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New distribution record of *Varuna litterata* from Caraga Region, Philippines: Analysis on morphometry, length/width-weight relationship, and condition factor

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Abstract. *Jumawan JH, Ruales JJJ, Avila MCA. 2022. New distribution record of* Varuna litterata *from Caraga Region, Philippines: Analysis on morphometry, length/width-weight relationship, and condition factor. Biodiversitas 23: 2935-2942.* The study reported the occurrence of *Varuna litterata* in its habitat as a new record in Caraga Region, Philippines. The crab samples were collected using a hand-picked method and were of marketable sizes. There were 14 morphometric traits measured with the corresponding weight and sex of each specimen. Majority of the crab samples were medium-sized, with weight ranging from 11-20 grams, a carapace width range of 28-34 cm, and a carapace length range of 27-32 cm. Exploratory analysis of length /width-weight data fits the power regression model depicted into graphs. A strong relationship and highly significant was observed on pooled samples of WT-CW variables (R^2: 0.9229: $P<0.001$) and WT-CL variables (R^2: 0.9197); $P<0.001$). The derived log-transformed for WT-CW relationship was logWT: -2.7994+2.6456 logCW. Results suggest that carapace length and width tend to be smaller relative to the weight, which is an indication of a negative allometric growth pattern. The computed Fulton's condition factor was higher in males than females, as supported by Kruskal Wallis test ($P<0.001$). The data provides baseline information for comparing similar studies and in understanding the population dynamics of this crab species.

Keywords: Allometric growth, Fulton’s condition factor, Hubo River, regression model

INTRODUCTION

There is limited information on the allometry, length/width-weight relationships, and condition factor of *Varuna litterata* in the Philippines. Inventory of the remaining edible crab populations in the wild is also insufficient, especially in the Mindanao islands of the country. The local community collects the crabs in desirable sizes either for food consumption or to be sold in local markets (Motoh 1980). These collected crab samples can also provide information on its growth and biology. Little is known about the maturity size, range, comparative morphometry of sexes, and IUCN red list status of *V. litterata* (Palomares and Pauly 2022). Inventory of the remaining edible crab populations in the country is also insufficient. Reporting the areas with the presence of existing *V. litterata* in its natural populations could also be helpful in future studies related to biogeography, genetic analysis, source of stocks for aquaculture, and understanding the population dynamics of crab species.

In the Philippines, *V. litterata* is commercially harvested and exploited as food in rural areas. The crab species is locally known as "talangka" and the eggs attached to the abdominal appendages of females are considered as a delicacy. The crab species occurrence is sporadically recorded in Luzon, Negros, Panay and Palawan islands. In Mindanao Island, it was reported to occur in Zamboanga provinces, Davao provinces, Sarangani province, and Misamis Oriental (Mapi-ot et al. 2020). The current study is the first to report on its occurrence in Caraga Region, located in the northeastern Mindanao Island of the Philippines. There is reported overexploitation of *V. litterata* in the country due to demand for protein food resulting to a low population in its natural habitats (Subang et al. 2020). The natural habitats of other edible crabs are also subjected to ecological disturbances and polluted environments due to anthropogenic activities (Nelson et al. 2015; Pati et al. 2017; Yogeshwaran et al. 2020).

The length/width-weight relationships are considered as an important component in understanding the ecology, taxonomy, behavioral, biological investigation, and habitat suitability evaluation of crustacean populations are regarded as more suitable for evaluating crustacean populations (Noori et al. 2015). The morphometric data of crabs is influenced by genetic and environmental factors, which can be evaluated by the proportions to its weight. On the other hand, the condition factor gives information on the "well-being" of species which in turn could suggest feeding and adjusting mechanisms to the environment. Both length/width-weight relationships and condition factor evaluation were commonly applied to various species of crabs, hence were adopted in this study. The species *V. litterata* is becoming scarce and the desirable sizes for food consumption are getting difficult to catch. Thus, a reliable crab supply while maintaining the protection of crab species in the wild is actively pursued to ensure long-term crab supply as a food source (Asaduzzaman et al. 2021). This study is the first report on the occurrence of the species in the local area and provides an initial evaluation of its biological condition, which is important baseline information for its conservation.

