabs market in these villages. Most people are caught crabs in the raining season and in

summer they change work the farmer. The commercial crabs are selling the whole-sale market in Kyuak Ta Lone and Toung Sone and also transport to Yangon and Thailand.

Table 4.2 A comparison of the taxonomic criteria in Crab in Bilin Township, Mon State

Sr. No	Species	Characters					
		Carapace	Anterolateral teeth	Cheliped	Palm	Dactylus	Walking legs
1.	*Scylla olivacea*	Carapace smooth convex with very low transverse ridges	Cut into nine sharply acuminate teeth of about equal size	Cheliped are large and very strong, yellowish green in dorsally and reddish dark brown in ventrally	Stout, a strong spine at the inner angle	With large and strong teeth	5^{th}pairs paddle and reddish dark brown
2.	*Metaplaxelegans*	Squarish, little convex, slightly convergent posteriorly	Short and sharply pointed	Equal, larger than walking legs	Large, subequal with merus	larger than walking legs	Long, pointed and curved
3.	*Ucaannulipes*	Squarish, Without longitudinal white bands	Short and sharply pointed	Equal, smaller than walking legs	Very small, smooth, subequal with merus and carpus	Very small, cylinder, smooth	Long, pointed and curved
4.	*Tubuca. dessumieri*	Squarish, length of carapace a little more than two-third of the greatest breadth	Long and sharply pointed	Unequal, more than 3 times longer than carapace	Cylinder, smooth, longer than merus	Very long, longer than palm	Long, pointed and curved
5.	*Sesarmaintermedian*	More quadrate and less transverse	Transverse furrows that cut the antero-lateral borders in two	Chelipeds are unequal in size larger than walking legs	Large, unequal and bigger thanmerus	Larger than walking legs	Long, pointed and curved

4.2 Taxonomic Description of collected sample

Phylum – Arthropoda

Class – Crustacean

Order – Decapoda

Suborder –Reptantia

Tribe –Brachyura

Subtribe–Brachyurhyncha

Family1. Portunidae

Portunid crabs are characterized by the flattening of the fifth pair of legs into broad paddles, which are used for swimming. This ability, together with their strong, sharp claws, allows many species to be fast and aggressive predators. Carapace depressed, or little convex in (strong convex in Sphaerocarcinus), hexagonal, sometimes sub quadrate, occasionally elongate-obviate or even sub circular, but generally broader than long; the region most often not well defined, seldom are dated.

Genus *Scylla*

Carapace transverse, broad, moderately convex, with an almost unbroken surface.Front proper well delimited from the inner supraorbital angles, cut into four teeth: its breadth is between a fourth and fifth the greatest breadth of the carapace. Antero-lateral borders oblique, arched, longer than the postero-lateral, cut into nine teeth of nearly equal size. Orbit without any dorsal inclination: two nearly closed fissures in its upper wall: the inner angle of the lower border dentiform and prominent. Chelipeds massive, longer than any of the legs: arm wrist and hand with definitely placed spines: hand deep and full, not prismatic, not costate.

Legs stout, moderately compressed: in the fourth pair the merus and carpus are shortened and broadened and the propodite and dactylus are typically foliaceous for swimming.

4.2.1. *Scylla olivacea* (Herbst, 1796)

Figure 4.2.1 *Scylla olivacea*(Herbst, 1796)

Reference **:**Peter 2002: p. 60; Keenan 1998: p.233, peter 2008, p. 153.

Materials Examined **:** Bilin Township, Mon State, Myanmar, And June, 2016 To February, 2017.

Synonyms **:** *Cancer olivaceous***(**Herbst, 1796)

Common name **:**Mud crab, Mangrove crabs, and serrates crab, edible crab, and orange mud crab.

Local name: Pinla-ka-nan

Measurement: the carapace from the left to the right lateral spines by using vernier caliper (12 cm).

Diagnostic features **:** Carapace smooth convex with very low transverse ridges, a low H-shape gastric groove; the frontal cut out into 6 frontal spines with blunted and rounded tips; the median pair of frontal lobes more rounded and projecting slightly forwards of the lateral ones; 9 anterolateral teeth gently curving anteriorly with pointed tips: very low spines present

on the outer surface of wrist of cheliped andthe dorsal surface of palm. Carapace is brown to brownish green in colors chelipeds and legs rusty brown and dark orange colours.

Anterolateral teeth are into nine sharply acuminate teeth of about equal size.Chelipod are large andvery strong, yellowish green in dorsally and reddish dark brown in ventrally. Palm are stout, a strong spine at the inner angle.Dactylusare with large and strong teeth. .Lateral spines are absent andwalking legs 5thpairs paddle and dark orange and dark brown in color. Elbow has one small blunt spine or no spines at all.Claws Light brownish orange colored, claw spines have reduced or blunt prominences. Lobes: Short, broad lobes between the eyes.Walking legs may have very faint pattern on legs. Palm of cheliped usually is a pair of blunt prominences on dorsal margin behind insertion of the dactyl, inner larger than outer; may be spinousin young adults.

General ecological aspects : Inhabit muddy bottom in brackish water along the coast and mud bank in estuaries and mangrove swamps. It livesin holes which excavated long the mud bank and mangrove swamps. These crabs are caught by using iron hooks from its burrow.

Ecological Importance : The fishermen catcha large number of crabs and sellto a local crab collector (buyer) whotransports them normally Yangon and occasionally to Thailand. It is commercially important, being available in large quantities through the year.

World distribution : South China Sea, Indian Ocean, Pacific Ocean – moderately widespread, often associated with *S. tranguebarica*.

4.2.2. *Sesarma intermidian* (de Haan, 1835)

Figure 4.2.2 ***Sesarma intermidian*** (de Haan, 1835)

Reference **:** De Man 1835: p. 61, pl. 16, Fig. 5; H. Milne Edwards 1853: p.168; Alcock 1900: p. 416: Tesch 1917: Vol. 3, p, p. 162.

Materials Examined : Bilin Township, Mon State, Myanmar, And June, 2016 To February, 2017.

Synonyms **:** *Graspus*

Common name **:** Crab

Local name **:** Phone-ka-nan

Measurement **:** The largest specimen in the collection measures:

Diagnostic features : Carapace is more quadrangle and less transverses gastric regions is much more pronounced than other regions. A dark red patch is present anterior to the gastric regions.

The frontal border straight, the post frontal lobes are less prominent and much smoother, and the front is broader. Chelipedsare unequal in size. No large sub terminal spine on the inner border of the arm, not does the upper border end in a spine. Carapace and all the appendages are dark color. At the anterior middle of the carapace a red patch exists.

General Ecological aspects : Inhabit in muddy places. It is caught mainly by hands.

Economic Importance : Edible, but the villages avoid consuming it because of its unhygienic environment.

World distribution : Formosa, Korea, Hong Kong (Alcock 1900).

Family 2.Graspidae

The palm of external maxillipeds articulates either at the antero-external angle, or at the summit, or at the middle of the anterior border of the merus; the exognath is either abnormally slender or abnormally broad. The inter antennular septum is very broad. The division of the orbit into two fossae is accented. (Front of great breadth: carapace usually quadrilateral, with the lateral borders either straight or very slightly arched, and the orbits at or very near the antero-lateral angles: the buccal cavern is square and there is generally a gap, which is often large and rhomboidal, between the external maxilliipeds). Maleopening sterna. (Alcock, 1900, p. 288, 289). Carapace squarish, transervely. One species of *Metaplax*. was found in this study.

