POPULATION DENSITY AND SEX RATIO OF THE MUD CRAB *(Scylla serrata)* IN BRGY. BUDBUDAN, HAMTIC, ANTIQUE

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SCIENCE RESEARCH 2

by

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Fourth Year- Photon
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APPROVAL SHEET

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Population Density and Sex Ratio of Mud Crab (*Scylla serrata*) in Budbudan, Hamtic, Antique

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ABSTRACT

Mud crabs (*Scylla serrata*) are a widely studied species. They occur along a wide area, and are known to be important economic resources. They serve mainly as a source of food for many places along the Indo Pacific region. There are many studies that focus on these crabs life cycle and ecology. Because of this, a lot of information with regards to the mud crabs' development is readily available. However, not all places where mud crabs are present are actually studied. Budbudan, a small barangay in the town of Hamtic, Antique, is one such place. However, the crab population in Budbudan is not actually in any way. This study aimed to provide baseline information about the local crab population in the area. This study focused on the population density and sex ratio of mud crabs in Budbudan, Hamtic, Antique. The results of the study showed that the population density and sex ratio of mud crabs in the entire area of Budbudan was not determined since only a 130 m^2 plot was surveyed. However, the population density of that 130 m^2 plot was found to be 0.2615 crabs/ m^2 and males are the more dominant gender.

Keywords: mud crab, population density, sex ratio, *Scylla serrata*

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Fourth Year- Photon

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CHAPTER 1

INTRODUCTION

A. Background of the Study

The mud crab (*Scylla serrata*) is a relatively large crab belonging to the family Portunidae. The species in this family are usually referred to as swimmer or paddle crabs due to their broadly flattened back legs with paddle like last segments (Wild Fisheries Research Program 2009). The species is characterized by a broad smooth shell, nine spines on either sides of the eyes and range from dark brown to mottled blue or grayish green. Mud crabs grow by moulting, whereby the shell splits and the crab forces itself backwards out of the shell. Then it expands to a larger size and the shell hardens. Mud crabs moult often and grow quickly (Ward and others 2007).

Mangrove marshes, muddy ponds, river mouths and other estuarine environments are among their usual habitats, though male, female and juvenile crabs may have unequal distribution in these areas. During the day, they may live intertidally in burrows but most bury in sub tidal levels. They are nocturnal, foraging at night and feeding mainly on mollusks, crustaceans and worms (Wild Fisheries Research Program 2009). They occur throughout most of the Indo- West Pacific area (Bonine and others 2008). Mud crabs are valued as a source of food and in come through most of the tropical Indo Pacific (Rajapackiam 2001 as cited by Bonine and others 2008).

Mud crabs can be caught throughout the lunar month, but catch rates appear to be greatest before and after spring tides (i.e. the new moon and full moon periods). Crabbing during the peak of the spring tide can be challenging because the strong current may move baits. Likewise, crabbing on neap tides is not ideal as there may be insufficient water movement to disperse the scent of the bait and the crabbing grounds may be too shallow to access safely (Phelan and others 2007).

In Budbudan, a small barangay in the town of Hamtic, Antique, Philippines, several brackish water ponds and mangrove marshes can be found. They are fed by brackish water from streams connected to the sea and experience the same tidal cycles.

Although most of them are manmade, these areas have developed into natural habitats for fauna that inhabit similar estuarine areas. Mud crabs serve as a major source of income in the area. A large portion of crabs sold in the local wet markets can actually be traced to Budbudan and neighboring locales. However, despite the key role of mud crab fishery in the area, the local crab population status has not been established.

B. Statement of the Problem

This study aimed to provide information on the population density and sex ratio of mud crabs (*Scylla serrata*) in Brgy. Budbudan, Hamtic, Antique.

C. Objectives

This study aimed to:

A. Measure the population density of mud crabs (expressed as crabs per square meter).

B. Determine the sex ratio of mud crab (number of males is to number of females).

D. Significance of the Study

As of now, no studies have been conducted on the local crab population in Budbudan. Although mud crabs are a relatively well researched species, there are places where their local populations are unobserved. The actual status of the local crab population in Budbudan remains unknown.

