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Carapace length-weight and Carapace width-weight relationship and condition factor of intertidal crabs from Maharashtra, India

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Abstract

Carapace length-weight and carapace width-weight relationship of 10 species of crabs collected from intertidal region of Maharashtra was studied. A significant positive correlation was found between carapace length-weight and carapace width-weight for all species. The regression coefficient (b) indicated positive allometry. The condition factor (K) showed significant variation among the species. The findings of the study will be useful in estimation of stocks, planning for conservation strategies and selection of species for culture.

Keywords: intertidal crabs, length-weight, condition factor, Maharashtra

Introduction

The length-weight relationship is considered suitable, not only for assessment of growth pattern in fishes, but also for crustaceans (Sukumaran and Neelakantan, 1997) [22]. Length-weight relationship provides taxonomic difference and events in life history of fishes and crustaceans (Jaiswar & Kulkarni, 2002) [7] and also considered useful in calculating the biomass, condition indices and several other aspects of population dynamics (Atar and Secer, 2003) [1]. It is also used to obtain information on the somatic growth condition of fish to find out whether it is isometric or allometric (LeCren, 1951; Ricker, 1975) [12, 19]. Any alteration in this relationship indicates variation in ecology of habitat or physiology of animal or both (Jaiswar & Kulkarni, 2002) [7]. Considerable amount of data on fishes has been reported (Panda *et al.*, 2011, Kumar *et al.*, 2012, Surendra *et al.*, 2017, Sreekanth *et al.*, 2017, Monalisha devi *et al.*, 2018, Vishwambharan *et al.*, 2018) [17, 11, 23, 21, 15, 25]. Similarly, length weight relationship of commercially important species of crabs has been investigated by many workers (Sukumaran & Neelkantan 1997, Gokc *et al.*, 2006, Mohapatra *et al.*, 2010, Josileen 2011, Oluwatoyin *et al.*, 2013; Khan 2013) [22, 5, 10, 9, 16, 10]. However, very limited reports exist on non-commercial species of crabs that are very important ecologically. Therefore, the paper represents the length weight relationship and condition factor of selected species of crabs collected from intertidal areas of Mumbai and Jaitapur coast.

Materials and Methods

A total of ten species of crabs were collected from intertidal areas of Mumbai (18°58'30"N 72°49'33"E) and Jaitapur (16.59°N 73.35° E) coast by handpicking during March 2014 to Feb 2015 (fig 1). Carapace length (CL- length along the midline, from the frontal tooth to posterior margin of carapace), Carapace width (CW- the distance between the last two anterolateral teeth) and weight of collected species of crabs were measured using Vernier caliper and sensitive balance, respectively. The length-weight and width-weight relationship was calculated by using the equation $W=aL^b$ (Le Cren 1951) [12], where W= weight, L= length, *a* and *b* are constant. The values for *a* and *b* were calculated by using linear regression. Fulton's condition factor was estimated by using formula $K=W \times 100/L^3$ (Fulton, 1902), where K is condition factor, W= weight, L=length.

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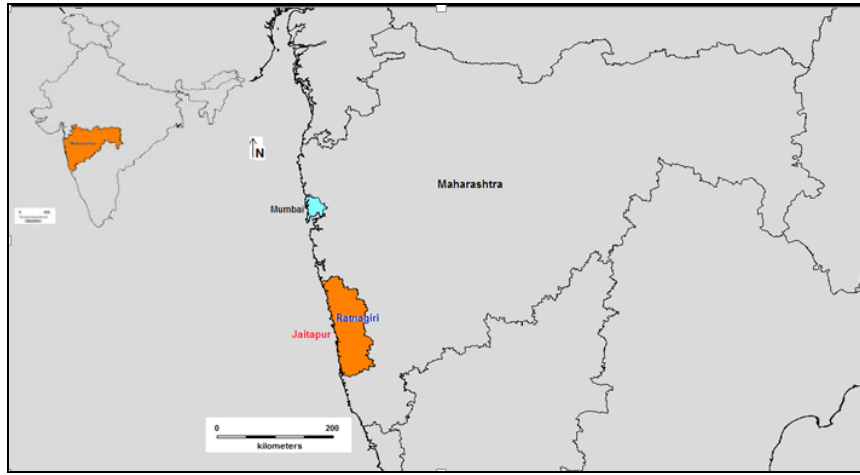