4.2.3. *Metaplax elegans* De Man, 1888

Figure 4.2.3 ***Metaplax elegans*** De Man, 1888

Reference **:** Davie (2003).

Materials Examined: Bilin Township, Mon State, Myanmar, June, 2016 To February, 2017.

Synonyms **:** *Metaplaxcrassipes*de Man, 1892

Common name **:** Crab

Local name **:** Chayshay-ka-nan

Measurement **:** The largest specimen in the collection measures:

Diagnosticfeatures **:** Carapace are squarish, little convex, slightly convergent posteriorly.Cheliped are equal, larger than walking legs. Palm is large, subequal with merus. Dactylus are larger than walking legs, lateral spines are absent and walking legs are long, pointed and curved. Carapace surface covered in minute, smooth granules, and more-or-less microscopic setae; three short oblique, granular. Dorsal carapace regions well indicated, with gastric, cardiac and intestinal regions strongly demarcated. Carapace and all the appendages are dark green color.

General Ecological Aspects : This species seems to be restricted to the intertidal silty-mud zone of the banks of rivers or rice fields subjected to tidal influence where salinity ranges from 0-15 p.p.t. During the rainy season.

Economic Importance : The local people used for culture food and duck food.

World distribution **:**Australia, South China, Japan and Adjacent Sea.

Family 3. Ocypodidae

Amphibious littoral and estuarine crabs, burrowing, and commonly gregarious. The palp of the external maxillipeds is coarse, and articulates at or near the antero-external angle of the merus: the exogonath is generally slender and often more or less concealed. The interantennular septum is generally broad, but in one subfamily (Macrophthalminae) is a thin plate. The front is usually of no great beneath, and is often a narrow lobe more or less deflexed. The orbits occupy the whole anterior border of the carapace outside the front, and their outer wall (between the far ends of the upper and lower borders) is often defective. The buccal cavern is usually large and a little narrow in front than behind, the external maxillipeds are foliaceous and usually completely close it, but if they never leave between them a wide rhomboidal space exposing the mandibles. The abdomen of the male is narrow. (Aclock, 1900, p.283)

Genus *Gelasimus*Latreille, 1817

This genus was established by latreille (1817) and has the fallowing characters.Carapace deep, sub quadrilateral but with the antero-lateral angles produced and acute and the lateral boreds more or less convergent posteriorly, occasionally sub hexagonal, a good deal broader than long, the regions never very strongly defined. The orbits are narrowish trenches occupying the whole anterior extent of the carapace between the narrow front and the antero-lateral angles, and are more or less sinuous and oblique. The eyestalks are very long and slender. The chelipeds differ greatly in the sexes. In the female, they are equal, are shorter and slenderer than the legs, and have broad tipped spoon-shaped fingers. In the male, one of the chelipeds resembles those of the female, but the other is of relatively gigantic proportions, the hand alone being often as big and heavy as all the rest of the animal. The abdomen cavity is narrow. In both sexes, it consists of seven separate segments. One species of Uca and two

species belonging to the genus Gelasimus: *Gelasimus annulipes* and *Tubuca dussumieri* have been recorded from Myanmar Coastal Waters during this study.

4.2.4. *Uca annulipes* (H. Milne Edwards, 1837)

Figure 4.2.4 *Uca annulipes* (H. Milne Edwards, 1837)

Reference **:** Peter 2008:p.241; Peer 2014, p.59, fig, 12

Materials Examined: Bilin Township, Mon State, Myanmarin June, 2016 To February, 2017.

Synonyms **:** *Cancer vocans minor***;** Ortmann

Common name **:** Fiddle crab

Local name **:** Phonekyi-ka-nan

Measurement **:** The largest specimen in the collection measures:

Diagnostic features **:** Carapace is squarish, without longitudinal white bands. This species distinguished by the sub quadrilateral carapace with moderately convergent lateral borders, the front being a fifth to a sixth its breadth. The tip of the thumb of the chelipeds appears notched-truncate due to the presence of an enlarged tooth. An oblique glandular ridge along the dentary edge of the thumb, and another along its lower edge are present.

The posterior border of the dorsum of the carapace is a good deal over half the greatest breadth of the carapace. The lateral borders of the dorsum of the carapace are only moderately convergent.Carapace and all the appendages are orange in color.

General Ecological Aspects : Abundantly found in the mudflats. When the mud flats are dry, they emerge during low tide caught by hand.

Economic Importance : Local People avoid for consumption or for utilization of any kind because of the unhygienic environment in which they live.

World distribution : Myeik, Myanmar, Andoman's, Nicobars and Sri Lanka, Malayan Archipelago, Japanese and Chinese Seas; Myanmar.

4.2.5. *Tubuca dussumieri* (H.Milne-Edwards, 1852)

Figure 4.5.5 *Tubuca dussumieri* (H.Milne-Edwards, 1852**)**

Reference : Peter 2008: p.243, fig 188.

Materials Examined : Bilin Township, Mon State, Myanmar, And June, 2016 To February, 2017.

Synonyms **:** *Uca dussurnieri*(lanchester, 1900)

Common name **:** Monk crab

Local name **:** Phonkyi-ka-nan

Measurement **:** The largest specimen in the collection measures:

Diagnostic features : Carapaces are squares, length of carapace a little more than two-third of the greatest breadth and much more or strongly defined and the raised lines that bound the dorsal plane of the carapace on each side are more curved, less rapidly convergent, and less distinct in their posterior part, which gives the carapace a much less posteriorly contracted look, and the orbits are less oblique. Cheliped are unequal, more than 3 times longer than carapace in the large cheliped the arm is long and slender. Palms are cylinder, smooth, longer than merus. Dectylus are large and strong teeth and lateral spines are absent Carapace and all the appendages are orange in color.

General Ecological aspects : This species are gregarious and lives in warrens in the mudflats. The large chelipedwas observed to scoop up mud and detritus and dump into the buccal frame. The residue was split out as round pellets. These little pellets are seen surrounding the burrows.

Economic Importance : Edible, but it is rarely eaten because of its unhygienic environment.

World distribution : Myeik, Myanmar Andomans, Nicobars andBimlipatam (Alcock 1900; Chhapgar 1956).

4.3. length (carapace width) weight relationship of male and female *Scylla olivacea*.

Totally 240 numbers of crabs (*Scylla olivacea*) in both sexes were examined to observe the length weight relationship (LWRs). For male the crab's samples ranging from 5 cm to 11.5 cm length and 20 to 360 g weight for female the crab's samples ranging from 5 cm to 15 cm length and 20 to 450 g weight were used to examine this study (Table 4.3).

The length carapace width and weight relationship of *Scylla olivacea* in this areas gave the equation as $W = 0.427L^{2.64}$, with the correlation coefficient $R^2 = 0.83$while that of the female gave the equation as $W = 0.68L^{2.39}$, with the correlation coefficient $R^2 = 0.9$. (Figure 4.3.1and 4.3.2) 4.4.3)

Table 4.3 Length-Weight relationship and related statistics of *Scylla olivacea*.