MATERIALS AND METHODS

Study area

The study was conducted and the collection of *V. litterata* was done at Hubo River, San Agustin, Surigao del Sur, Philippines, with the coordinates 8.755045° N, 126.210971° E (Figure 1). The Hubo River runs through the municipalities of Marihatag and San Agustin in Surigao del Sur. It drains into the eastern part of Mindanao and has an estimated drainage area of 213 square kilometers. This study reports the presence of *V. litterata* in Hubo River in its natural habitat.

Data collection and measurement

A total of 106 specimens of *Varuna litterata* were collected and analyzed in this study. The freshwater crabs were collected in the month of October 2021. All samples were collected using the hand-picked method assisted by trained local collectors (Yasser et al. 2020). The size of the crab samples were the preferred sizes ideal for food delicacy and selling to local markets. Sampling was carried out at dawn when the crabs were inactive and aided with flashlights. Carapace and chelae were carefully examined, and specimens with injuries or with missing limbs were discarded from the analyses. Identification of the crab's sex was based on the morphology of the abdomen, which was narrow for males and wider for females (Figures 2D and 2E). Crabs were rinsed with tap water and placed in the freezer for preservation purposes. Individual freshwater crab body weights were measured in grams using the digital weighing scale.

Description and morphometric traits of crab samples.

Information on morphometric measurements of *V. litterata* sampled in its natural habitat is very limited in the Philippines. This is the basis for including this component, as most morphological traits were based on taxonomic reports on the presence of the species in the country (Jingkatal and Ramos, 2019; Lagare et al. 2020; Subang et al. 2020). The measurement for morphometric traits was shown in Figure 2 using a caliper which includes the carapace width (CW), carapace length (CL), merus length (MEL), merus width (MEW), manus length (MAL), and dactylus length (DAL), 2nd pereopod length (2PL), 2nd pereopod width (2PW), 3rd pereopod length (3PL), 3rd pereopod width (3PW), 4th pereopod length (4PL), 4th pereopod width (4PW), natatory leg dactylus length (NDL), and natatory leg dactylus width (NDW). The morphometric data were summarized using descriptive statistics like mean, standard deviation, maximum, and minimum values.

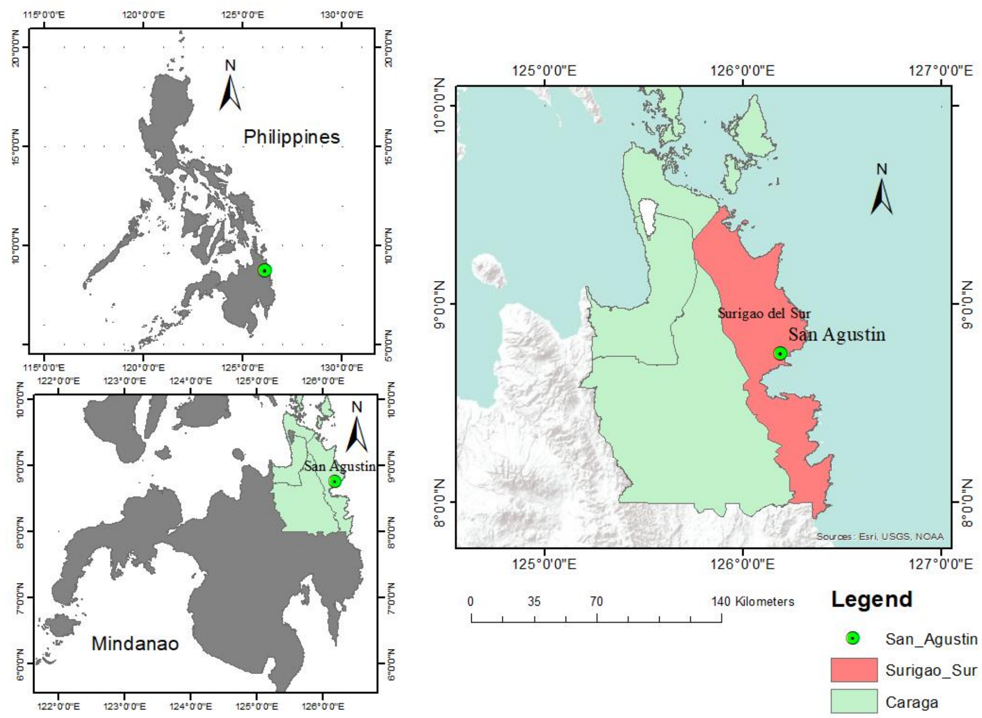

Figure 1. Map of the sampling area: A. Map of the Philippines; B. Map of Caraga Region inset of Mindanao Island; C. location of Hubo River, San Agustin, Surigao del Sur, Philippines

