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Fishery characteristics of portunid crabs (*Scylla serrata*) from two different sites along the Sindh Coast (northern Arabian Sea)

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Abstract

Portunid crab (*Scylla serrata*) is most abundant species and commonly known as mud crab. This study was conducted to estimate the sex ratio, carapace width (CW), body weight (BW) and maturity size from two different study sites along the Sindh Coast, Pakistan. A total of 253 and 272 individuals were collected from site 1 and site 2 respectively. The male and female represented sex ratio (1: 0.97) from site-1 and (1: 1.04) from site-2. The average catch per unit effort (CPUE) estimated during whole study period were (1.17±0.40) and (1.26±0.35) from site 1 and 2 respectively. The regression analysis for carapace width-weight indicated strong relationship and size frequency distribution representing higher abundance of individuals within the size class of CW (71-80), (81-90) and (91-110). This study would be helpful for management and monitoring local fishing practice to improve the catch and sustainability of wild population.

Key words : *Scylla serrata*, Portunid crab, Fisheries characteristics

INTRODUCTION

Among the varieties of nutritive crustaceans, mud crab has significant market value[1]. It is commonly found throughout in Indo-west Pacific and Indian Ocean, including Philippines, Japan, Indonesia, Pakistan, Bangladesh, India, East and South Africa [2]. Mud crabs are mainly inhabitant of mangrove swamps as well as other coastal environments such as off-shore water and estuarine for short periods during their life span[3]. The female crabs usually travel toward off shore for spawning. However, larval stages remain as plankton for certain period and they return to mangrove areas in the form of juveniles[4].Mud crab usually prefer to reside in burrows within the mangrove forest at low tide to avoid predation. During this period they feed on fish, mollusks and crustaceans [5]. Distribution and abundance of mud crab are also influenced by the several environmental, behavioral and physiological factors such as temperature, salinity, cannibalism and moulting[1, 6-8]. In addition, overexploitation is considerable factor for the variation in population dynamics for last two decades due to increasing market value which threatening wild abundance [9].

In Pakistan different aspects of Portunid crabs have been studied such as, identification of Portunid species from Karachi [10-13]. biochemical composition calorific values and condition index of edible crabs[14-15] distribution, abundance, diversity indices, population biology, fecundity and toxicity of Portunid swim crab from coastal areas of Pakistan[16-20]. Despite of its biological and economical importance in our country local fishermen usually capture the mud crabs by hand picking method or by placing the trap-net without any consideration for negative impact on wild population. No report, in our knowledge, is available related to abundance of mud crabs from selected sites. Therefore, this work has been planned to establish baseline information about the marketable sized mud crab abundance, helpful for crab fisheries management.

MATERIALS AND METHODS

SAMPLING SITE

Samples of mud crab (*Scylla serrata*) were collected from two different locations, Kakapir mangrove area and Khararo creek area along the Sindh Coast.

Site 1: Kakapir mangrove area (24^{O} 84' 50.37N and 66^{O}89 '97. 37 E) located at Hawksbay, Karachi district. This site façade with dense mangrove vegetation facing open sea.

Site 2: Khararo Creek (24^{O}57'99.42 N and 67^{O}49'87.84 E) located at Thatta district and have large tidal creek with mangrove forest.

CRAB SAMPLING

Samples were collected during Jan-Dec 2014 by circular commercial crab traps(diameter 56cm). This trapping net having vinyl-coated 1.5 cm mesh size wire and two escape rings (5.0 cm inner diameter) for smaller (<60 mm CW) individuals to elude capture. Trash fish and chicken viscera were used as bait in traps, placed at three different locations at each site along the channel for 6 hours during low to high tide. After lifting of nets, samples were washed properly to remove mud, barnacles and algae. Samples were then properly tagged and preserved for further analysis[21-26].

SEX IDENTIFICATION AND SEXUAL MATURITY DETERMINATION

All samples were sexually identified depending on the shape of abdomen[21, 24]. The females have wider and more globular abdomen than male crabs, having narrow and straight abdomen. Maturity of female crab was identified by darkening and widening of the abdomen while presence of spermatophores indicates the sign of maturity in male as described previously [27].