Species/Sex	n	Carapace length (cm)				Weight (g)				Regression parameters		
		min	max	mean	sd	min	max	mean	sd	a	b	r^2
Male	120	7	11.5	8.2	±1.75	60	360	128.5	±87.64	0.427	2.64	0.83
Female	120	6.5	15	8.6	±2.42	65	450	138.9	±105.5	0.68	2.39	0.9

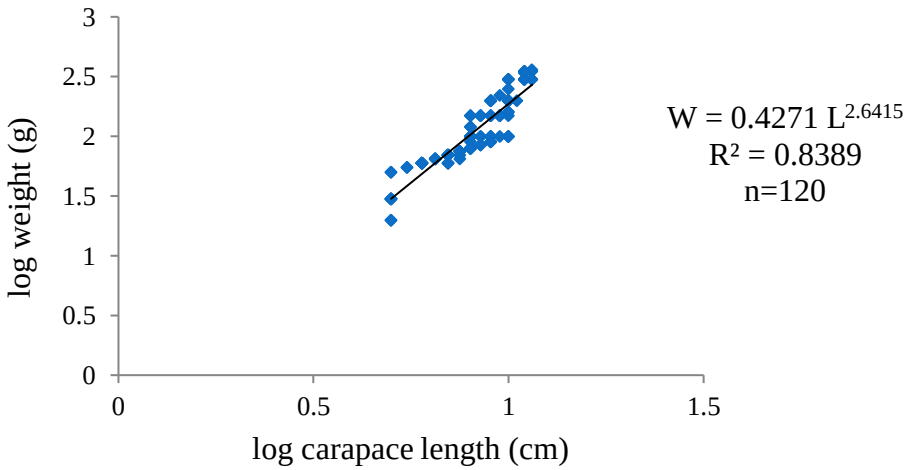

Figure 4.3.1 Length-weight relationship of male mud crab*Scylla olivacea*.

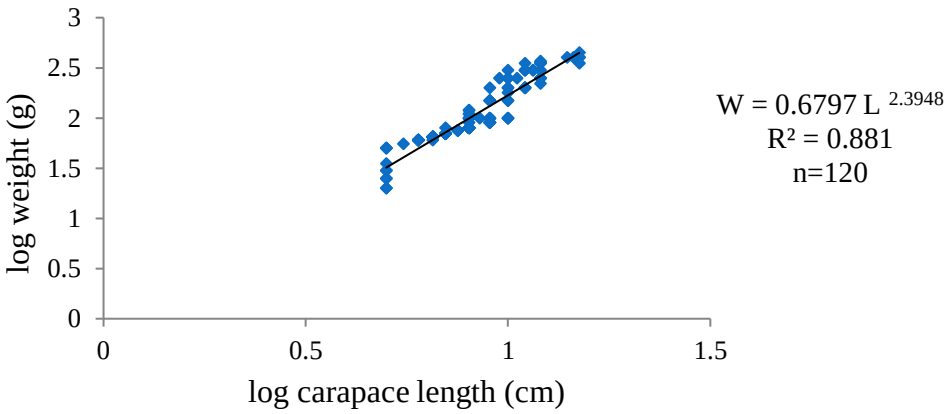

Figure 4.3.2 Length-weight relationship of Female mud crabs *Scylla olivacea.*

4.4. Size (carapace length) distribution of mud crab *Scylla olivacea*.

Totally 240 samples with the size group (carapace length) of class interval two from the length 3 cm to 17 cm in both sexes were used to observed the distribution of size group for each month.

The detailed data is presented in Appendix.1 and summarized in Fig.4.4.1 to.4.4.8.The size group of 7 to 9 cm was dominating in males from October to January while in females this size group was dominate from October to December. The size group of 3 to 5 cm was only found in both sexes during December to January. The largest size 13-15 cm was only found for females from October to December.

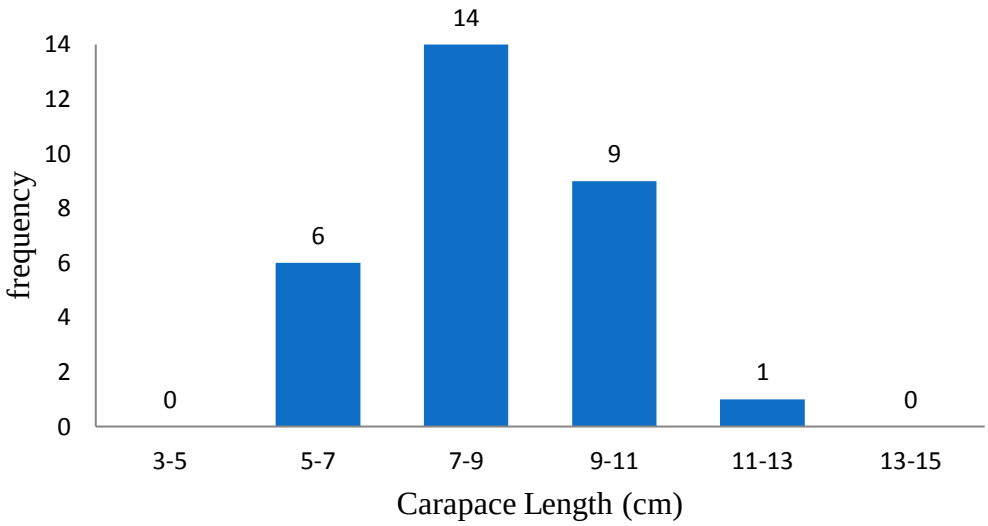

Figure 4.4.1 Length (cm) frequency of male mud crab*Scylla olivacea*in October (2016).

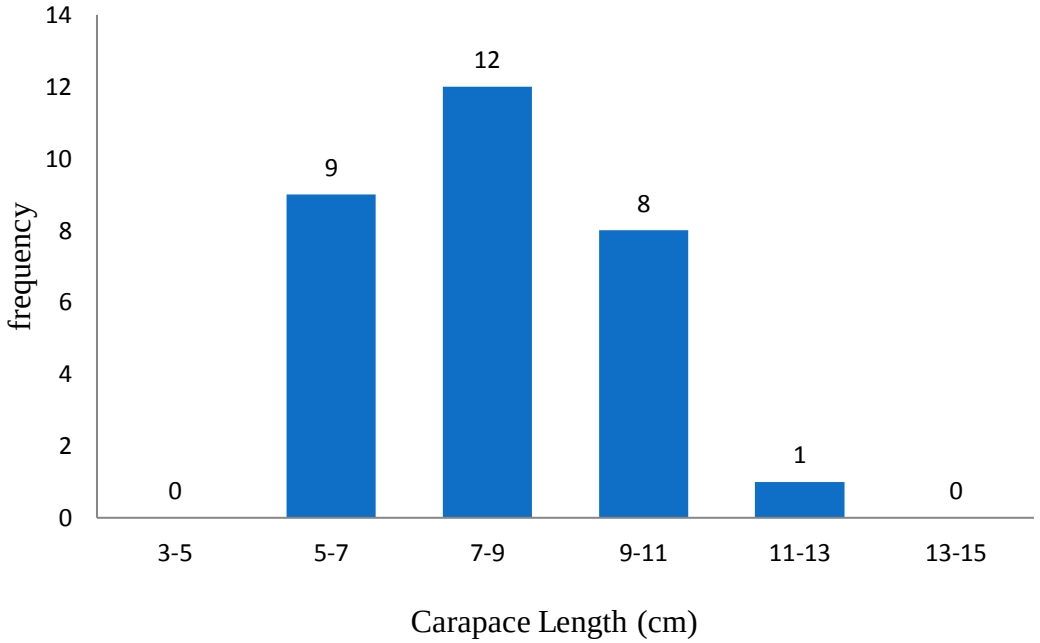

Figure 4.4.2 Length (cm) frequency of male mud crab*Scylla olivacea*in November (2016).