Since these crabs are fished all year round and they serve as an important economical resource, the local stocks are in great demand. This poses a possibility that the crab population will eventually be depleted.

Because of this gap in information, it is necessary to provide it. The results from this study will not only serve as baseline information on the current status of the crab population, it can also aid in conservation efforts that might be implemented in the future.

E. Scope and Delimitations

This study is focus on the measurement of population density and sex ratio of mud crabs in Budbudan, Hamtic, Antique. It includes the method of catching and handling mud crabs (*Scylla serrata*), how their traps are set, and the materials needed in conducting the study as well as the factors that are needed to be considered.

F. Definition of Terms

The following terms used in this study are given their respective conceptual and operational meanings.

Abdomen- is the bottom part of a crab's exoskeleton.

In this study, the abdomen refers to the bottom part of a crab which is used to identify the sex of the individual crabs.

Buri – is a dried leaf of a palm tree usually used as twine or in weaving mats and other native products.

In this study, the "buri" is used as defined.

Carapace- is a thick hard case or shell made of bone or chitin that covers the back or part of the back of an animal.

In this study, the "carapace" is used as defined.

Population- is all the organisms that both belong to the same species and live in the same geographical area.

In this study, "population" is used as defined.

Population Ecology- concerns the interaction between organisms and their environment by measuring properties of population.

In this study, "population ecology" is used as defined.

Population Density- is a measurement of population per unit area or unit volume or population divided by total land area.

In this study, "population density" refers to the number of mud crabs per unit area.

Sex Ratio- is the ratio of males to females in a population.

In this study, "sex ratio" refers to the ratio of male mud crabs to female mud crabs.

CHAPTER 2

REVIEW OF RELATED LITERATURE

A. Mud Crab (*Scylla serrata*)

Mud crabs can also be referred to as serrated swimming crabs. They belong to the genus *Scylla*. They are mostly found intertidal habitats. Mud crabs are valued as a source of food and income throughout much of the tropical Indo- West Pacific since most of them are found in Indo- Pacific regions (Bonine and others 2008).

Male and female mud crabs each reach a maximum size of approximately 200 mm. However, female crabs rarely exceed 1.5 kg weight whereas males can reach over 2.0 kg.

A.1. Anatomy

Mud crabs (*Scylla serrata*) has a broad smooth shell (carapace) with nine equally sized spines on either side of the eyes. It has five pairs of legs. The first pair is chelae or claws, the following three are walking legs and the last pair of legs are swimming paddles (Ward and others 2008).

Mud crabs can reach a maximum carapace width well in excess of 200 mm over the course of a 3- to 4-yr life span (Robertson 1996 as cited by Bonine and others 2008). Female mud crabs mature at between 80 and 120 mm CW (Robertson and Kruger 1994 as cited by Bonine and others 2008). Male mud crabs mature physiologically at 90–110 mm CW but may not be large enough to compete successfully for mates until achieving fully adult morphology (e.g., large claws) upon reaching carapace widths of 140–160 mm (Knuckley 1999 as cited by Bonine and others 2008). Scylla serrata exhibits sexual dimorphism, with male crabs tending to be heavier than females of similar carapace width (Chakrabarti 1981 as cited by Bonine and others 2008).

As juveniles, male and female mud crabs are difficult to differentiate. However, differences between the sexes become more apparent as the crabs

mature. At maturity females develop a large, rounded, pigmented abdominal flap which is modified to carry and protect the eggs, whereas males have a thin, unpigmented triangular abdominal flap. Elongate filamentous setae develop on the pleopods of mature females. Males develop very large claws compared to the females (Ward and others 2008).

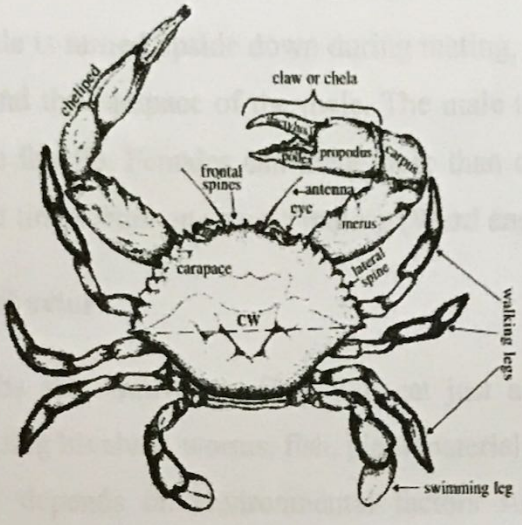

Figure 1. Parts of a Mud crab (*Scylla serrata*)