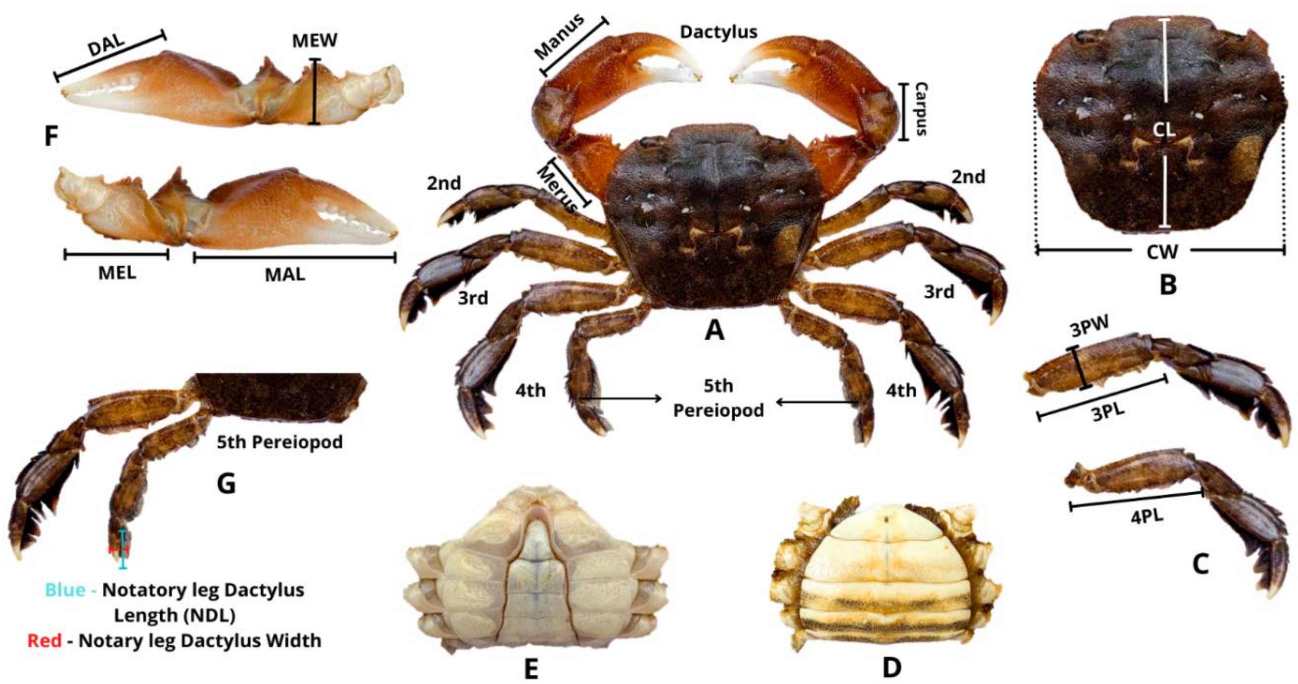

Figure 2. The measurements used for morphometric studies in *Varuna litterata*: A. dorsal surface and appendages; B. carapace; C. pereiopods; D. abdomen (female); E. abdomen (male); G. notatory leg; F. cheliped

Determining the class sizes of crab samples

The collected crab samples were the preferred sizes for food consumption which could also be categorized based on the size of carapace and weight. It is important that the class sizes would be quantified and described. In this manner, a frequency distribution table was initially constructed based on the weight, carapace length, and carapace width of crab samples. These data variables were selected as the main basis to arbitrarily describe the crabs into small, medium, and large class sizes. A class limit of three was implemented and the resulting data was displayed in a histogram.

Fitting the morphometry data into the regression model

The values on carapace width (CW), carapace length (CL) and the weight (WT) data were used to analyze the length-width/weight relationships. These were further classified into female, male, and pooled data categories for comparison. The selected variables were initially evaluated for the fitting regression model. The exponential, linear and power functions were considered and the highest R^2 values were selected for analysis on the crab's allometric growth. The selected regression model based on the highest R^2 values was displayed in the graph defined by the equation.