MORPHOMETRIC MEASUREMENTS

The morphological characteristic carapace width (CW)

i.e.distance between the tips of ninth antero-lateral spine of carapace, was determined by using verniercalliper with least count 0.01mm. Body weight (BW) was measured by using digital weight balance with least count 0.1gm. Catch per unit effort (CPUE) per month was determined using formula: $\{n_c/ (n_t x t)\}$ where n_c= number of crabs caught; t= Dip time of trap in hours; n_t; number of traps. Now, CPUE expressed as number of crabs caught per trap per hour [28].

STATISTICALANALYSIS:

Data were analyzed by using three way (ANOVA) to define variability of CW and BW using factors (Months, sex and maturity status). Regression analysis has also been carried out to define the relationship between CW and BW of mature and immature of both sexes.

RESULTS

CAPTURE PER UNIT EFFORT (CPUE)

Site 1's lowest CPUE of mud crab (*Scylla serrata*), observed in April (0.72 crabs trap^{1} hour^{-1}) and the highest in July (2.17crab trap^{1} hour^{-1}). The average CPUE estimated during whole study period was (1.17±0.40 crabs trap^{1} hour^{-1}).Variability observed during all sampling months is represented in Table1. Similarly from site 2 the lowest CPUE was recorded during April (0.83 crab trap^{1} hour^{-1}) and the highest CPUE was observed in the month of July (1.89 crabs trap^{1} hour^{-1}).The mean value (1.26±0.35) of CPUE was estimated from site 2 during sampling period (Figure 1).

ABUNDANCE AND SEX RATIO

During present work, total number of specimens i.e. (n=253) from site-1 and (n=272) from site 2 were analyzed. The overall sex ratio represents no difference (P>0.05) from the expected ratio (1:1)of male and female from both site-1 (1: 0.97) and site-2 (1:1.04).

Site1: In the month of January, abundance of female was higher (52.94%) as compare to that of male (47.06%). However, in February and March male population was (60.00 %) and (56.25%) respectively as compared to female population of(40%) and (43.75%) for the months of February and March respectively. In April (53.85%) and May (53.33%) almost similar percentage of female populations were observed followed by the decreasing pattern of population during June, July, Aug and September whereas higher abundance of male in June (64.29%); July (56.41%), Aug (66.67%) and Sep (54.55%) was observed. In the months of October till December, sharp increment in the female population was recorded than the male population depicted in Table 1.

Site 2: Total number of catch was 272 indicating high variation in abundance percentage of both male and female, during whole sampling period. January showed female abundance of (35.29 %)whereas that of male is (64.71%). From the month of February till May, female population was higher as compared to male population while population of male was high

Table 1: Monthly percentage occurrence of male and female mud crab from study site 1 and site 2.

	Site 1		Site 2	
Month	Male (%)	Female (%)	Male (%)	Female (%)
JAN	47.06	52.94	64.71	35.29
FEB	60.00	40.00	38.46	61.54
MAR	56.25	43.75	40.91	59.09
APR	46.15	53.85	40.00	60.00
MAY	46.67	53.33	43.75	56.25
JUNE	64.29	35.71	53.33	46.67
JULY	56.41	43.59	44.12	55.88
AUG	66.67	33.33	54.84	45.16
SEP	54.55	45.45	47.62	52.38
OCT	25.00	75.00	38.10	61.90
NOV	36.84	63.16	65.22	34.78
DEC	23.53	76.47	56.25	43.75