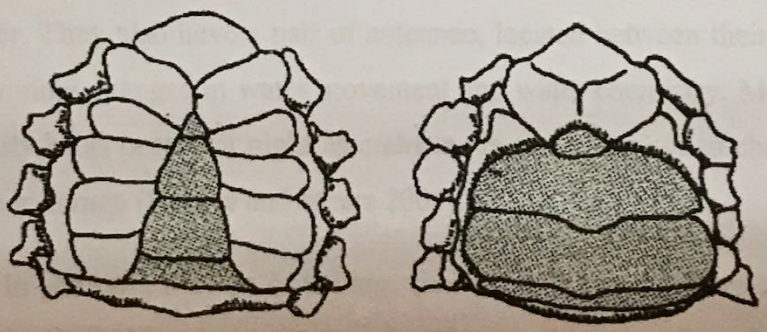

Figure 2. Differentiating male mud crabs from female mud crabs.

A.2. Reproduction

Reproduction occurs year- round in the tropics, with seasonal maxima that appear to coincide with seasonally high rainfall (Le Vay 2001). Mud crabs reach

sexual maturity at 130- 150 mm (18 months) depending on sex and location (Knuckey 1999 as cited by Bonine and others 2008). Mating occurs after a mature female or an immature female approaching maturity has moulted and the shell is still soft. When a female is about to moult, a male will hold her underneath him with the first pair of his walking legs. In this 'doubled' position, which may be maintained for up to one week, the male protects the female until she can defend herself. The female is turned upside down during mating, with her abdominal flap forced open around the carapace of the male. The male transfers gelatinous bags of sperm into the female. Females can mate more than once per season and can spawn up to three times from one single mating (Ward and others 2008).

A.3. Diet and Behavior

Mud crabs are omnivores. They will eat just about anything that they encounter, including bivalves, worms, fish, plant material and smaller crabs. Their feeding activity depends on environmental factors such as temperature and physiological factors such as moult condition (Phelan and others 2007).

Mud crabs use a range of senses to locate their food. The eyes of mud crabs are set on stalks, which allow them to see 360 degrees, both in and out of the water. They also have a pair of antennae, located between their eyes that can detect minute changes in water movement and water chemistry. Most movement on a daily basis occurs at night as crabs move from burrows to channel and reef habitats to forage (Bonine and others 2008).

In addition, the tips of the legs (known as the dactyls) are covered in tiny hairs that are highly sensitive to touch and taste. When handling food, mud crabs use the larger claw as a 'crusher' and the smaller claw as a 'cutter'. Both claws are extremely powerful. Mud crabs also use their claws to defend themselves and can even drop a claw to facilitate escape. A new, fully functional claw will grow back in three to four months (Phelan and others 2007).

A.4. Distribution

Mud crabs are distributed throughout the Indo- West Pacific region usually ni tropical and subtropical, mangrove and estuarine habitats. Juvenile *Scylla serrata* are most common in intertidal habitats, whether in mudflats or in mangroves (Chandrasekaran and Natarajan 1994 as cited by Bonine and others 2008), moving into deeper habitat as they grow. Male *Scylla serrata* are commonly found in mangrove channels or in association with burrows located in mangrove forests, on mudflats, or in the banks of channels (Perrine 1978 as cited by Bonine and others 2008). These burrows can serve as refugia during low tide and for mating. Female *Scylla serrata*, on the other hand, are far more commonly found in subtidal reef flats than in the mangrove forest proper (Nandi and Dev Roy 1990 as cited by Bonine and others 2008).

B. Study Site

The site is composed of several rectangular brackish water ponds of varying sizes and separated by strips of land. The ponds are manmade and are fed by water from nearby stream connected to the sea. The ponds are normally used in culturing shrimps, prawns and fishes while mud crabs occur naturally in the areas.