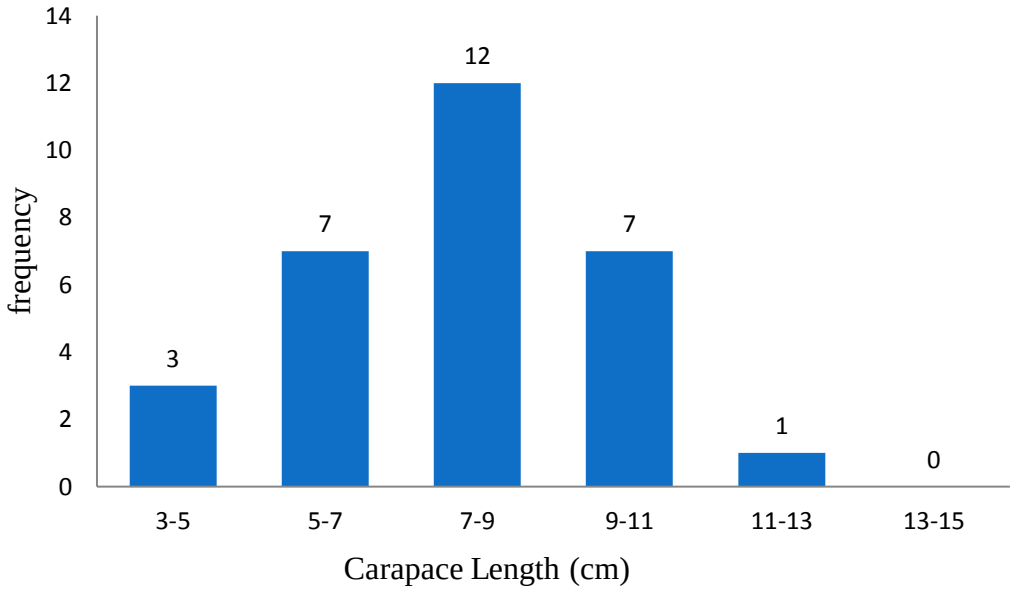

Figure 4.4.3 Length (cm) frequency of male mud crab*Scylla olivacea* in December (2016).

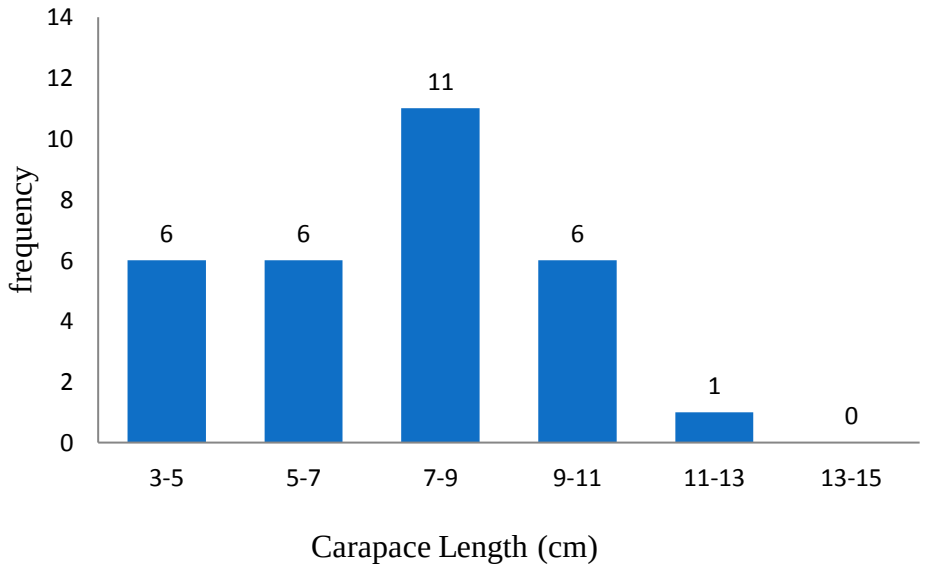

Figure 4.4.4 Length (cm) frequency of male mud crab*Scylla olivacea* in January (2017).

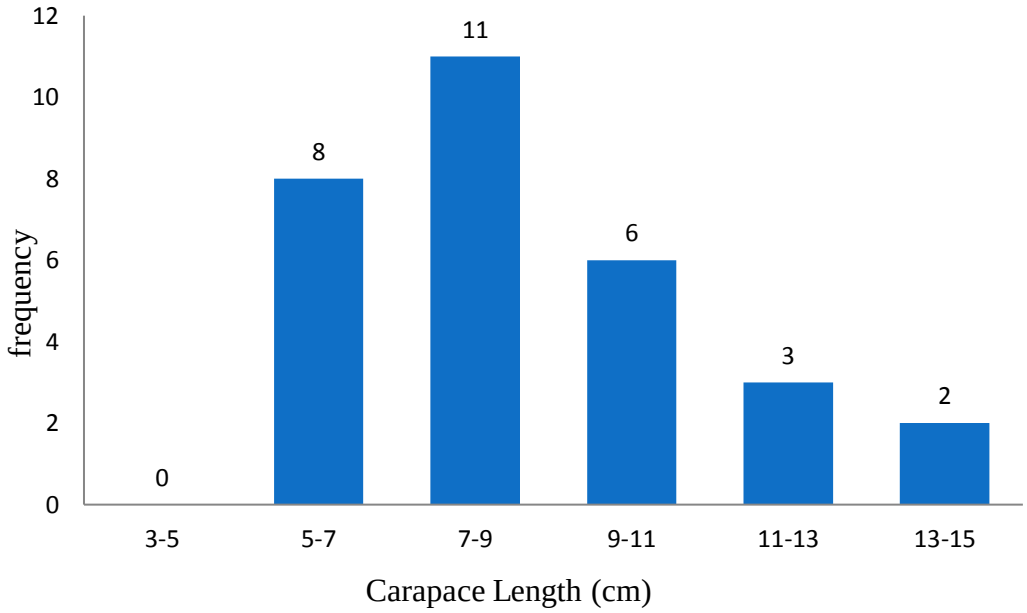

Figure 4.4.5 Length (cm) frequency of female mud crab*Scylla olivacea*in October (2016).