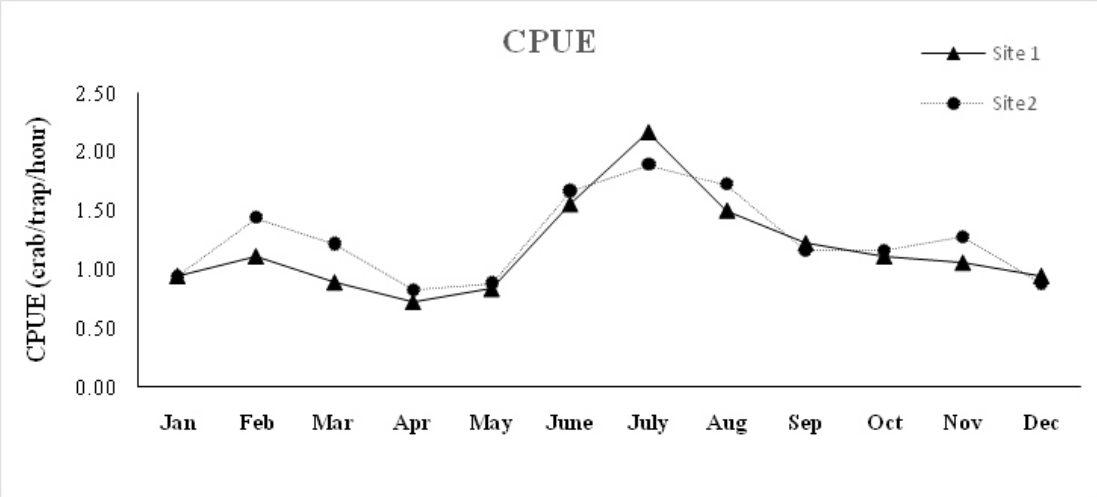

Figure 1 : Representing seasonal CPUE (Capture per unit effort) from site 1 and site 2.

Table 2: Size frequency distribution of total catch from site 1 and site 2

Size Class (CW)	Site 1 (n)	Site 2 (n)	Total (n)
61-70	10	02	12
71-80	89	89	178
81-90	34	77	111
91-100	48	79	127
101-110	66	21	77
111-120	06	04	10

Table 3: Showing morphometric characteristics (BW body weight; CW carapace width) of mud crab (Scylla serrata) from site 1 and site 2.

Sites		Male (Mature)		Male(Immature)		Female (Mature)		Female(Immature)		Total (Male)		Total (Female)	
		CW (mm)	BW (gm)	CW (mm)	BW (gm)	CW (mm)	BW (gm)	CW (mm)	BW (gm)	CW (mm)	BW (gm)	CW (mm)	BW (gm)
Site1	Mean	96.71	230	74.87	98.48	98.23	223.19	75.9	97.51	89.2	184.93	87.36	160.29
	SD	8.38	65.17	4.73	14.61	9.88	66.26	3.97	12.86	12.72	81.95	13.69	80.34
	Max	118.2	400.02	86.55	139.65	116.6	335.15	86.55	139.65	118.2	400.02	116.6	335.15
	Min	76	99.02	67.32	72.29	72.08	96.35	65.32	72.4	67.32	72.29	65.32	71.4
Site 2	Mean	91.65	191.44	75.05	93.88	97.12	204.57	80.63	110.84	83.78	145.22	89.41	160.74
	SD	8.23	65.27	1.9	13.55	7.63	49.02	3.85	18.11	10.3	68.58	10.2	60.21
	Max	126.81	369.4	81.06	133.07	125.72	326.07	86.4	142.99	126.81	369.4	125.72	326.07
	Min	80.34	102.37	70.12	76.32	81.34	98.05	71.34	80.01	70.12	76.32	71.34	80.01

in June (53.33%) as compare to female (46.67%). High abundance (55.88%) of female crabs was also observed in the month of July which decline to (45.16%) in August. Furthermore, increase in female population was observed in September (52.38%) and in October (61.90%). However, high percentage of male population was observed in November (65.22%) and December (56.25%) (Table 1).

CARAPACE WIDTH (CW) - BODY WEIGHT (BW) RELATIONSHIPS

Site 1: The relationship between CW and BW of mature male and female and immature male and female were determined by