C. Population Ecology

Population ecology studies organisms from the point of view of the size and structure of their populations. It concerns the interactions between organisms and their environments by measuring properties of population rather than the behavior of individual organisms. Its properties include population size, population density, patterns of dispersion, demographics, population growth and limits on population growth (Campbell and Reese 2002).

C.1. Population Density

Given that a population is defined in terms of some natural or arbitrarily defined geographical range, the population density can be defined simply as the number of individuals per unit area. Population density can also be determined in terms of measure other than population

size per unit area (Campbell and Reese 2002). It is defined by measuring the total area and dividing it by the total number of individuals found in that area. Population density of either human or other species is studied so that the population can be controlled within its suitable capacity. It can help determine if a particular area is overpopulated or not (Wikipedia.org 2012).

C.2. Demographics

Demographics is defined as its vital statistics, particularly those statistics that can impact on present and future population size. Two statistics that are of particular import are a population's age structure and its sex ratio (Campbell and Reese 2002).

C.2.1. Sex Ratio

Sex ratio is simply defined as the ratio of males to females in a given population (Campbell and Reese 2002).It can be estimated by dividing the total number of female crabs by the total number of male crabs (Ali and others 2004). The growth rate of a population is dependent on the sex ratio of a population. For example, fewer females entail a slower rate of population growth for the main reason that uteruses are limiting and males can inseminate more than once. However, this does not hold true to species where the ability to inseminate is limited (Campbell and others 2002).

CHAPTER 3

METHODOLOGY

A. Overview of the Study

This study aimed to assess the population of the mud crabs (*Scylla serrata*) in Brgy. Budbudan, Hamtic, Antique and determine the population density and sex ratio of the mud crabs there. Since mud crabs are nocturnal, naturally, they are more active at night. Catch rates are also shown to be greater before and after spring tides. With this in mind, setting of traps should be favorable at night and during days approaching the full moon or new moon.

B. Materials

Frogs and cow skin are used as baits and the traps are provided by the local crab catchers.

C. Sampling Procedures

A. Preparing the bait

It is advisable to use frogs as bait since it can be availed of without any cost. However, if procuring of frogs is difficult, other baits such as entrails or cow skin will also serve the same purpose.

In this study, both cow skin and frog meat was used as bait.

Cow skin was used in the first two days since frogs were scarce at the time. The skin is divided into smaller strips using a knife and rolled into tubes. A notch is then sliced in the rolled up skin. Buri is used to secure the bait to each basket. The notch in each roll ensures that the buri does not slip. Each parcel was then tied to opposite ends of the basket, making sure that the bait hangs neither too close to the sides nor to the top. This is done to lure the crab into the basket in order to reach the bait.

Frogs were caught and brought to the sampling site; each frog was then cut up into parts to be used as bait. The frogs were lain belly side up and sliced across the abdomen. The innards were then scraped out using the edge of the knife and the carcass was then divided into two lengthwise. Each piece was then tied in similar fashion to the cow skin bait.

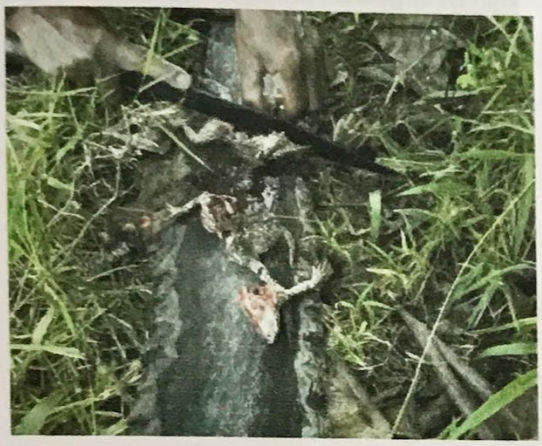

Plate 1: Preparation of the Bait

Plate 2: Tying of the Bait in the Trap

B. Setting and Collection of traps

The most common trap used in the area is the crab basket (Butcher and others), which is made out of woven rattan. Once the bait is in place, the traps can then be distributed along the perimeter of the site.

The traps were first soaked in the water for a few minutes to make sure that they will not float to the surface they are set. Afterwards they are pulled out using a long pole tipped with a hook and distributed along the perimeter of the pond. They were cast into the water where they sank to the muddy bottom. Traps were left overnight and were removed in the morning. Long poles tipped with hooks are used to pull the traps out of the water.