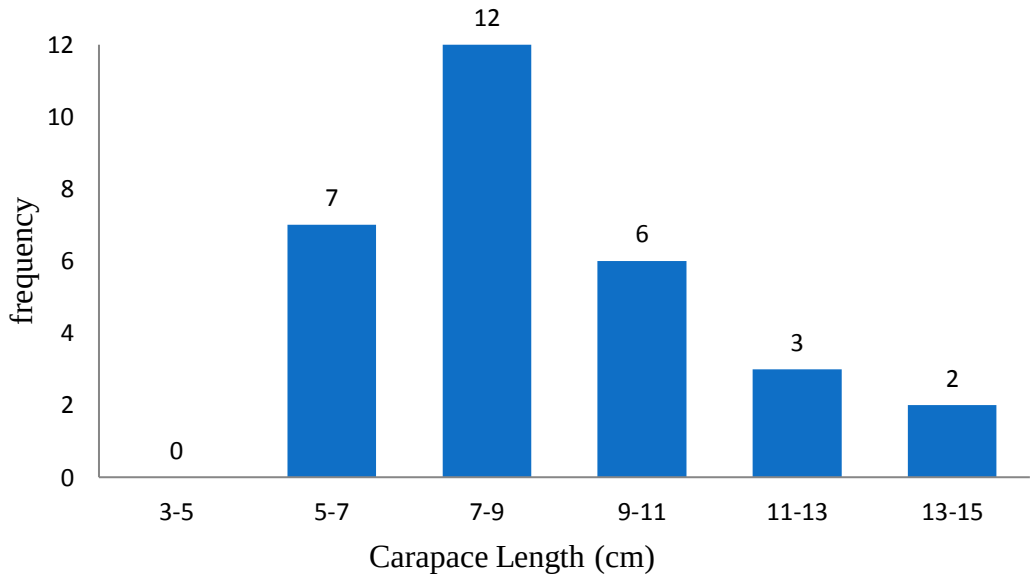

Figure 4.4.6 Length (cm) frequency of female mud crab*Scyllaolivacea*inNovember (2016).

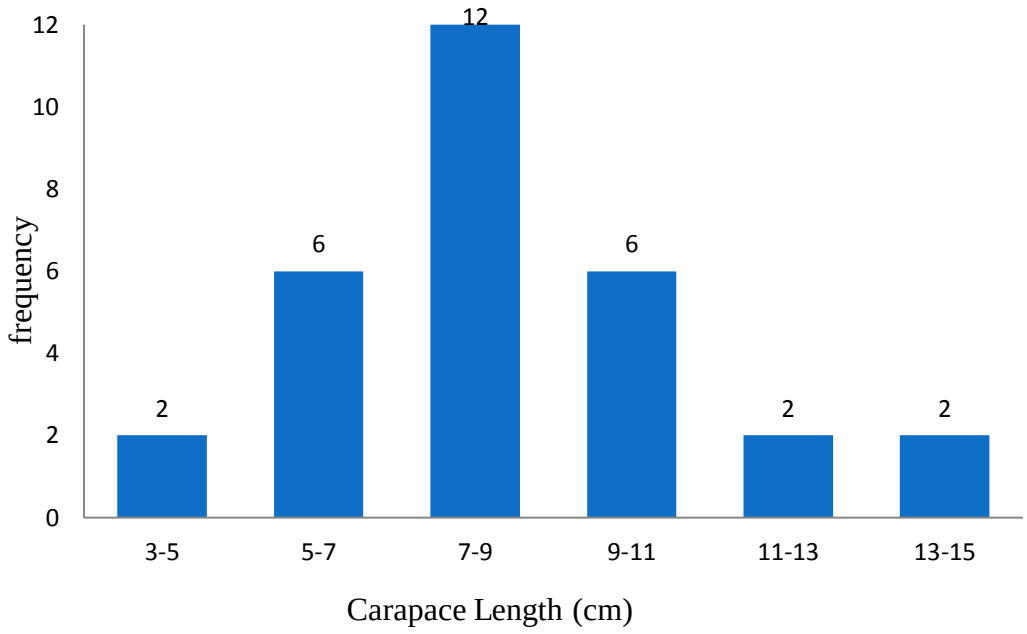

Figure 4.4.7 Length (cm) frequency of female mud crab *Scylla olivacea* in December (2016).

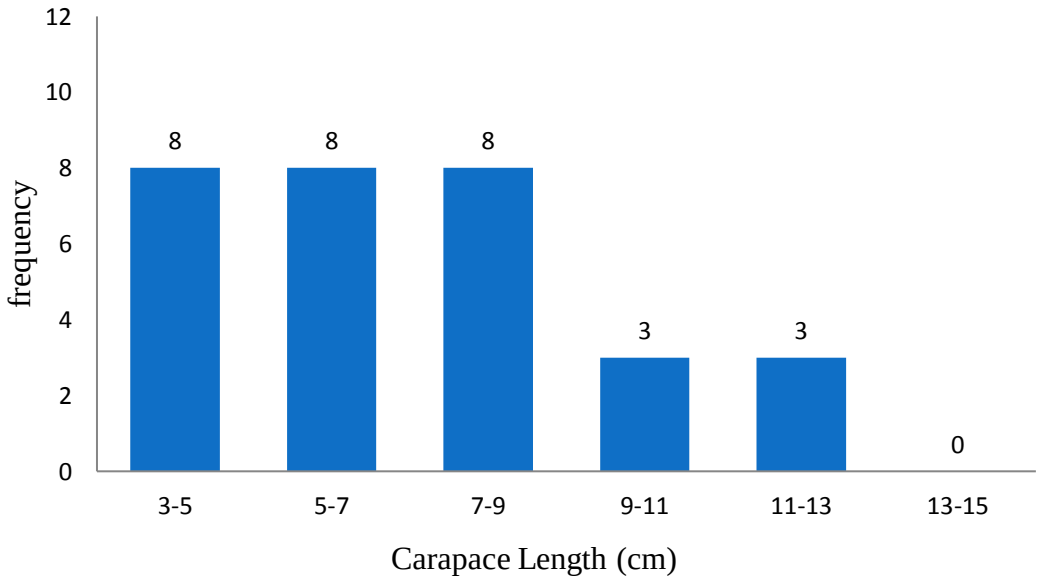

Figure 4.4.8 Length (cm) frequency of female mud crab *Scylla olivacea* in January (2017).

4.5. Catch weight (kg) of mud crab *Scylla olivacea* in the study area in Belin Township.

Table 4.4 Monthly catch weight (kg) of mud crab *Scylla olivacea*, in Toung Sone and Kyuak Ta Lone (villages).

Months	Catch Weight(kg)	
	Taung Sone (kg)	Kyuak Ta Lone (kg)
June	112	1350
July	368	1300
August	440	1100
September	448	1100
October	480	1200
November	-	120
December	-	90
January	-	50
February	-	-
Total	1848	6310

Table 4.5 Catching rate per hour fished (CPUE) of *Scylla olivacea*. for four months at four stations.