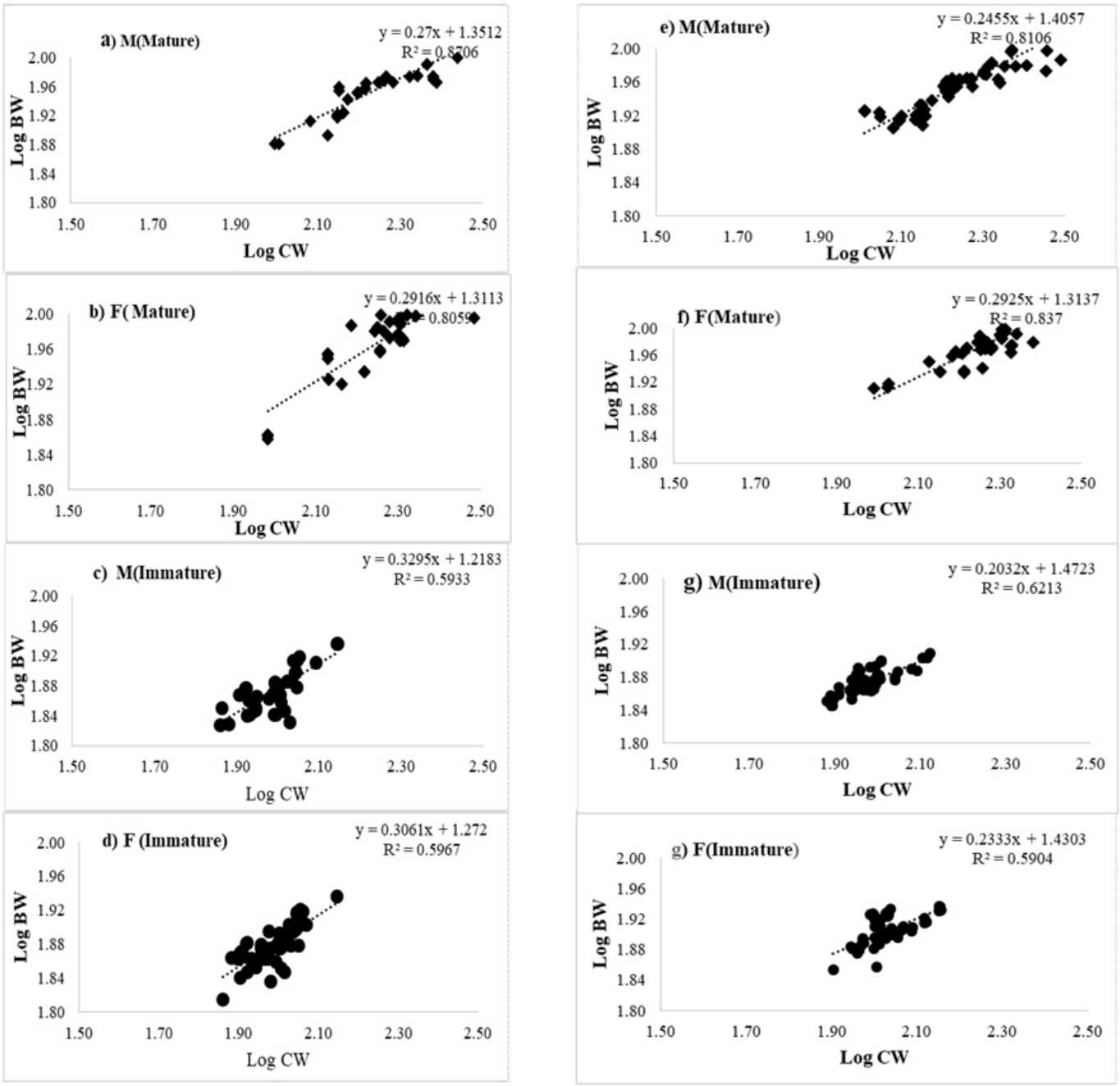

Figure 2 : Regression analysis showing relationship between CW and BW from site 1 (a,b,c,d) and site 2 (e,f,g,h).

regression analysis (Figure 3). The CW-BW showed significantly strong relationship (P≤0.05) for mature male (y=0.27x+1.3512; r^2=0.8706) and mature female (y = 0.2916x + 1.3113; r^2 = 0.8059) The CW-BW moderate relationship existed between immature male (y=0.3295x+1.2183; r^2 = 0.5933) and immature female (y =0.3061x+1.272; r^2=0.5967).

Site 2: There was highly significant relationship (P≤0.05) between CW and BW of mature male and female (y=0.2455x+1.4057; r^2=0.8106)and(y=0.2925x+1.3137; r^2=0.837) respectively. However, Immature male (y=0.2032x+1.4723; r^2 = 0.6213) and immature female (y=0.2333x+1.4303; r^2=0.5904) both represent statistically moderate relationship between CW and BW (Figure 2).

MORPHOMETRIC MEASUREMENTS

Site1: Three way ANOVA has indicated no significant difference in BW of male and female(F=0.28; P>0.05) as well as no significant variability has been observed in BW of specimens in different months (F=0.28; P>0.05). But mature samples showed statistically higher BW as compared to immature specimens (F=365.88; P<0.05). The mean BW of male (184.79gm±82.34) which is higher than that of female BW (159.84gm±78.88). Moreover, mature specimen of both male (230.00gm±65.16) and female (223.18gm±66.26) represented higher body weight than immature male (98.48gm±14.61)and female (97.50gm±12.86) respectively. Using sex as a factor in ANOVA indicates no considerable difference (F=1.20; P>0.05)