Plate 3: Setting of Traps

Plate 4: Collection of traps

C. Measuring the Captured Samples

- **For the Population Density:**
  - Calculating the Population Density
    - The total number of mud crab found in the sampling site is divided by the total land area of the sampling site (Campbell and Reese 2002).
  - Measuring of Sampling Site
    - The ponds are mostly rectangular in shape and their areas were available in the barangay's records. We were only permitted the use of one site, totaling an area of approximately 2 hectares. From this only 130 m^2 was used for the actual sampling.

- **For the Sex Ratio:**

In identifying the sex of mud crabs, males have triangular or T-shaped aprons while the females' are rounder in shape (Phelan and others 2007).

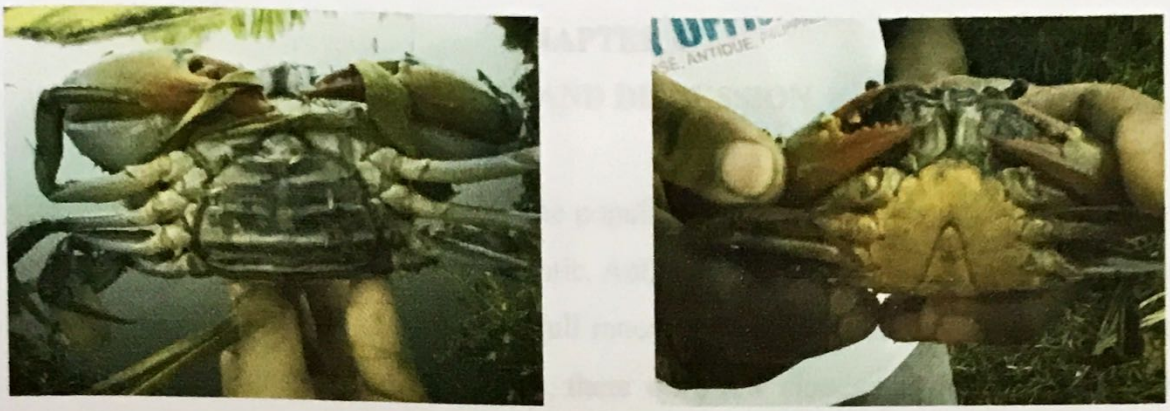

Plate 5: Identification of the Sex (left: female, right: male)

According to Ali and others, it was estimated using the formula:

$$SR = \frac{\text{No. of female crab}}{\text{No. of male crab}}$$

CHAPTER 4
RESULTS AND DISCUSSION

This study aimed to determine the population density and sex ratio of mud crabs (*Scylla serrata*) in Brgy. Budbudan, Hamtic, Antique. This was on the 3rd, 4th and 5th days of February 2012, two days before the full moon. It remained sunny during these times. There were no signs of impending rain, there were few clouds and it stayed warm all throughout the day. Traps were set during low tide and left overnight. Only a 130 m² plot out of 41 hectares was used.