Stations	October, 2016			November, 2016			December, 2016			January, 2017		
	Fishing hour per day	Total Catch Weight (kg)	Catching rate CPUE	Fishing hour per day	Total Catch Weight (kg)	Catching rate CPUE	Fishing hour per day	Total Catch Weight (kg)	Catching rate CPUE	Fishing hour per day	Total Catch Weight (kg)	Catching rate CPUE
TheinChaung	8	6.4	0.8	8	5.6	0.7	8	4.8	0.6	8	4.8	0.6
Ywar Tan Shay	6	4	0.67	6	3.2	0.53	6	2.4	0.4	6	2.4	0.4
Pouk Taw	6	4.8	0.8	6	4	0.67	6	3.2	0.53	6	2.4	0.4
TapyayKone	7	12.8	1.83	7	8	1.14	7	7.2	1.03	7	6.4	0.91

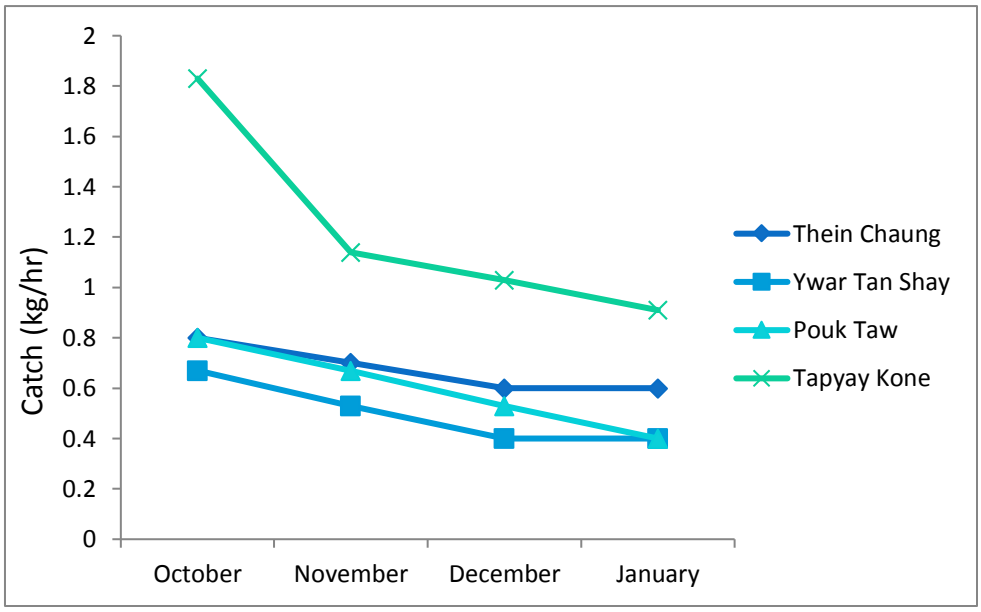

Figure 4.5.1 Catching rate of *Scylla olivacea*. For four months at four stations.

CHAPTER 5
DISCUSSIONS

5.1 Species and taxonomy

A variety of crabs from Pouk Taw,TheinChaung, ThapyayKone, Ywar Tan Shay, Taung Sone and Kyuak Ta Lone in Bilin Township, Mon State, were observed in the present study. Five species were collected, belonging to 3 families, 4 genera were identified. The systematic of each of the species including morphology, characters and keys were presented.

The recorded species are *Scylla olivacea, Sesarma intermedian, Metaplax elegans, Uca annulipes* and *Tubuca dussumieri*. belonged to three families thePortunidae, Grapsidae and Ocypodidae. The species including1 species of Portunidae, 2 species of Grapsidae and 2 species of Ocypodidae were recorded in the present study.

Crabs (Decapoda) were dominated and constitute the important groups of intertidal communities (Sandar Win., 1997). Among the specimen, the crabs of *Scylla* sp. wasthe most important has both ecological and economic importance to the marine environment. However, NyuntSandarAung (2016) described both Portunidae and Craspidae are produced in Taninthayi region in commercial scale.

This species are most abundantly found in the study areas. Among the crabs family recorded, Portunidae are the most important in the production in commercial scale. During the study period high production of this family was observed in rainy season, the mud crab *Scylla olivacea* (portunidae) was observed as the high production in commercial scale. The consumption of this specie is high for its high nutritious valueComparisons of the taxonomic criteria in crabs from Bilin Township were also presented in Table (5.1).Somedifficulties were observed while identification of species of *Gelasimus* of the family Ocypodidae, as this group has recently undergone revision. However, the identification of the crabs in this study followed Peter (2008).

Among the recorded species were noted as the previous recorded by Sandar Win (1997), EiEiHtwe (2007), Nyein Chan (2012) and NyuntSandarAung (2016). A total of 1 species mud crab and 4 species of mangrove crabs were present study.

5.2 Crabs Catch Data and Socioeconomics

In the present study mud crabs *Scylla olivacea* were the most important and were caught all year round. In the rainy season(from June to October) the amount mud crabs are most abundant, and in summer (From November to February) are declined. Female mud crabs carrying eggs in September and October. In November the female mud crab migrate offshore to spawn.

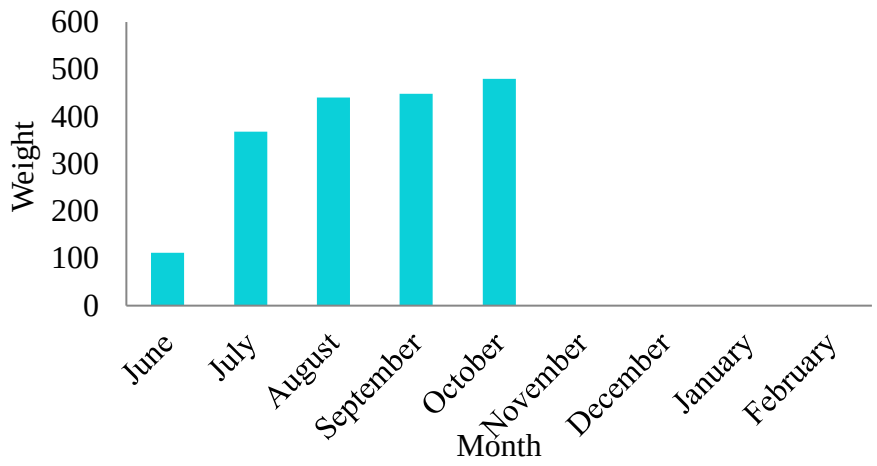

Figure 5.1 Monthly catch weights (kg) of mud crab *Scylla olivacea*, at TaungSoneVillage.

In ToungSonebuyer, they collected weight of crabs (*Scylla olivacea*)(112) kg in June,(368)kg in July, (440)kg in August, (448)kg in September and (480)kg in October, and then in (November, December, January and February) that buyer get a few kg of crabs the collected crab export to Yangon.