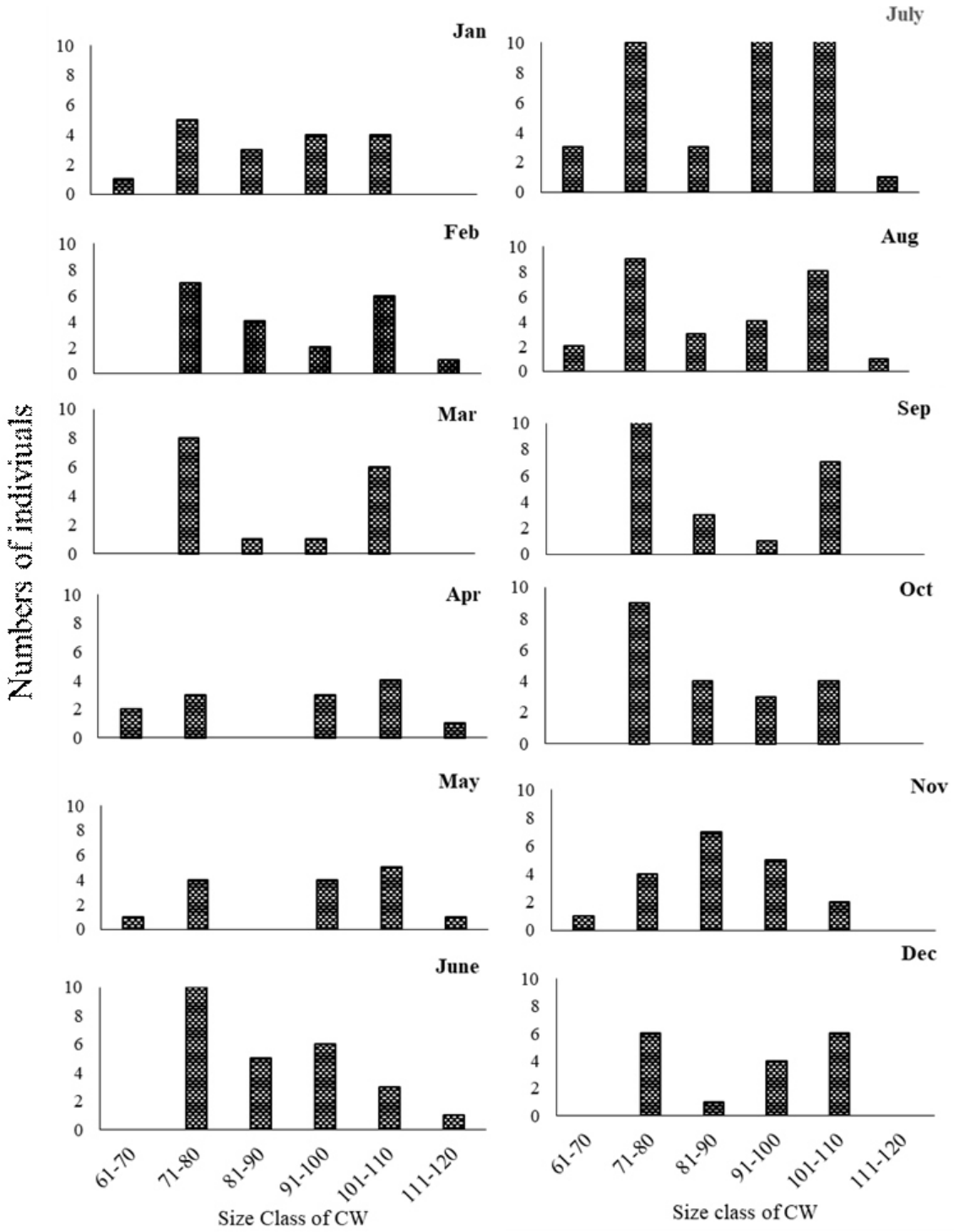

Figure 3 : Size frequency distribution of mud crab (Scylla serrata) found along the coast of Sindh (Site 1)

in CW.Significant difference (F=0.40; P>0.05) has not also been observed in CW during all sampling months (Jan-Dec). However, CW between mature and immature specimens was significantly different (F=507.17; P<0.05).

Site2: Of the total crabs captured (n = 272), no significant difference has been observed in CW (F=1.57; P>0.05) and BW (F=1.84; P>0.05) during twelve months of sampling, while male and female both showed significantly different CW (F=55.44; P<0.05) and BW (F=6.26; P<0.05) during the same period. .Furthermore, CW (F=448.34; P<0.05) and BW (F=299.61; P<0.05)of mature crabs were also statistically higher as compare to that of immature ones. The mean value of CW and BW is depicted in Table-2.

