

## Reproductive Biology of Christian crabs (*Charybdis feriatus*, Linnaeus, 1758) in San Miguel Bay, Philippines

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### Abstract

The reproductive biology of *Charybdis feriatus* was investigated from April 2012 to March 2013 to determine gonad maturity, GSI, fecundity, breeding cycle and size at first maturity. Monthly sample of 30 specimens was randomly collected for gonado-somatic index (GSI), gonad maturity, and fecundity. Gravimetric and volumetric methods were used to estimate fecundity and GSI based on gonad weight/total weight (100). Maturity Stages are based on published literature. Results showed that *Charybdis feriatus* is a continuous breeder with a distinct period of peak reproductive activity during NE monsoon with peak in January where higher values of GSI, matured, and ovigerous females observed. Mean GSI of female and male were 7.35 and 6.27%. Ovigerous females were present year round, the highest occurring is in December (50%). Fecundity ranges from 1,514,000 to 6,357,000eggs. Smallest reproductively active female was 8.3cm carapace width (CW). The fecundity relationship with size (CW) showed high correlation ( $R^2=0.92$ ). Recommended options include (1) close season, (2) size regulation, (3) no taking of egg-bearing swimming crabs, and (4) egg-bearing crabs contained in a spawning tank and allowed to release its eggs and the larvae released in fishing ground or marine protected areas.

Keywords: *Charybdis feriatus*, Gonado-somatic index (GSI), Gonad maturity, Fecundity, Breeding cycle, Size at first maturity.

### Introduction

Christian crab (*Charybdis feriatus*), locally known as “krusan” is the most sought species because of its meat quality, taste, size, export demand and premium price of US\$ 8 to US\$ 15/kg. As such, the intensity of fishing has put immense pressure on wild population which when kept unregulated may lead to overfishing and resource depletion. Although, crabs may be resilient because *C. feriatus* generally attain sexual maturity in their first year of life, breed year round with distinct periods of peak reproductive activity and berried female produces up to six million eggs (Whitaker, 2000), the intensity of fishing pressure is very high. In addition, very little work has been carried on the aspect of reproductive biology in San Miguel Bay. Understanding the species reproductive biology is therefore important not only for natural stock management but also for future culture and species domestication (Reeby, *et al.* 1990). It is also the most important aspects in evaluating the harvesting strategies of

exploited populations (Campbell *et al.* 1984).

The study examined the reproductive biology of *C. feriatus* with respect to fecundity, gonado-somatic Index (GSI), gonad maturity, breeding cycle and size at first maturity. The output of this study is expected to provide options for the management and sustainability of crab population in the bay.

### Materials and Methods

A monthly sample of 30 crabs specimen caught by crab pot and crab gillnet in San Miguel Bay were randomly collected for reproductive analysis such as gonado-somatic index (GSI), gonad maturity, and fecundity. Reproductive breeding cycle and size at first maturity were also determined. Immediately after collection, crab specimens were dissected and the gonads and eggs were preserved at 95% ethanol and transferred to laboratory for analysis. Carapace width was measured with a 0.01 mm precision Vernier caliper (SE

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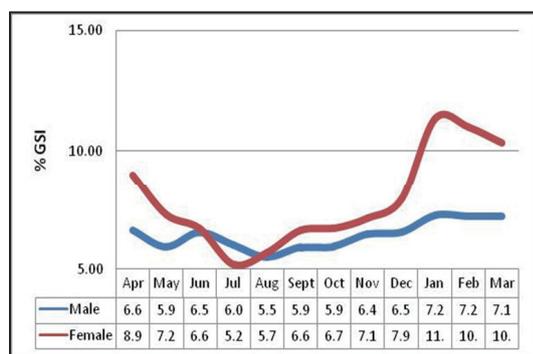
781BC Stainless Steel, 0.1 cm) and weight was taken to the nearest tenth of a gram. Gonad of crabs were taken for GSI [GSI = gonad weight/total weight (100)] and maturity was determined by opening the carapaces and classified by size and color of the gonad (Kumar, *et al.*, 2000; Islam and Kurokura, 2012). For fecundity, attached eggs on the female abdomen were carefully scraped from abdominal flap of fresh or live crabs. Gravimetric and volumetric methods were used to estimate fecundity. Fecundity was computed as the number of eggs carried externally by the female (Kumar, *et al.*, 2000). The relationship between fecundity and crab size was expressed as [Log fecundity = log a + b (log size)] (Parsons, 1988). The size at sexual maturity was determined by examining the berried females and documenting the smallest to carry eggs. The relative percentages of GSI, gravid females and stages of sexual maturity in the samples were analyzed to describe the reproductive cycle of crabs.

## Results and Discussion

### Gonado-somatic index (GSI)

Monthly distribution of GSI showed continuous gonadal activity all year round (Figure 1). GSI values of male and female *C. feriatus* ranges from 5.50-7.25% and 5.20-11.33% respectively.

Months with higher and lower values of GSI were observed during the north-east monsoon (November-May) and south-west monsoon (June-October), respectively. Difference in rainfall pattern associated with the South West and North East monsoon and other related environmental factors affect reproductive cycles (Anilkumar and Adiyodi, 1983).



