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Impact of Trawl Fish Ban on Artisanal Brachyuran Crab Fishery in and Around Sikka, Gulf of Kutch, Gujarat, India

Gadhavi M.K.*[1], Kardani H.K.[1], Pathak Rajal[1], Prajapati P.C.[1] and Vachhrajani K.D.[2]
[1]Fisheries Research Station, Sikka Campus, Junagadh Agricultural University, Sikka 361140, Gujarat, INDIA
[2]Department of Zoology, Faculty of Science, The M. S. University of Baroda, Vadodara 390002, Gujarat, INDIA

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Abstract

Over the last two decades exploitation of mud crab population has increased in many countries of South East Asia and it supports substantial commercial fishery and is an important component of traditional fisheries. In Sikka, large numbers of fishermen are engaged in artisanal crab fishery using spears, traps and other traditional gears like umbrella net and fence net. The species of crabs which are largely captured are Scylla serrata and Portunus pelagicus. In the absence of regulations, fishing activities may target all size-classes, including juvenile crabs, adult and sub-adult crabs as well as gravid females. In Gujarat during monsoon, from 15th June to 15th August mechanical trawler fishing activities has banned, which are known as no fishing time or fishing-ban. During this period most of the fisherman prefer traditional crab fishing as crabs are easily captured with minimum efforts. The purpose of this study is to find impact of trawl fish ban (TFB) on artisanal crab fishery and compare with Post trawl fish ban (PTFB) period in and around Sikka. Data was collected from three sites; i. Vador ii. GSFC jetty area and iii. Reliance Jetty area. We studied trend of crab fishery and morphometric study of captured crab from June –August, 2012 (TFB) and September to November, 2012 (PTFB). Results suggest that number of fishermen in artisanal fishery increased four folds during trawl fish ban and the study area is heavily exploited for crab fishery. The catch per unit effort is decreased while total catch is greatly increased during TFB. The findings suggest that the area is extensively explored for crab fishery during TFB period and that more number of smaller crabs is captured during this period.

Keywords: Brachyuran crab, trawl fish ban, artisanal fishery, Sikka.

Introduction

Mud crabs of the genus *Scylla* are large and conspicuous crustaceans associated with mangrove ecosystems throughout the Indo-Pacific region[1]. In this region they support extensive artisanal fisheries, with large male crabs and mature female crabs being particularly valuable[2]. While blue swimming crab *Portunus pelagicus* is found in tropical regions and distributed in indo Pacific Ocean, Mediterranean Sea and east coast of Africa. In tropical region the blue swimming crab shares a huge portion in small-scale coastal fisheries in many countries[3,4,5,6]. In India, crab catches are obtained largely from Tamil Nadu, Kerala, Karnataka, Odisha and to certain extent from Maharashtra and Gujarat[7,8,9]. However, substantial quantities of crabs are landed every year as by-catches of shrimp trawlers and of indigenous fishing units throughout the country. Crustacean fisheries accounted 16% of the total fishery landing of India with an annual production of 312,000 tons per year where the crab fishery constituted about 7%[7,10,11].

In the state of Gujarat, since last two decades small-scale crab fishery has developed in Kutch and Saurashtra mainly at Jakhau, Jamnagar, Dwaraka, Vanakbara - Diu, Navabander, and Patanbara – Veraval[12]. In Jamnagar district crab fishing is widespread where mainly traditional fishing practices are used, while at some places trawler fishing is also carried out. Rao and Kasim[13] described the commercial viability of this part of Gujarat. In spite of the fact that the state actually leads in marine crab production in India, crab fishery as a whole has not been accorded much significance in the fisheries scenario of the state[12]. It is at the most a subsistence fishery in the creeks of Peninsular Saurashtra and in the Gulf of Kutch, where it was fished by spears, traps and other traditional gear like umbrella nets and fence nets, and it hardly secured dominance in the trawl fishery. According to the Gujarat state fisheries department, in the southern belt of Gulf of Kutch (Jamnagar district) crab fishing ranged from 312 to 779 tons/year; mainly represented by two genera, *Scylla serrata* and *Portunus pelagicus*.