Fig 1

Results

Carapace length-weight and carapace width-weight relationship for ten species of crabs viz. *Charybdis lucifera*, *Charybdis annulata*, *Thalamita crenata*, *Leptodius exaratus*, *Ashtoret lunaris*, *Menippe rumphii*, *Metopograpsus messor*, *Ryphila cancellus*, *Ocypode ceratophthalmus*, *Grapsus albolineatus*, collected from intertidal areas of Mumbai and Jaitapur, was established. For each species, the resultant parameters obtained for carapace length-weight, carapace width-weight relationship and condition factor are presented in Table.1a & 1b. The linear regression between carapace length or width and weight were found to be highly significant ($p < 0.001$). The coefficient of correlation (r) ranged from 0.58 to 0.90, indicating very high correlation among compared characters for all species. The regression coefficient (b) was in range of 0.583 to 3.674. The coefficient of determination (R^2) was found to range from 0.334 to 0.813 for

all species. Besides, Fulton's condition factor was found to range between 0.04 and 0.1 for carapace length-weight and 0.01 and 0.6 for carapace width-weight (Table-1-a & b).

Carapace length and weight relationship for different species can be written as: $W = -1.705 L^{1.841}$ for *C. lucifera*, $W = -1.518 L^{1.844}$ *C. annulata*, $W = -0.821 L^{1.337}$ *T. crenata*, $W = -0.337 L^{0.583}$ *L. exaratus*, $W = -2.809 L^{2.557}$ *A. lunaris*, $W = -1.764 L^{1.988}$ *M. rumphii*, $W = -0.679 L^{0.811}$ *M. messor*, $W = -3.996 L^{3.674}$ *R. cancellus*, $W = -2.226 L^{2.359}$ *O. ceratophthalmus*, $W = -1.991 L^{2.042}$ *G. albolineatus*. Similarly, Carapace width and weight relationship can also be presented as: $W = -1.975 L^{1.803}$ for *C. lucifera*, $W = -2.532 L^{2.323}$ *C. annulata*, $W = -1.195 L^{1.448}$ *T. crenata*, $W = -0.423 L^{0.569}$ *L. exaratus*, $W = -3.739 L^{2.832}$ *A. lunaris*, $W = -2.919 L^{2.617}$ *M. rumphii*, $W = -1.020 L^{1.031}$ *M. messor*, $W = -3.587 L^{3.309}$ *R. cancellus*, $W = -2.626 L^{2.548}$ *O. ceratophthalma*, $W = -2.045 L^{2.068}$ *G. albolineatus*.

Table 1(a): Carapace length-weight relationship

Species	Length	Weight	n	a	b	r	r ²	CF (K)
<i>Charybdis lucifera</i>	1.8-47.4	0.43-50	73	-1.705	1.841	0.87	0.7564	0.05
<i>Charybdis annulata</i>	6.7-53.84	0.11-54	74	-1.518	1.844	0.794	0.6306	0.10
<i>Thalamita crenata</i>	2.7-47.68	0.5-66.5	50	-0.821	1.3369	0.78	0.6083	0.07
<i>Leptodius exaratus</i>	0.7-23.74	0.1-9.5	92	-0.367	0.5831	0.578	0.3342	0.10
<i>Ashtoret lunaris</i>	17.23-49.63	1.0-40.3	60	-2.81	2.5571	0.849	0.6858	0.04
<i>Menippe rumphii</i>	16.09-50.34	1.0-56	59	-1.764	1.9883	0.877	0.7174	0.06
<i>Metopograpsus messor</i>	4.78-24.0	0.5-8.5	35	-0.679	0.8109	0.699	0.4878	0.10
<i>Ryphila cancellus</i>	8.06-13.51	0.252-1.2	26	-3.996	3.6742	0.901	0.8136	0.06
<i>Ocypode ceratophthalma</i>	6.06-43.33	0.162-79	45	-2.226	2.3594	0.776	0.5215	0.09
<i>Grapsus albolineatus</i>	13.73-49.23	1.0-34	35	-1.991	2.0419	0.8	0.5654	0.04