SIZE FREQUENCY COMPOSITION

Site 1: Overall results indicated that most of specimen have

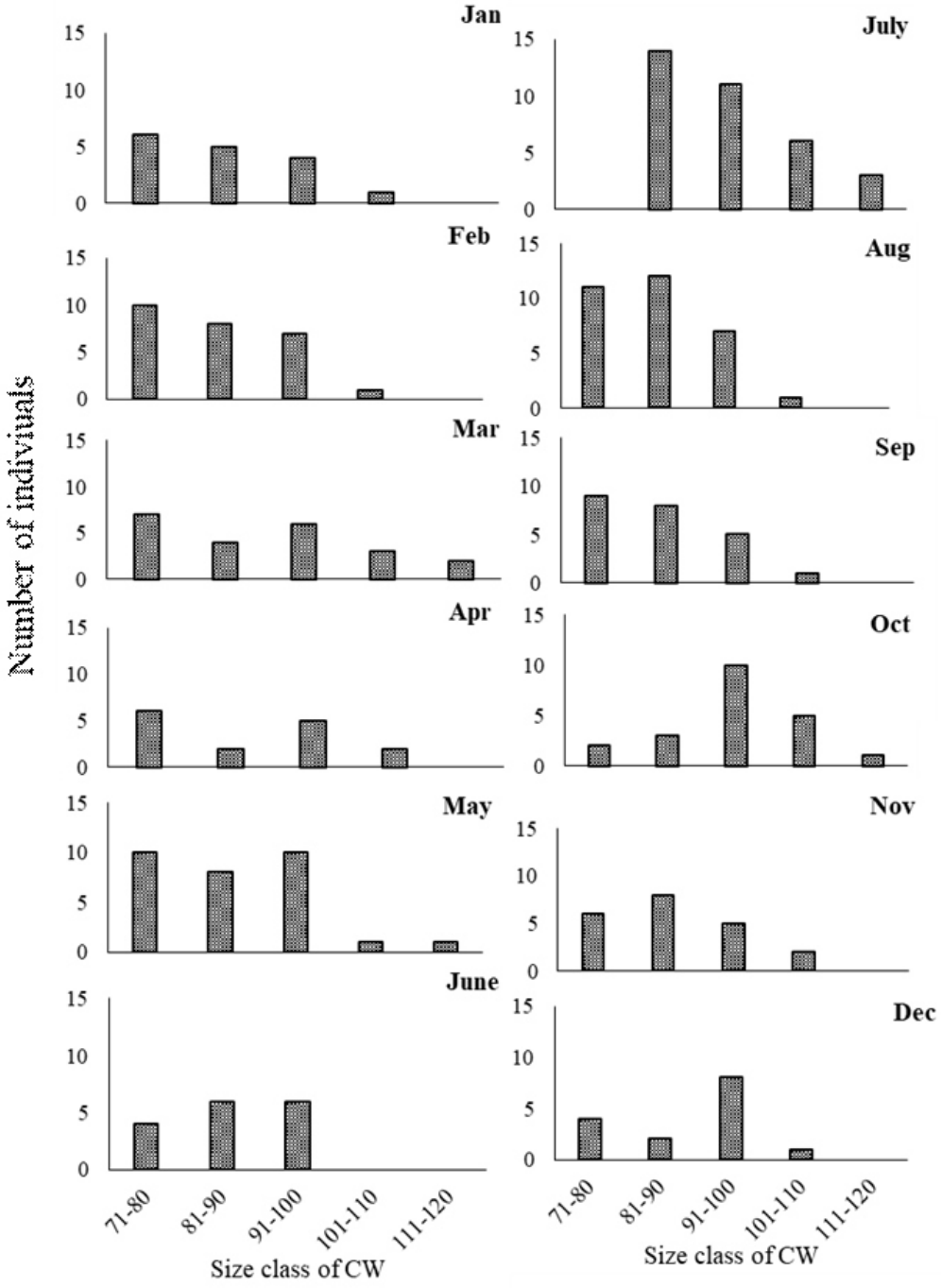

Figure 4 : Size frequency distribution of mud crab (Scylla serrata) found along the coast of Sindh (Site 2)