Analysis on the length/width-weight relationship and condition factor

The power equation was the validated best-fitting regression model performed using morphometry data of crab samples (Noori et al. 2015). The allometric growth equation is defined by Y=aXb, where Y is the dependent variable (WT: weight); X is the independent variable (CW: carapace width; and CL: carapace length); a is the intercept on y-axis; and b is the allometric growth coefficient (slope). The value of the b was used to determine the growth pattern as: b=3, isometric growth; b>3, positively allometric growth; and b<3, negatively allometric growth. The strength of the correlation of X and Y variables was indicated by the coefficient of determination R^2 values of the regression analysis. The power regression equation was log-transformed to compare the length/width-weight relationship among female, male, and pooled crab data sets. Consequently, the dependent and independent variables were analyzed by linear regression log**Y= a + b logX**. The strength of the relationship of variables was assessed by the R^2 values and the significant differences were tested using Analysis of Variance (ANOVA) at $P<0.05$. The condition factor (CF) was calculated using the modified Fulton's formula: CF = (100WT)/CWb (Froese 2006). Only the WT and CW were used to evaluate the CF values for female, male, and pooled data sets. The non-parametric Kruskal-Wallis statistic ($P<0.05$) was implemented to test significant differences among compared data sets. The CF values provide information on the well-being of the sampled crab.

RESULTS AND DISCUSSION

Habitat, identification, and morphometric description of *Varuna litterata* samples

This study is a new distribution record on the occurrence of existing populations of *V. litterata* in its natural habitat. It was in Hubo River, Brgy. Buhisan in the municipality of San Agustin, Surigao del Sur, Philippines. The matured crab samples were collected at about 2000 meters of linear distance from the river mouth. The elevation profile along the river path was about 15 to 20 meters above sea level (masl). The river section where the crab samples were collected is a typical freshwater ecosystem and the preferred location of catching matured crab samples. The *V. litterata* species were known to inhabit the estuarine part of the river system facing the oceanic waters and going inward as far as 20 km to the freshwater ecosystem (Palomares and Pauly 2022). The stretch of Hubo River has noticeable active quarrying areas, a disruptive activity for freshwater crab habitat.

The *V. litterata* species display the morphological diagnostic characters leading to its identification (Figure 2). The carapace is a squarish, smooth, and flat dorsal surface, slightly broader in width than the length, straight frontal margin, and the sinuate supraorbital margin appears cut at an inner angle. The anterolateral margin with 2 broad short teeth located behind the orbit, the former tooth is more prominent than the latter. The posterolateral margin is somewhat inclined outwards, defined by a slanting ridge. The carpus, propodus, and dactylus part of the walking legs with distinct, closely packed hairs are rather flattened designed for paddling.

A total of 106 individual species were collected and analyzed, of which 59 (57%) were males and 47 (44%) were females. Descriptive statistical analysis showed that males of *V. litterata* had a mean body weight of 12.7 grams and the minimum and maximum weight ranged from 5.00 to 22.00 grams, while females had a mean body weight of 11.9 grams and ranged from 5 to 25 grams. This implies that males are slightly heavier than females of *V. litterata*. In terms of carapace length and width, the females are a bit longer in carapace length (29.2 mm) compared to males (29 mm), whereas males have a wider carapace (31.9 mm) than females (30.8 mm). A similar report by Mahapatra et al. (2017) indicates that males of *V. litterata* are heavier in weight and longer in carapace length than females in India. The results of the mean, standard deviation, maximum, and minimum of the other morphometrics like merus length (MEL), merus width (MEW), manus length (MAL), dactylus length (DAL), 2nd pereopod length (2PL), 2nd pereopod width (2PW), 3rd pereopod length (3PL), 3rd pereopod width (3PW), 4th pereopod length (4PL), 4th pereopod width (4PW), natatory leg dactylus length (NDL) and natatory leg dactylus width (NDW) in males, females, and combined sexes were presented in Table 1.

Studies pertaining to freshwater and estuarine crabs in Mindanao Island of the Philippines is limited in the past decade. Research fields are sporadically related to biology and taxonomy of crab samples found in several sites on Mindanao Island (Jingkatal and Ramos 2019; Lagare et al. 2020). Fishery assessments pertaining to economically important mud crabs were conducted in Caraga region, Philippines (Castrence-Gonzales et al. 2018; Presilda et al. 2018). A more focused study on economically important crab species was tackled (Baylon and Tito 2012; Abduho and Madios 2018). However, there are interesting findings on the discovery of new freshwater crab species occurring in cave environments in Caraga region, Philippines (Takeda 2009; Husana 2020). Discovery of new species implied that further research is still needed on freshwater and estuarine crabs in the southern Philippines. The present study is relevant as it reports a new distribution record of *V. litterata* in its remaining natural habitats providing information on allometry, length/width weight relationship and condition factor.