Table 1(b): Carapace width-weight relationship

Species	Width	Weight	n	a	b	r	r ²	CF (K)
<i>Charybdis lucifera</i>	2.6-71.48	0.43-50	73	-1.975	1.803	0.853	0.7271	0.02
<i>Charybdis annulata</i>	9.4-67.94	0.11-54	74	-2.532	2.323	0.811	0.6573	0.1
<i>Thalamita crenata</i>	3.9-68.24	0.5-66.5	50	-1.195	1.4489	0.823	0.678	0.03
<i>Leptodius exaratus</i>	0.9-34.64	0.1-9.5	92	-0.423	0.569	0.595	0.3537	0.05
<i>Ashtoret lunaris</i>	25.83-70.3	1.0-40.3	60	-3.739	2.8326	0.828	0.7201	0.01
<i>Menippe rumphii</i>	21.17-56.34	1.0-56	59	-2.92	2.617	0.847	0.7694	0.04
<i>Metopograpsus messor</i>	8.29-28	0.5-8.5	35	-1.02	1.0314	0.714	0.5094	0.05
<i>Ryphila cancellus</i>	7.6-13.36	0.252-1.2	26	-3.587	3.3096	0.902	0.8125	0.06
<i>Ocypode ceratophthalma</i>	8.14-51.96	0.162-79	45	-2.626	2.5475	0.722	0.6027	0.6
<i>Grapsus albolineatus</i>	14.04-50.47	1.0-34	35	-2.045	2.0681	0.752	0.6401	0.04

Discussion

The correlation coefficient (r) showed positive and highly significant ($p < 0.001$) correlation for length-weight and

width-weight relationship. The findings are similar to results of Yogamoorthi & Siva Sankar (2010) [27]; Dubey *et al.*, (2014) [3]; Atar & Secer, (2003) [1]; Sukumaran &

Neelakantan, (1997) ^[22]. According to Pauly (1984) ^[18] and Sparre (1992) ^[20], b value should not be <3 or >3, values other than 3 indicate allometric growth. Variation in the relative growth coefficient b reported for different places suggests interregional difference in length-weight relationship (Jaiswar *et al.*, 2004) ^[8] and results in allometric growth (Dubey *et al.*, 2014) ^[3]; Atar & Secer, 2003; Oluwatoyin *et al.*, 2013; Mehanna *et al.*, 2013) ^[1, 16, 13]. In present study, calculated 'b' values were different for studied species which may be due to species specific and environmental factors such as shape, fatness, sex, stage of maturity, time of year, temperature, salinity and food. Condition factor (K) is the important biological parameters which indicate the suitability of a specific water body for growth of fish (LeCren, 1951) ^[12]. Condition factor has been used as an index of growth and feeding intensity (Fagade, 1979) ^[4]. It also reported to decrease with increase in length (Bakare, 1970; Fagade, 1979) ^[2, 4] and influences the reproductive cycle in fish (Welcome, 1979) ^[26]. The condition factor (K) showed variation between carapace length-weight and carapace width-weight relationship which may be influenced by the seasonal changes of gonads, feeding intensity, habitat and other environmental factors (Dubey *et al.*, 2014) ^[3]. The species like *A. lunaris*, *O. ceratophthalma*, *R. cancellus* and *G. albolineatus* seems to be good candidate species for culture or fattening for economic benefits as their growth coefficient was found to be high. The data can be used as baseline data for future crab fishery management purposes.

Conclusion

The present studies provide the first detailed information on both economical and non-economical crabs of Maharashtra. Though they are commercially non-economical, they play very important role in functioning of aquatic ecosystem especially intertidal. It can be used as guideline for future research by the fishery biologists and conservation biologist, for successful development, management and production.

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