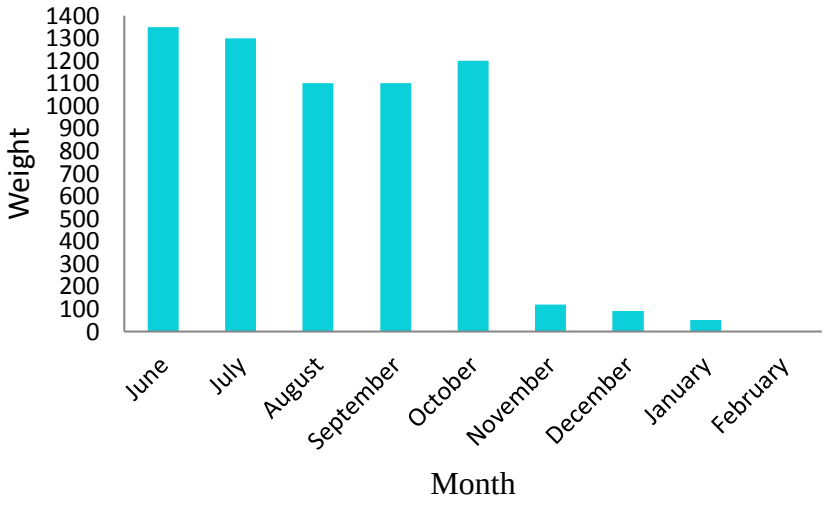

Figure 5.2 Monthly catch weights (kg) of mud crab*Scylla olivacea*, at Kyuak Ta Lone Village

In Kyauk Ta Lone buyer, they collected weight of crab (*Scyllaolivacea*)(1280-1584)kg in June, (1120-1552)kg in July, (1120-1344)kg in August, (1120-1344)kg in September, (1248-1472)kg in October, (120)kg in November, (90)kg in December, (50)kg in June.Mud crabs is very rarein February and the buyer do not collect. (Table 4.4)The big crabs export to Yangon and small crabs export to Thailand for real culture andsoft its shell.

In Thein Chaung village, CPUE value was highest in October (2016) (0.8 kg/day/hour) and lowest in January (2017) (0.6 kg/boat/day). In Ywar Tan Shay village, CPUE value was highest in October (2016) (0.67 kg/day/hour) and lowest in January (2017) (0.6 kg/day/hour). In Pouk Taw, CPUE values was highest in October (2016) (0.8 kg/day/hour) and lowest in January (2017) (2.4 kg/day/hour). In Tapyay Kone villge, CPUE values was highest in October (2016) (1.83 kg/day/hour) and lowest in January (2017) (0.91kg/day/hour). In all four month Tapyay Kone village are the most catch.

Crab fishery is one of the most valuable products in coastal area in Mon State. The crab fisheries and processing were conducted for commercial scale. The crab fisheries in Mon State have been developing since 1987. Ten years ago in Kyuak Ta Lone buyer collect mud crabs (*Scylla olivacea*) about 16000 kg per month but, during this study the mud crabs decline to about (1600)kg per month.Because of the mud flats are real habitats of mud crabs which are destroyed by erosion. This may bebecause of high demand of mud crabs; there are pressures on crab resources in this study area, resulting in overfishing. The collected samples were grouped as the seven size groups ranging from 5cm to 17 cm such as 3-5; 5-7; 7-9; 9-11; 11-13; 13-15; 15-17; respectively. The size group 7 to 9 cm was dominated in male in November. The size groups 3 to 5 cm were not collected in both sexes during October. Nearly equal number of both sexes was observed in the size groups of 7 to 9 cm in November. The both sexes of size groups of 3 to 5 cm were not collected in November. In December, the both sexes crab with the carapace width of the size group of 7 to 9 cm were dominated. The size groups of 3 to 5 cm were not collected in both sexes in January was presented in figure (4.4.1 and 4.4.2).

The mud crabs of the genus *Scylla* was well known for themost commercial species among other crabs species. The species was mentioned by Alcock (1968) including *S. serrata*, and *S. olivacea* which inhabit muddy substrate in brackish water along the coast or mudbanks in estuaries and in swamps. It was also found in holes excavated along the mud banks in neap and mangrove swamps.

In the present study120 female and 120 male crabs samples are measured for the carapace width (cm) and weight (g) for LWR relationship in the table (4.2.1).The largest size of female is 15cm and 450 g, the largest size of male is 11.5 cm and 360g from calculating and transforming linear regression graph,the coefficient “a’for female and male mud crab are 0.068 and 0.427 and “b” value are 2.39 and 2.64. The value of R^2 for the female and male mud

crabare 0.9 and 0.83 which are nearly to 1 indicated that strongly relationship between carapace length and weight.The value of a is a constant or index for specific species and b value round about 3 is indicated isometric growth in male crab.Kimberly *et al.* (2008) have stated the allometric relationship between carapace width (cm) and weight (kg) for group of crabs from Kosrae. They stated that allometric relationship for male crabs differed significantly from those for female crabs, with male crabs tending to be heavier than female for a given carapace width. The width-length regression equations and exponent b often lies between 2.5 and 3.5, and usually close to 3 (Petrakis and stergious, 1995; Muhammed and Javed, 2013). Muhammed *et.al*. (2013) had cited that the result obtained from an extraordinarily large number of length-weight data taken from a wide variety of crustacean by Pauly (1984) and Miyasa Ka et. al (2007) showed the values of $b<2.5$ or $b>3.5$ are generally based on a very small range of sizes and or such values of b are more likely to be an error. An exponent (b) value of 3 indicates symmetrical or isometric growth and the value other than 3 indicated allometric growth (Muhammed et.al. 2013). The study of length-weight and width-weight relationship of *Scylla serrata* by Muhammed and Javed (2013) indicated the value of b was below 3 and this showed the allometric growth for both sexes and there were no significant differences in slopes between male and females.

CHAPTER 6

CONCLUSION

A total of 5 species crabs belonging to 3 families and 4 genera were carried from Pouk Taw, TheinChaung, ThapyayKone, Ywar Tan Shay, TaungSone and Kyuak Ta Lone in Bilin Township, Mon State.From the result of the ,five species of crabs are found and systematic study of their morphology and characteristics were carried out. Among the species *Scylla olivacea* is most important and high production in commercial scale.

Among the crabs catches in the present study *Scylla olivacea* is caught all year round. The most important is found in raining season and catch decline in summer. In two stations the collected of the mud crabs (*Scylla olivacea*) are most increase in October and decrease in January.

In the present study 120 female and 120 male crabs samples are measured for the carapace width (cm) and weight (g) for LWR relationship in the table (4.2.1). The largest size of female is 15 cm and 450 g, the largest size of male is 11.5 cm and 360 g from calculating and transforming linear regression graph, the coefficient "a' for female and male mud crab are 0.068 and 0.427 and "b" value are 2.39 and 2.64. The value of R^2 for the female and male mud crab are 0.9 and 0.83 which are nearly to 1 indicated that strongly relationship between carapace length and weight. The value of a is a constant or index for specific species and b value round about 3 is indicated isometric growth in male crab.

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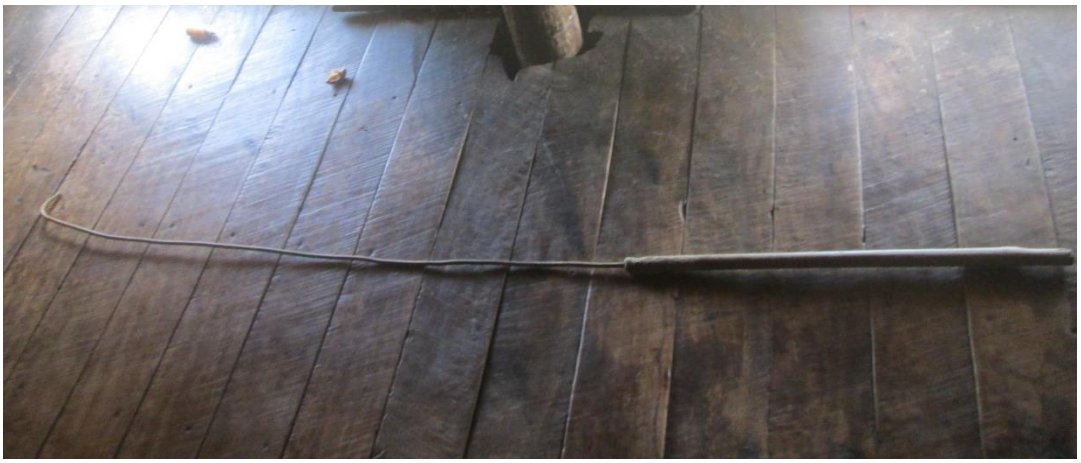
Appendix 1. photograph of Crab hook.