Table 1. Descriptive statistics summary result on the morphometrics of *Varuna litterata*

	Female				Male				Combined			
Morphometrics	**Mean**	**SD**	**Min.**	**Max.**	**Mean**	**SD**	**Min.**	**Max.**	**Mean**	**SD**	**Min.**	**Max.**
n	**47**				**59**				**106**			
WT (gram)	11.9	4.1	5.0	25.0	12.7	3.9	5.0	22.0	12.3	4.0	5.0	25.0
CW (mm)	30.8	3.9	22.0	40.5	31.9	4.0	21.0	40.0	31.4	3.9	21.0	40.5
CL (mm)	29.2	3.6	21.0	39.0	29.0	3.3	20.0	35.0	29.1	3.4	20.0	39.0
MEL (mm)	9.8	1.5	7.5	14.0	12.6	2.5	8.0	20.0	11.3	2.5	7.5	20.0
MEW (mm)	5.4	0.9	3.5	8.0	7.3	2.0	4.0	13.0	6.5	1.9	3.5	13.0
MAL (mm)	14.7	2.2	10.5	21.0	21.3	4.8	11.0	31.0	18.4	5.1	10.5	31.0
DAL (mm)	9.3	1.5	6.5	13.5	12.9	3.1	7.0	19.0	11.3	3.1	6.5	19.0
2PL (mm)	12.3	1.3	9.5	16.0	13.3	1.6	9.0	16.5	12.8	1.5	9.0	16.5
2PW (mm)	4.2	0.6	3.0	5.5	3.8	0.4	2.0	4.5	4.0	0.5	2.0	5.5
3PL (mm)	15.1	1.8	10.0	20.0	16.0	1.9	11.5	19.5	15.6	1.9	10.0	20.0
3PW (mm)	5.5	0.7	4.0	7.0	4.9	0.5	3.5	6.0	5.2	0.6	3.5	7.0
4PL (mm)	14.9	1.5	12.0	19.0	15.3	1.7	11.5	19.0	15.1	1.6	11.5	19.0
4PW (mm)	5.6	0.8	4.0	7.5	5.0	0.5	4.0	7.0	5.3	0.7	4.0	7.5
NDL (mm)	7.9	1.0	5.5	10.5	8.1	1.2	5.5	13.0	8.0	1.1	5.5	13.0
NDW (mm)	2.3	0.4	1.5	3.5	2.3	0.4	1.5	3.0	2.3	0.4	1.5	3.5

Note: WT: body weight; CW: carapace weight; CL: carapace length; MEL: merus length; MEW: merus width, MAL: manus length; DAL: dactylus length; 2PL: 2nd pereopod length; 2PW: 2nd pereopod width; 3PL: 3rd pereopod length; 3PW: 3rd pereopod width; 4PL: 4th pereopod length; 4PW: 4th pereopod width; NDL: natatory leg dactylus length; NDW: natatory leg dactylus width.

The class sizes of crab samples were categorized in three classes representing small, medium, and large, based of the size of the carapace and weight data. The histogram for weight data showed the small crab size ranged from 1-10 grams (consisting of 32%), the medium size ranged from 11-20 grams (consisting of 65%), and the large size ranged from 21-30 grams (consisting of 3%) as shown in Figure 3A. The carapace width data indicated small size ranged from 20-27 mm (consisting of 12%), the medium size ranged from 28-34 mm (consisting of 69%), and the large size ranged from 35-41 mm (consisting of 19%) shown in Figure 3B. The carapace length data revealed small size ranged from 20-26 mm (consisting of 14%), medium-size ranged from 27-32 mm (consisting of 72%), and large size ranged from 33-39 mm (consisting of 14%) as shown in Figure 3C. The data indicated that majority of the collected samples could be categorized as medium for marketable and food consumption size.