A. Results

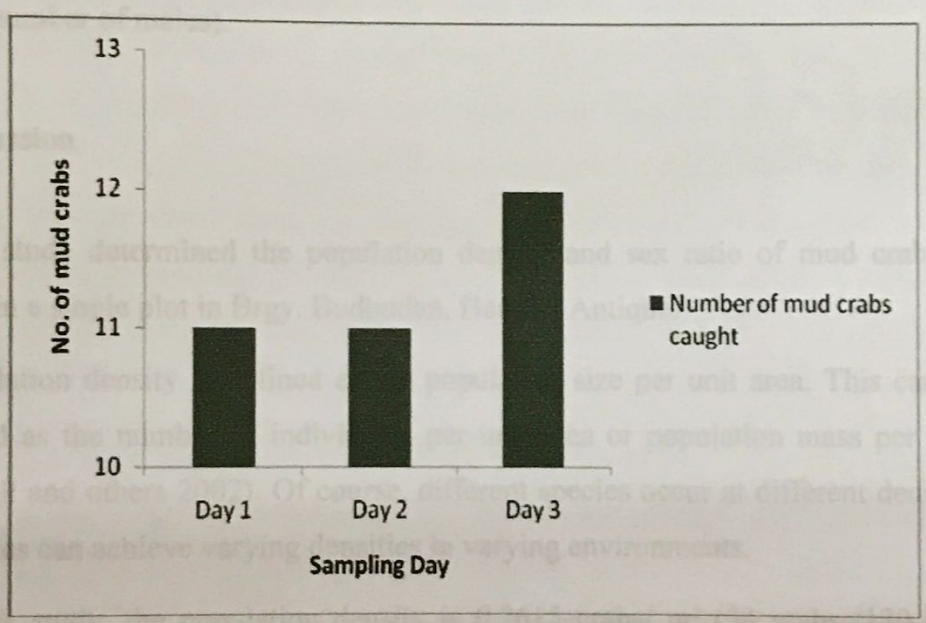

Figure 3. Number of mud crabs (*Scylla serrata*) caught from February 3-5, 2012.

The average population density is 0.2615 crabs/ m² (34 crabs /130 m²).

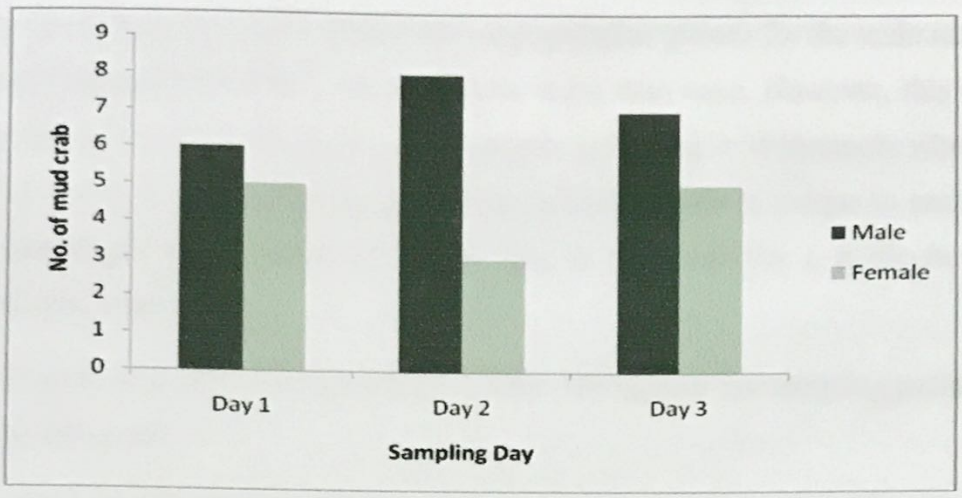

Figure 4. Sex ratio of the mud crabs (*Scylla serrata*) caught from February 3-5, 2012.

The overall sex ratio of male to female is found to be 1:0.62 (number of females/number of males).

B. Discussion

This study determined the population density and sex ratio of mud crabs (*Scylla serrata*) in a single plot in Brgy. Budbudan, Hamtic, Antique.

Population density is defined as the population size per unit area. This can also be expressed as the number of individuals per unit area or population mass per unit area (Campbell and others 2002). Of course, different species occur at different densities and one species can achieve varying densities in varying environments.

In this study, the population density is 0.2615 crabs/ m^2 (34 crabs /130 m^2). In a similar study conducted by Barnes in 2002 in Tanzania, they gave preliminary estimates of abundance and size structure and investigated the population structure, population density and the possible migrations of crabs between islands. They measured population density in terms of crab biomass per area and burrow density.

Sex ratio as defined by Kamal in 2004 is the number of females divided by the number of males. Sex ratio is a parameter that falls beneath the wide scope of demographics and is concerned mainly with the ratio of males to females. More often than not, the growth rate of a population is dependent on the sex ratio of a population. For

example, fewer females entail a slower rate of population growth for the main reason that uteruses are limiting and males can inseminate more than once. However, this does not hold true to species where the ability to inseminate is limited or in instances where males play vital roles in rearing offspring. In general, a healthy ratio is unique to each species and is determined by the ratio of gender that is favorable for a particular species (Campbell and others 2002).

In this study, the ratio was found to be 1:0.62. Throughout the sampling period, males dominated each catch.