An initial survey on crab fishery was carried out by FRS campus, Sikka in coastal talukas of Jamnagar district which included Jamnagar, Jodiya, Khambhalia, Kalyanpur and Okha Mandal during March and April, 2012. During this study we came to know that due to trawl fish ban (during June15-August 15) majority of Fisherman remain engaged with artisanal crab fishery. Banning of trawling during monsoon season is important among the regulatory measures of resource conservation in India[14]. Consequently all the maritime states in India have enacted legislation for ban on trawling in various periods of monsoon season.

It was observed that the fishermen engage themselves in artisanal crab fishery during the trawl fish ban period. Therefore, present study was carried out to compare the status of crab fishery during these two differing periods.

Methodology

The studies on crab fishery were carried out at Sikka region (figure 1) during trawl fish ban period (TFB) (June – August, 2012) and post-trawl fish ban period (PTFB) (September – November, 2012) to evaluate the effect of trawl fish ban on artisanal crab fishery. Study area includes three regions; S1 Vador area (525 hectare), S2 GSFC Jetty area (500 hectare), and S3 Reliance Jetty area (600 hectare). Survey of the study area was carried out twice in a month, at the interval of 15 days. Both primary and secondary data were utilized for the study. To utilize primary data total number of fisherman, total catch and catch per unit effort (CPU) were estimated. For utilization of secondary data 1-5% of total catch was selected for catch composition and morphometric analysis of the crab.

Morphometric analysis: About 200 individuals of *Scylla serrata* and 80 individuals of *Portunus pelagicus* were randomly selected from the total catch of study area. They were analyzed for carapace width-weight relationship, average weight average carapace width and M: F ratio. Crabs in the inter-moult stage with all appendages intact were considered for the study since crabs in pre-moult and post-moult stages showed marked variations in weight. All materials were analyzed in fresh conditions. The crabs were washed thoroughly to remove all mud, sand and epizoic forms. Carapace Width (CW) between tips of the longest lateral spines across the middle line between the frontal notch and posterior margin was measured using a vernier caliper (0.1 mm accuracy). Individual crab weight was taken in a Docbel (BRAUN) weighing balance (accuracy: 2 g) after removing all adhering water from the body using a blotting paper.

Stastical Analysis: PAST (1.91)[15] used for statistical analysis.

The carapace width-weight relationships for *S. serrata and P. pelagicus* were determined separately for male, female and for both sexes by the method of least squares using the logarithmic forms of the exponential equation;
W = a + CW (b),

W= weight (g), CW= carapace width (mm) and ‘a’ and ‘b’ are constants.

For this purpose, the observed values of carapace width and weight of individual crabs were transferred into logarithmic values and regression analysis was carried out to calculate the ‘a’ and ‘b’ values. The correlation coefficient was determined to know the degree of association of the two variables.

Figure-1
Satellite image of study area

Results and Discussion

Crab fishery: During low tide artisanal crab fishing is carried out in intertidal zone for all the days, throughout the year, however fishing hours varies according to lunar cycle and season. Artisanal crab fishery constituted of two species, viz., *Scylla serrata* and *Portunus pelagicus.* The major contributor was of *Scylla serrata* with 80% and 90% of total catch during TFB and PTFB respectively. Total fishermen number increased to four folds during TFB compared to PTFB hence total catch increased 350% during TFB; however CPU increased 140% during PTFB (table 1).

Table-1
Preliminary finding on crab fishery

Period	Trawl Fish Ban (TFB)			Post Trawl Fish Ban (PTFB)		
Site	S1	S2	S3	S1	S2	S3
Fisherman (appx.)	45	75	65	12	15	16
Av. Catch (kg.) /fisherman /day	6.5	7.8	7.2	9.2	10.3	10.2
Total Catch (kg.) /day	300	600	500	120	150	130
CPU kg/ fisherman / hr	1.5	1.95	1.8	2.3	2.6	2.55

Male-female ratio: M: F ratio is decreased in *S. serrata* and increased in *P. pelagicus* during PTFB (table 2).