The length/width-weight data of the crab samples were subjected to exploratory analysis of fitting data models. It is important that the actual data needs to be validated rather than assuming it fits an expected type of data model. The highest coefficient of determination R^2 values was selected as the best fitting regression model. All data sets fit the power equation as compared to exponential and linear regression equations (Table 2). The results showed that the power equation fits for WT-CW relationships (pooled data with R^2: 0.9247; female data with R^2: 0.9248; and male data with R^2: 0.9258). The power equation also fits best for WT-CL relationships (pooled data with R^2: 0.8918; female data with R^2: 0.9147; and male data with R^2: 0.9053. A scatter diagram was obtained by plotting WT against CW and CL of pooled, female, and male crab data sets. The graph of length/width-weight fitting the power regression model was displayed in Figure 4.

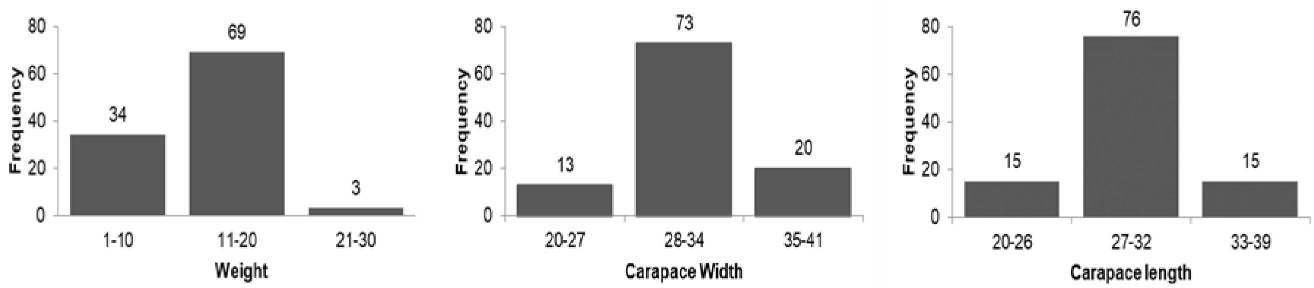

Figure 3. The histogram of the crab weight and sizes of carapace categorized into small, medium, and large classes

Table 2. Exploratory analysis of fitting the length/width-weight data into various regression models with corresponding equation and coefficient of determination R^2 values. The equation with high R^2 values were indicated in bold letters

Relationship	Data models	Equations	R^2 Values
WT-CW, Pooled	Exponential	$WT = 21.546e^{0.03\,CW}$	$R^2 = 0.8550$
	Linear	WT = 0.9276 CW + 19.994	$R^2 = 0.8926$
	Power	$WT = 12.574\,CW^{0.3695}$	**$R^2 = 0.9247$**
WT-CW, Female	Exponential	$WT = 21.848e^{0.0283\,CW}$	$R^2 = 0.8470$
	Linear	WT = 0.8823 CW + 20.321	$R^2 = 0.8900$
	Power	$WT = 12.787\,CW^{0.3602}$	**$R^2 = 0.9248$**
WT-CW, Male	Exponential	$WT = 21.317e^{0.0312\,CW}$	$R^2 = 0.8709$
	Linear	WT = 0.9588 CW + 19.768	$R^2 = 0.8975$
	Power	$WT = 12.487\,CW^{0.374}$	**$R^2 = 0.9258$**
WT-CL, Pooled	Exponential	$WT = 20.638e^{0.0274\,CL}$	$R^2 = 0.8373$
	Linear	WT = 0.7911 CL + 19.393	$R^2 = 0.8639$
	Power	$WT = 12.617\,CL^{0.3378}$	**$R^2 = 0.8918$**
WT-CL, Female	Exponential	$WT = 20.846e^{0.0279\,CL}$	$R^2 = 0.8631$
	Linear	WT = 0.8335 CL + 19.346	$R^2 = 0.8952$
	Power	$WT = 12.405\,CL^{0.3514}$	**$R^2 = 0.9147$**
WT-CL, Male	Exponential	$WT = 20.321e^{0.0277\,CL}$	$R^2 = 0.8356$
	Linear	WT = 0.7731 CL + 19.259	$R^2 = 0.8639$
	Power	$WT = 12.549\,CL^{0.3349}$	**$R^2 = 0.9053$**