size class (71-80mm) of CW while low abundance was observed within the size class of CW (111-120 mm) (Table-3). Analysis of seasonal size frequency distribution has indicated that majority of specimen lies within the size class (71-80 mm) of CW from January to March. In the months of April and May, maximum number of specimen lies within the size class (101-110mm) of CW. In June, again higher number of specimen showed CW within the size class of (71-80mm).July showed most of specimens existed in size classes (91-100) and (100-110)of CW. From August to October size class (71-80mm) of CW was dominating. In the month of November, maximum number of specimens were observed within size class (81-90mm) of CW. However, in December majority of specimen lies within size classes(71-80mm) and (101-110mm) of CW (Figure 3).

Site 2: Among the total catch, majority of crabs (n=78) indicated its (70-80mm) CW size class as compare to small number of samples (n=10) showed its size class within size range (111-120mm)(Table-3).According to monthly catch majority of specimens were identified within size class (71-80mm) of CW during the months of January toApril. In the month of May, CW of most of specimen lie within the size classes of (81-90mm) and (91-100mm). However, in June specimen also showed its majority within the size classes (71-80mm) and (91-100mm) of CW. From July to September and December, dominating size

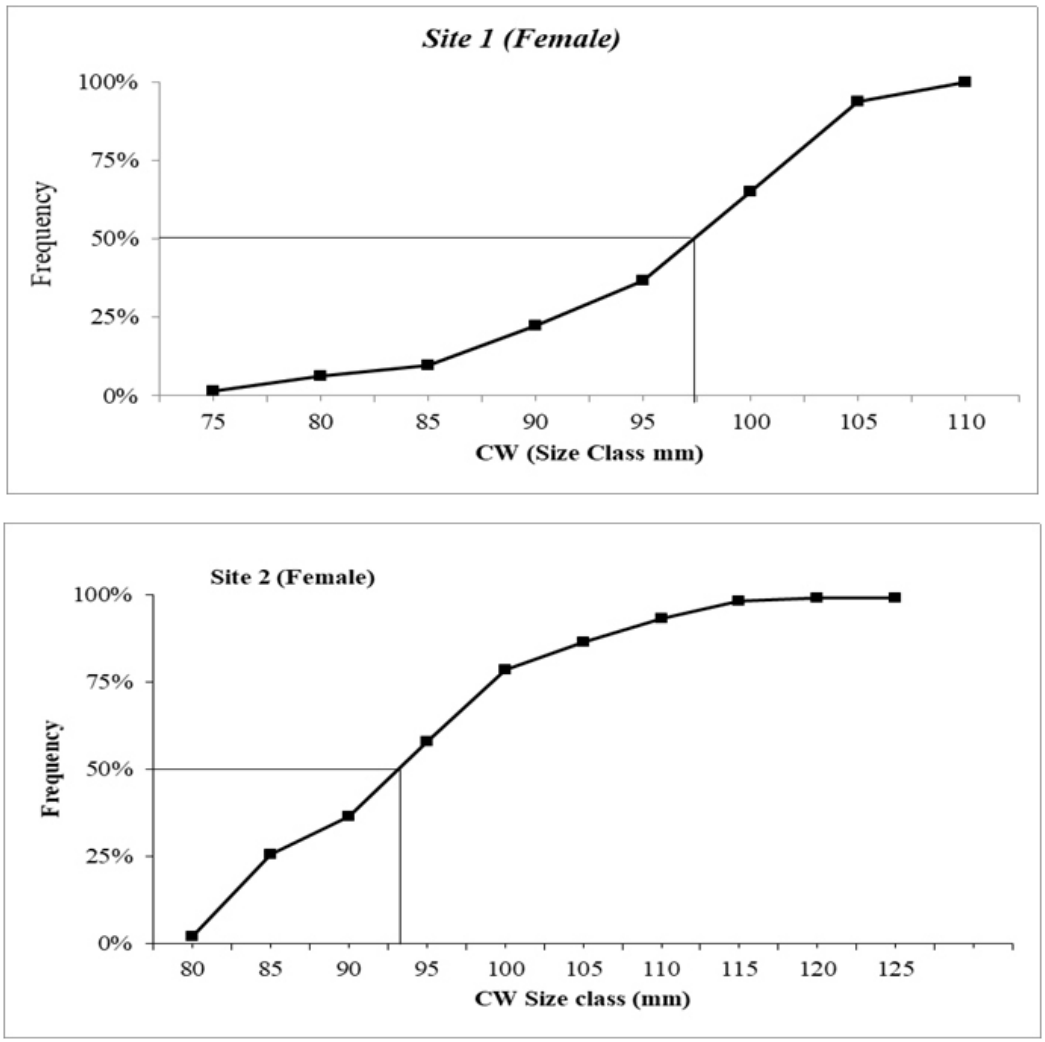

Figure 5 : Estimation of percent of mature females mud crab (*S. serrata*) as a function of CW (50%) of cumulative frequency at 97.5 mm from site 1 and 94.00mm from site 2.