Table-2
Male female ration (M: F)

Crab Species	*S. Serrata*	*P. pelagicus*
TFB	1:0.85	1:0.6
PTFB	1:0.72	1:0.82

Carapace width-weight Relationship: A scatter diagram each for males, females and both sexes during TFB season and PTFB season of *S. serrata and P. pelagicus* was obtained by plotting the graph of carapace width against total weight of individual crabs (figure 2-13). The logarithmic equation derived from scatter diagram is shown in tables 3 and 4.

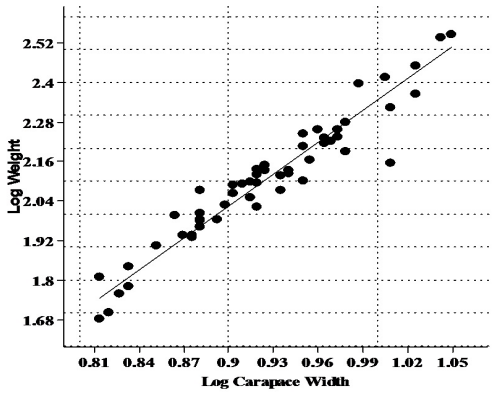

Figure-2
Logarithmic relationship between carapace width-weight of male S. serrata during TFB

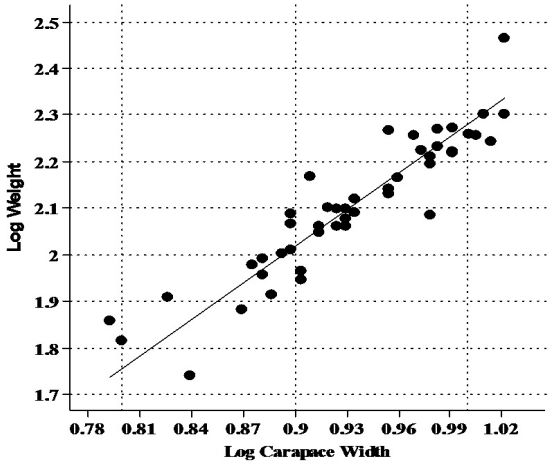

Figure-3
Logarithmic relationship between carapace width-weight of female S. serrata during TFB

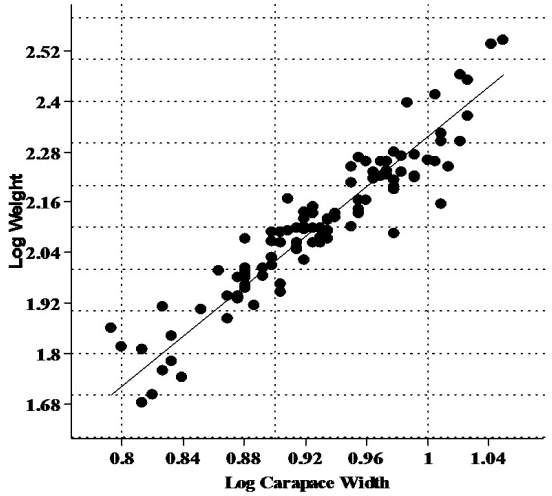

Figure-4
Logarithmic relationship between carapace width-weight of both sexes S. serrata during TFB