This result is in agreement with the results gathered from previous studies like Bonine in 2008 and Ali in 2004. In these other studies it is also shown that males are the more dominant gender. This imbalance in sex ratio can be attributed to several factors. A gender biased type of harvesting, as studied by Pillans in 2005 for example, can be the cause. Aside from selling their catch in markets, local crab fishermen in Budbudan also accept orders from private customers. These customers most often than not specify a preference on male crabs, since they are heavier. This preference is not limited though, since customers also sometimes ask for more females, a purely male or purely female order. Spawning habits and the crabs' intrinsic migratory behavior can also affect this imbalance.

Because of their migratory behavior, as further discussed by Fondo and others (2010), they have a free range of movement. They are known to travel great distances from a range of 4 to 45 km, although most large migrations are brought about by spawning seasons.

According to Fondo and others in 2010, although spawning occurs throughout the year, females have a tendency to travel closer to the sea during peak seasons for spawning on the months of December to February. Therefore females are not so plentiful inland as the males during these months.

Lastly, the uneven distribution of individual crabs may also play a role. In a study by Bonine in 2008, it was shown that males, females and juveniles were distributed along different areas. Juveniles stayed in inter tidal zones. Female crabs tend to stay closer to the sea like in subtidal reef flats. Males on the other hand, are found closer inland, like in

mangrove areas or in the banks of channels. The males' burrows' may serve as refuge during low tide or during mating.

In comparison with studies conducted by Bonine about the population characteristics and Ali about the biology of mud crabs, this study's time period is relatively short. Studies conducted by Bonine (2008) and Ali (2001) can span months and even years to complete. This is done to come up with a complete profile of the areas that are surveyed. However, this is with the consideration that these studies survey large areas like entire islands and rivers, such as the island of Kosrae in the Federal States of Micronesia. The sampling areas are also different, consisting of naturally occurring habitats like rivers and mangrove forests (Bonine 2008). In contrast, this study was conducted in man-made brackish water ponds. The sampling techniques used also differed and were adapted to fit the area to be sampled. In Bonine's study, the area was divided into nine sectors according to proximity to human populations and by the positions of the rivers. Effort was concentrated on collecting a representative sample but the sampling was not based on any formal random sampling design. In a study by Ewel in 2009, belt transects were used to survey the study site in Palau, situated 3 to 3.3 m away from each other during low tide. 4 to 11 traps were then left overnight within these transects. In this study, only one 130 m^2 plot was used, since that was the plot allowed for survey. The chosen site was among the few sites where the presence of the crabs was already known. The site was a well established crab harvesting ground.

However, the crab population in Budbudan is not actually propagated in any way. Surrounding ponds are used exclusively for fish and shrimp culture, but crabs manage to find their way to these ponds. The crabs occur naturally, traveling from nearby rivers and marshes to the ponds. As mentioned above crabs have a nomadic lifestyle and are known to wander along their habitats when they mate and forage for food. This establishes the fact that the local crab population in Budbudan is wild.

It is known that mud crabs, particularly of the genus *Scylla*, are already being subjected to mud crab aquaculture. Studies conducted by Le Vay (2001) and by Shelley (2008) all have focused on the prospect of mud crab aquaculture. It is foreseeable as a profitable enterprise due to the high demand on the mud crab as a food source. More

information on the ecological side of their lives can be helpful to the further development of this culture.

But this advancement does not render wild crab populations as useless subjects to research because most seed stock needed to establish these aquaculture operations actually come from wild mud crab populations (Shelley 2008). There is increasing pressure on the species due to the great demand in the market, and ultimately, if not monitored, this will eventually lead to an endangerment of the species (Le Vay 2001), so careful maintenance of wild stock is actually crucial to maintaining cultured populations. In the Philippines, caution is being given against the use of hatchery stock. Concerns such as the resistance of hatchery stock to disease, their robustness, their growth rate and their value for money in comparison to wild stock is being considered. 95 percent of seed stock actually comes from wild populations (Shelley 2008).