Appendix 2. a) buckets to export Yangon and Myawaddy: b) the crabs lower 5-8 cm; c) the female crab with eggs: d) upper 8-10 cm.

Appendix 3. a) burrow with crab: b) burrow no crab: c) show crab burrow: d) caught the crab in burrow by hook.

Appendix 4. (a-e) Crabs collecting site.

Appendix 5. The occurrence of Mud crabs in six study sites of Bilin Township, Mon State.

Sr. No	Species	Study area (Bilin Township)					
		Pouktaw	TheinChaung	ThapyayKone	YwarTan Shay	ToungSone	Kyuak Ta Lone
1.	*Scylla olivacea*	+	+	+	+	+	+
2.	*Sesarma intermedian*	+	+	+	+	-	-
3.	*Metaplax elegans*	+	+	+	+	_	_
4.	*Ucaannulipes*	+	+	+	+	_	_
5.	*Tubucadussumieri*	+	+	+	+	_	_
	Total	5	5	5	5	1	1

Abbreviation; + present; - absent

Appendix 6. Monthly frequency distribution of carapace width of male and female *Scylla olivacea*.inBilin Township.

Sr. No.	Size (group)	October		November		December		January	
	Carapace Width(cm)	M	F	M	F	M	F	M	F
1.	3-5	0	0	0	0	3	2	6	8
		(0.0)	(0.0)	(0.0)	(0.0)	(10)	(6.7)	(20)	(26.7)
2.	5-7	6	8	9	7	7	6	6	8
		(20)	(26.7)	(30)	(23.3)	(23.3)	(20)	(20)	(26.7)
3.	7-9	14	11	12	12	12	12	11	8
		(46.7)	(36.7)	(40)	(40)	(40)	(40)	(36.7)	(26.7)
4.	9-11	9	6	8	6	7	6	6	3
		(30)	(20)	(26.7)	(20)	(23.3)	(20)	(20)	(10)
5.	11-13	1	3	1	3	1	2	1	3
		(3.3)	(10)	(3.3)	(10)	(3.3)	(6.7)	(3.3)	(10)
6.	13-15	0	2	0	2	0	2	0	0
		(0.0)	(6.7)	(0.0)	(6.7)	(0.0)	(6.7)	(0.0)	(0.0)
	Total (N)	30	30	30	30	30	30	30	30

Percentage (%) in parenthesis

M = Male

F = Female

Appendix 7. Length and weightmeasurementof *Scylla olivacea*in October (2016).

No.	Male		Female	
	Length(cm)	Weight(g)	Length(cm)	Weight(g)
1.	11.5	360	15	450
2.	11	350	15	400
3.	11	300	12	300
4.	10	300	12	250
5.	10	300	12	220
6.	10	200	11	300
7.	10	200	11	200
8.	9.5	220	11	200
9.	9	200	10	200
10.	9	200	10	250
11.	9	150	10	100
12.	9	150	9	100
13.	9.5	150	9	150
14.	9.5	150	9	90
15.	8.5	150	8	100
16.	8.5	150	8	100
17.	8	120	8	90
18.	8	120	8	80
19.	8	150	8	80
20.	8	100	8	80
21.	8	100	8	80
22.	8	100	7.5	75
23.	7	70	7	80
24.	7	70	7	70
25.	7	70	7	70
26.	7.5	75	6.5	65
27.	7.5	65	6.5	65
28.	7	60	6.5	60
29.	7	60	6.5	65
30.	7	60	6.5	65

Appendix 8. Length and weightmeasurement of*scyllaolivacea*in November (2016).

No.	Male		Female	
	Length(cm)	Weight(g)	Length(cm)	Weight(g)
1.	11	340	15	400
2.	11	350	15	350
3.	11.5	300	12	350
4.	11	300	12	250
5.	10	250	11.5	300
6.	10	200	11	300
7.	10	100	11	200
8.	10	160	10.5	250
9.	10	200	10	200
10.	9	200	10	150
11.	9	150	9.5	250
12.	9	100	9	200
13.	9	90	9	100
14.	8.5	150	9	150
15.	8	150	9	90
16.	8	100	9	90
17.	8	80	8	120
18.	8	80	8	110
19.	8	80	8	100
20.	7.5	75	8	80
21.	7.5	75	8	80
22.	7	70	8	80
23.	7	70	7.5	75
24.	7	70	7	70
25.	6.5	65	7	70
26.	6.5	65	6.5	65
27.	6	60	6.5	65
28.	6	60	6	60
29.	6	60	6	60
30.	6	60	6	60

Appendix 9. Length and weightMeasurement of *Scylla olivacea*in December (2016).

No.	Male		Female	
	Length(cm)	Weight(g)	Length(cm)	Weight(g)
1.	11.5	350	14.5	400
2.	11	350	14	400
3.	11	300	12	370
4.	10	300	12	250
5.	10	200	11	350
6.	10	150	11	300
7.	10	100	10	300
8.	10	100	10	250
9.	9	200	10	100
10.	9	100	10	100
11.	9.5	100	9	150
12.	8.5	100	9	100
13.	8.5	85	9	100
14.	8	100	9	90
15.	8	80	9	90
16.	8	90	8	120
17.	8	80	8	110
18.	7.5	70	8	100
19.	7.5	75	8	80
20.	7.5	75	8	80
21	7	70	8	80
22.	7	70	7.5	75
23.	6.5	65	7	70
24.	6.5	65	7	70
25.	6	60	6	60
26.	6	60	6.5	65
27.	5	50	6.5	65
28.	5.5	55	6	60
29.	5	30	5	50
30.	5	30	5	35

Appendix 10. Lengths and weights Measurement of *Scylla olivacea*in January (2017).

No.	Male		Female	
	Length(cm)	Weight(g)	Length(cm)	Weight(g)
1.	11.5	300	12	360
2.	11	300	12	350
3.	10.5	200	11.5	300
4.	10	200	11	200
5.	10	160	10	180
6.	9.5	150	10	150
7.	9.5	150	9	150
8.	9	100	9	90
9.	9	90	9	90
10.	9	90	8.5	100
11.	8.5	100	8	80
12.	8.5	85	8	80
13.	8	80	8	80
14.	8	80	7.5	75
15.	8	100	7	70
16.	8	100	7	70
17.	8	80	6.5	65
18.	7.5	75	6.5	65
19.	7	70	6	60
20.	7	70	6	60
21.	6.5	65	6	60
22.	6	60	5.5	55
23.	6	60	5	50
24.	5.5	55	5	50
25.	5	50	5	30
26.	5	20	5	30
27.	5	20	5	25
28.	5	30	5	25
29.	5	30	5	20
30.	5	30	5	20