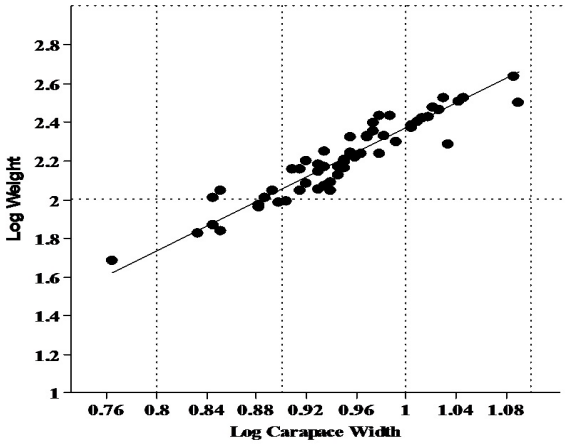

Figure-5
Logarithmic relationship between carapace width-weight of male S. serrata during PTFB

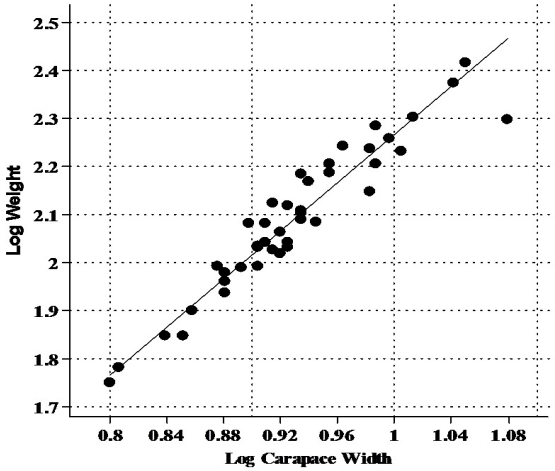

Figure-6
Logarithmic relationship between carapace width-weight of female *S. serrata* during PTFB

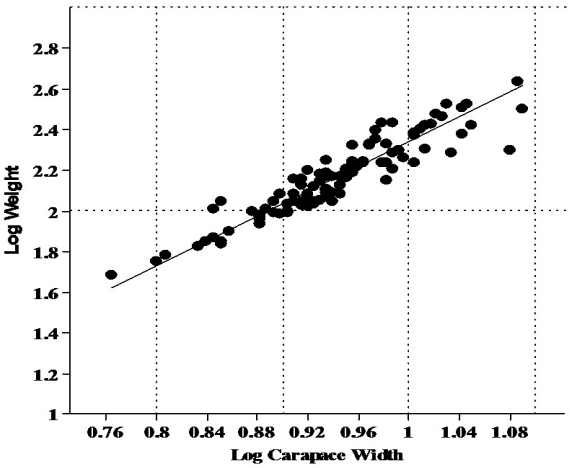

Figure-7
Logarithmic relationship between carapace width-weight of both sexes *S. serrata* during PTFB

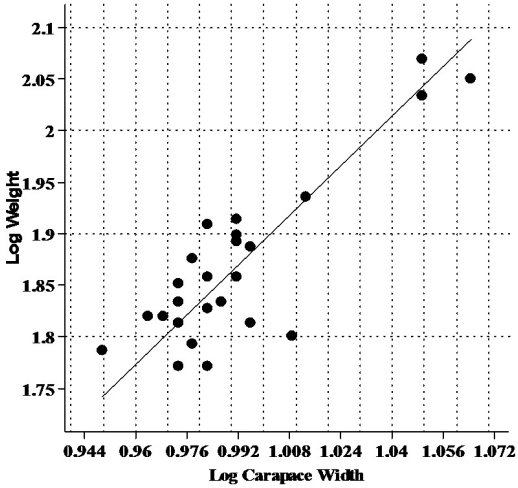

Figure-8
Logarithmic relationship between carapace width-weight of male *P. pelagicus* during TFB