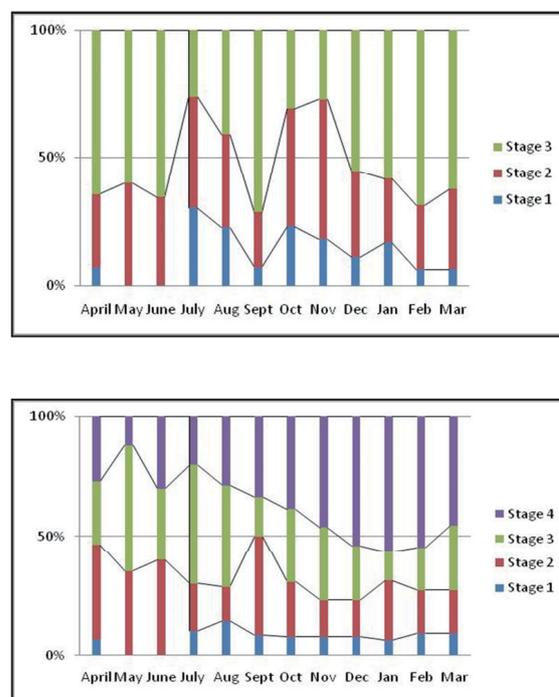
**Fig.1. Gonado-somatic indices (%) of *C. feriatus* in San Miguel Bay**

A number of abiotic and biotic factors such as temperature, day-length, food availability, rainfall, tidal regime, photoperiod has been pointed out as major modulators of reproduction in crustaceans (Meusy and Payen, 1988;

Morgan and Christy, 1995). GSI trend showed a gradual decline up to July, followed by a gradual incremental towards January. Mean ( $\pm$  stdev) GSI of female and male *C. feriatus* were 7.35% ( $\pm$  1.75) and 6.27% ( $\pm$  0.50), respectively, which indicate that female *C. feriatus* on the average used about 7.35% of its body weight for egg production. The observed mean GSI is quiet lower than the reported GSI mean value of 8.42% for female *C. feriatus* by K.V. Ramesh Babu (2006) in Mangalore, India.

### Gonad Maturity

Information on maturity stages of female and male *C. feriatus* from April to March are shown in Figure 2. A total of 152 female and 216 male were assessed for ovarian condition. Female maturity stages were observed in the entire sampling period except *Stage 1* in May and June. *Maturity Stage 2* occurred at high percentage in September (42%), while *Stage 3* (53%) in May and then *Stage 4* in November up to March (46%-56%). Whereas, in males a higher percentage of *Stage 3* was observed during the sampling, except July, October and November which showed higher values on *Stage 2*. Studies by Dineshbabu A.P. (2011) on reproductive stages showed that *C. feriatus* is a continuous breeder with two peak breeding season, one during October – November and another during May-June.



**Fig.2. Maturity Stages of Female (upper) and Male (lower) *C. feriatus* in San Miguel Bay.**

Similar observation was noted in SMB. In the study Pillai and Nair (1973) on 12 species of crabs in Southeast India, *Charybdis feriatus* showed a tendency to breed continuously with distinct periods of peak reproductive activity during the annual reproductive cycle, confirming the interview to fishers that these are harvested all year round with peak months of harvesting.

### ***Fecundity***

Females with carapace (CW) from 8.3 cm to 15 cm produce about 1,514,000 to 6,357,000. In general, Portunids lay around 1 to 6 million eggs per spawning. In the study of Parado-Estepa, *et al.* 2002 and Josileen J. 2011, female *C. feriatus* produced up to  $1.2 \times 10^6$  zoea and  $1.4 \times 10^6$  zoea, respectively. Relationship between size (CW) and fecundity was tested and resulted to high correlation with value of 0.92 coefficient of determination. Hence, the fecundity or number of eggs produced is directly related to the size of the individual (Kumar *et al.*, 1999).

### ***Breeding cycle and Size at first maturity***

Ovigerous *C. feriatus* were present throughout the year, whereas the highest percentages occurred in December and January with values 50% and 24%, respectively. In southwestern India, Pillai and Nair (1973) observed peak number of ovigerous females during January. The smallest reproductively active female or the size at first maturity was noted at 8.3 cm carapace width (CW), which is a bit larger than the reported size at first maturity (6.9 cm) in Sorsogon Bay (Nieves *et al.*, 2013). In the study of del Norte-Campus *et al.* (2004) at Northern Panay, female *C. feriatus* with 53.4 mm CW starts to mature sexually, which was the smallest female sample with a ripe gonad collected. Moreover, it was found out that male to female sex ratio (2:1) were significantly ( $P < 0.05$ ) different from the expected 1:1 ratio using a Chi-square ( $\chi^2$ ) test. Del Norte-Campus, *et al.* (2004) and Dineshbabu (2011) also reported a *C. feriatus* male dominated population in Northern Panay, Philippines and Karnataka coast, India, respectively.

### **Conclusion and Recommendation**

Biological information generated showed that *C. feriatus* is a continuous breeder with a distinct period of peak reproductive activity during NE monsoon (November-May) with peak in January complemented with the result of GSI, gonad maturity, and high occurrence of ovigerous females. Recommended options include (1) close season, (2) size regulation, (3) no taking of egg-bearing swimming crabs, and

(4) egg-bearing crabs contained in a spawning tank and allowed to release its eggs and the larvae released in fishing ground or marine protected areas.

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