class of CW was(91-100mm). While in October and November specimens showed (81-90mm) of CW size class(Figure 4)

DISCUSSION

Crab belonging to genus *Syclla*, are widely distributed throughout the Indo Pacific.[12, 29-32]. In Pakistan, different species of this genusare also found and easily captured by local fishermen from mangrove forests and off shore waters. Although mud crab is frequently found inPakistani waters, it is not preferred as sea food in Pakistan as compared to fish and shrimps. However, crab is an expensive delicacyin Far Eastern countries, American and European continents, making it an important export sea food item[33].

The overall sex ratio (male : female) of the mud crab *Scylla serrata* indicated that male and female were evenly captured during whole sampling period. However, variability in sex ratio of male and female was observed during sampling months. La Sara (2001) found that sex ratio of *S. serrata* and *S. tranquebarica* in several coastal waters of Southeast Sulawesi were 7. 25: 1 and 1.14: 1, respectively[34]. Variability of sex ratio in different investigation reports may be varied due to catching methods, seasonal factors and diet availability.

The occurrence of female was low in the months of February and March as well as in the month of November from site 1. Similarly, from site 2 population of female was lean from November to January, owing to migration of gravid females toward the off-shore waters for spawning [21, 35,36]. This spawning behavior is in agreement with previous reports [36].

CPUE may be a good index of relative abundance[37]and also utilized as sensitive measure of variability in crab population [38]. Present results indicate that variability in CPUE during whole study period with highest value in July and lowest in April corresponding to salinity as a main influencing factor on CPUE[39].The average CPUE from site1 was 1.17 crabs per traps per hour and from site 2 was 1.26 crabs per trapper hour which is representing low CPUE as Robertson (1996) reported that 0-1.67 crab per trapper night neither able to sustain the population, nor able to meet the increased market demand due to overexploitation[40]. Moreover, CPUE mainly influenced by fishing time, distance covered for catch. Studies also indicate that the CPUE is associated with the fishing method. Usually, trap is one of the easiest and more convenient way of collecting mud crabs in mangroves and offshore habitats[23, 40-42]

The relationship of body weight with CW has useful

application in the field of fisheries [33]. It is used to estimate biomass as well as yield of meat from different size of specimens [47]. In present work, regression analysis has also been applied indicating highly positive and significant relationship of CW with weight BW of mature crabs from both sites as previously allometric growth pattern in *Scylla serrata* has been reported from Indonesia[43]. However, immature specimens showed moderate relationship of CW with weight BW may be due to the factors such as molting, food, growth rates etc.

Estimation of female maturity depending on size is considered as an important factor in fisheries management. In present study, estimated size CW for female maturity were observed at 97.5 mm and 94.00mm from both sites 1 and 2 respectively. However, mud crabs of smaller size from coastal area of Ranong showed maturity at 70 mm carapace width and all were found to be mature at 100 mm carapace width. In Moreton Bay, Australia, maturity starts from 90 mm and ends at 120 mm.[24, 44]. From Lawele Bay, Southeast Sulawesi, estimated size of maturity for females was 151.57 mm of CW[34].As the maturity at different sizes from different locations indicating that the growth rate is dependent on seasons, geographical positions, availability of natural diet and other environmental parameters [34]. Quinn and Kojis, (1987) reported that high water temperature have played an important role for fast growth and maturity[45]. Therefore, mud crab (*Scylla serrata*) attain its maturity at a smaller size in tropical region. Moreover, higher incidence of maturation seems to be associated with seasonal high rainfall, which may be related to periods of high productivity in coastal waters [23, 46].

CONCLUSION

In present study baseline biological and population feature such as CW-body weight relationship, maturity size and sex ratio of mud crab (*Scylla Serrata*) has been studied and it would be helpful in fisheries management particularly in Pakistan.

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