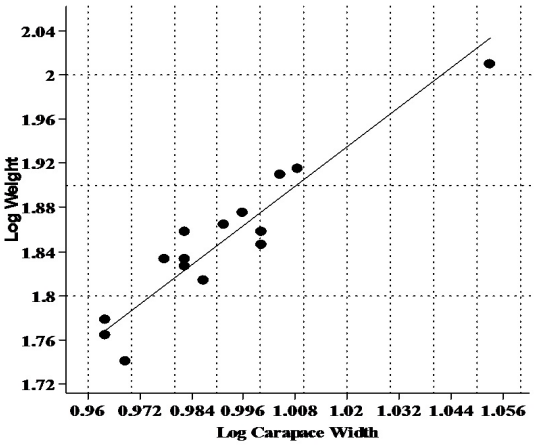

Figure-9
Logarithmic relationship between carapace width-weight of female *P. pelagicus* during TFB

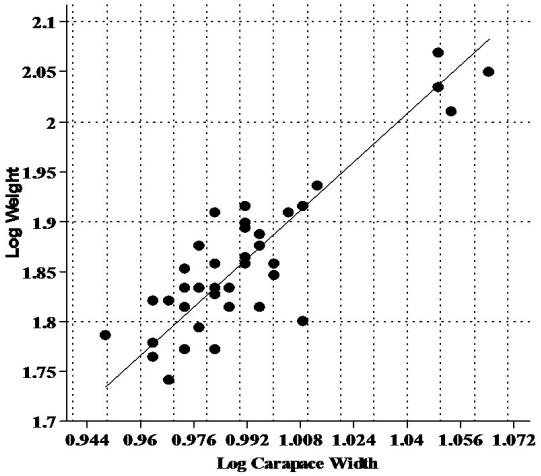

Figure-10
Logarithmic relationship between carapace width-weight of both sexes' *P. pelagicus* during TFB

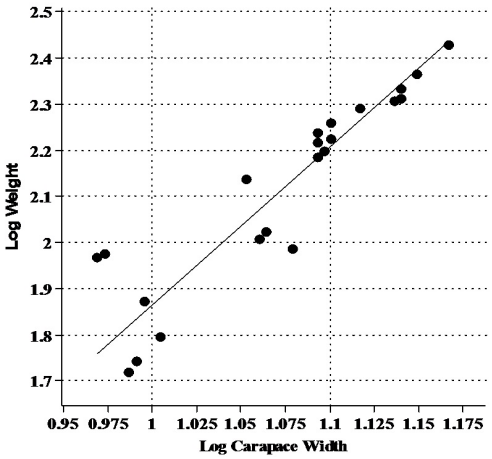

Figure-11
Logarithmic relationship between carapace width-weight of male *P. pelagicus* during PTFB

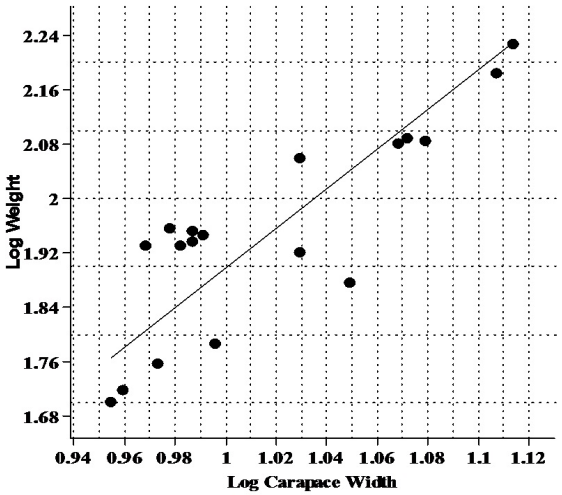

Figure-12
Logarithmic relationship between carapace width-weight of female *P. pelagicus* during PTFB