In a rural area such as Budbudan, such advancements would not seem practical at the moment, although in the long run it would be profitable. According to Shelley, from surveys done by Aldon in 1997, crab aquaculture has a payback time of 1.4 to 2.27 years. This kind of project entails time and money to fully complete, things which are not so readily available to the local crab fishermen. The first step then, in ultimately improving the area and switching to mud crab aquaculture, would be to further maintain the wild stock available that would eventually serve as the seed stock for future projects.

The population density of the entire Budbudan area was not determined, since only 130 m^2 plot was surveyed, not the entire area. Therefore, the population density and sex ratio of the crabs determined were specific to that area only.

Only one plot was used in the study for the primary reason that only one plot was allowed for survey. However, this one plot was also one of the few plots in the area where the crabs are confirmed to be found according to the local crab catchers. The disadvantage of using one plot is that it will not be sufficient to form an accurate representative sample of the entire area. In most studies like that of Bonine in 2008, a 1562 ha mangrove forests divided into several sites was surveyed. In this study however, only a 130 m^2 plot was surveyed.

More time can be given in surveying a larger representative area since this would give results on a larger scale. Although the results of the study are consistent with the results of other related studies such as those done by Bonine and Ali for the month of February, because only one plot was used, there is still a margin for error.

It is not possible to catch all individuals in a given population for this requires a lot of time and effort. In Bonine's study in 2008, the catch per unit effort was estimated to be a total of 95%, having an estimate capture rate of 0.754 a night. Because of this, there is no guarantee that the number of crabs caught during the sampling period is the exact number of crabs present in the given area. Also, only one area was sampled in the locale, since that was the one area that was both allowed for survey and was a known crab habitat. But there is no possibility that samples in that area were replicated since all captured crabs were taken away and sold. Therefore it is recommended that more plots be sampled in order to come up with a more accurate set of data.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study aimed to determine the population density and sex ratio of mud crabs in Brgy. Budbudan, Hamtic, Antique.

A. Summary of Findings

1. The population density in the chosen 130 m^2 area was 0.2615 crabs/ m^2 (34 crabs per 130 m^2).
2. The sex ratio in the chosen 130 m^2 area was 1:0.62 (male:female).

B. Conclusion

The population density and sex ratio of mud crab (*Scylla serrata*) in the entire area of Budbudan was not determined since only one plot was surveyed. However, the population density of that 130 m^2 plot was found to be 0.2615 crabs/ m^2. During the study, more males were caught.

C. Recommendations

This study did not determine the population density and sex ratio (*Scylla serrata*) in the entire watered areas of Brgy. Budbudan as intended. However, it did determine the population density and sex ratio of a single 130 m^2 plot in the intended area. This area can serve as a representative sample, although it is not sufficient to form an accurate survey of the entire area of Budbudan.

Therefore it is recommended that:

1. More sites should be surveyed to establish a more accurate representative sample for the entire Brgy. Budbudan area. Another alternative would be to survey the entire watered area of Brgy. Budbudan to come up with the area's complete population density and

sex ratio of mud crabs. In order to do these, more time should be given in conducting the study.

2. Peak seasons can also be considered in future studies, if that consideration is relevant to the objectives of said future studies.
3. An in depth investigation on effectiveness of different baits can also be done, since this will aid in maximizing the yield per sampling site.

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APPENDIX A

A. RAW DATA

Feb. 3, 2012

Basket No.	No. of Crabs	Male	Female
1	2	1	1
2	2	1	1
3	2	1	1
4	1	1	
5	1		1
6	2	1	1
7	1	1	

Feb. 4, 2012

Basket No.	No. of Crabs	Male	Female
1	1	1	
2	2	1	1
3	2	2	
4	2	2	
5	2	2	
6	2		2
7			

Feb. 5, 2012

Basket No.	No. of Crabs	Male	Female
1	3	2	1
2	2	1	1
3	2	2	
4	2	2	
5	1		1
6	1		1
7	1		1

B. CALCULATIONS

Population Density:

Total no. of mud crabs: 34

Total area: 130 m^2

$$34 \div 130\ m^2 = 0.2615\ crabs/\ m^2$$

Sex Ratio:

$$SR = \frac{\text{No. of female crab}}{\text{No. of male crab}}$$

Total no. of males: 21

Total no. of females: 13

$$13 \div 21 = 0.62\ (1{:}0.62)$$