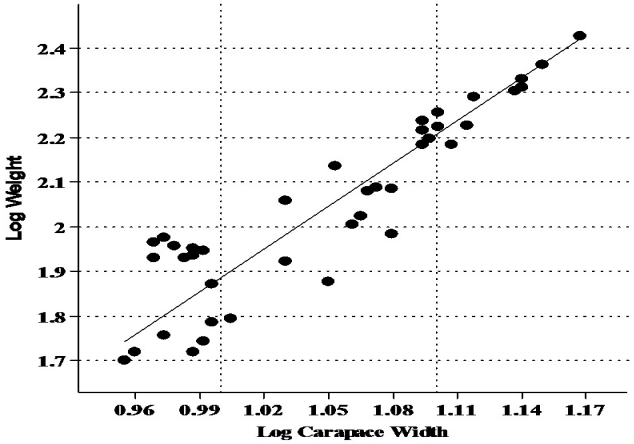

Figure-13
Logarithmic relationship between carapace width-weight of both sexes' *P. pelagicus* during PTFB

Table-3
Logarithmic equation showing carapace width-weight relationship (*S. serrata*)

Season	TFB	PTFB
Both Sexes	Log W = -0.64803 + 2.9641 log CW (r = 0.938)	Log W = -0.7081 + 3.0456 log CW (r = 0.930)
Male	Log W = -0.8742 + 3.2206 log CW (r = 0.959)	Log W = -0.8092 + 3.1783 log CW (r = 0.940)
Female	Log W = -0.3340 + 2.6135 log CW (r = 0.923)	Log W = -0.2414 + 2.5068 log CW (r = 0.953)

The coefficient of correlation (r) obtained for the carapace width-weight for all the results were nearly equal to 1 indicating that the values were significant. The exponential values (b) of the carapace width-weight relationship of male and female for *Scylla serrata* during TFB were 3.2206 and 2.6135, whereas in during PTFB these were 3.1783 and 2.5068 respectively, thereby indicating that males were significantly heavier than females. The exponential values (b) of the carapace width-weight relationship of male and female for *Portunus pelagicus* during TFB were 3.055 and 2.9597, whereas those during PTFB were 3.4032 and 2.9014 respectively, thereby indicating that males were significantly heavier than females. This tendency is in conformity with the earlier observations in *P. pelagicus, P. sanguinolentus* and *S. tranquebarica*[16,17,18].

Table-4
Logarithmic equation showing carapace width-weight relationship (*P. Pelagicus*)

Season	TFB	PTFB
Both Sexes	Log W = -1.1313 + 3.0184 log CW (r = 0.875)	Log W = -1.297 + 3.184 log CW (r = 0.909)
Male	Log W = -1.1118 + 3.055 log CW (r = 0.857)	Log W = -1.537 + 3.4032 log CW (r = 0.914)
Female	Log W = -1.0845 + 2.9597 log CW (r = 0.943)	Log W = -1.003 + 2.9014 log CW (r = 0.846)

An ideal organism which maintains its shape throughout, the value of 'b' will be '3'[19], but in a number of organisms the value of 'b' lies between 2.5 and 4.0[20]. In present study we found that the 'b' values of carapace width - weight relationships for *S. serrata* were found to be from 2.6135 to 3.2206 and for *P. pelagicus* it varies from 2.9014 to 3.4032.

The exponential values (b) of the Carapace width-weight relationship of *S. serrata* (for both sexes) during TFB were 2.9641 while in case of PTFB was 3.0456, indicating no significant difference. Range of carapace width was 62-112 (average 85) and 58-112 (average 88) during TFB and PTFB respectively, while Range of weight was 48-349 (average 137) and 48-430 (average 158) during TFB and PTFB respectively. The exponential values (b) of the carapace width-weight relationship of *P. pelagicus* (for both sexes) during TFB were 3.0184 while in case of PTFB was 3.184, there by indicating not much significant difference. Range of carapace width for *P. pelagicus* was 89-116 (Average 98) and 90-147 (Average 113) during TFB and PTFB respectively, and range of weight was 55-117 (Average 74) and 50-266 (Average 122) during TFB and PTFB, respectively.

Conclusion

The findings clearly suggest that during TFB smaller sized crab is fished as compared to PTFB since all the sites are been heavily exploited. This may have very distinct effect on the crab resources and fishery over a longer period of time. Measures and regulations are required for such activities also in view of the commercial value as well as conservation aspects.

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