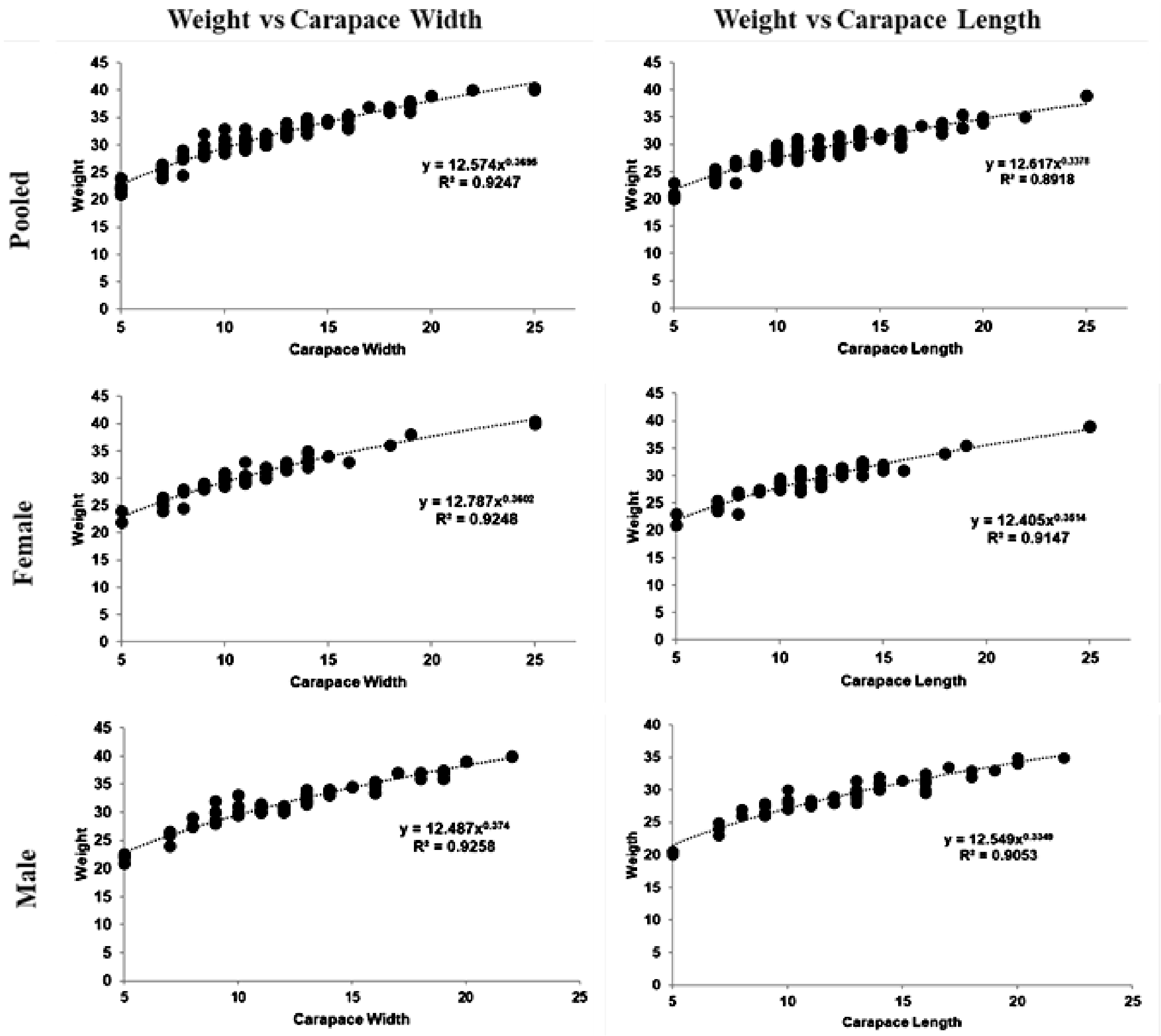

Figure 4. The power regression model of the length/width-weight of crab samples. The CW-CT and CW-CL relationships were tested using pooled, female, and male data sets. The y variable is the weight and the x variable is CT and CL respectively

The length/width-weight relationship is considered more suitable for evaluating crab populations (Sangun et al. 2009). The data is usable in knowing the variations of length and width variables given the expected weight of crab species. The application of this principle is adapted to determine the length/width-weight relationship of the marketable size of *V. litterata*. The length/width-weight relationship is commonly displayed as a regression equation and several studies directly assume to fit the power equation (Hamida and Hamida 2019). It was indicated that regression analysis needs to be evaluated to generate a more reliable fitting equation for interconversion between variables (Pinheiro and Fiscarelli 2009). After carefully evaluating the fitting regression equation, a robust analysis on crab morphometry and weight relationship can be performed. In this aspect, the comparison of the length/width-weight relationship among sexes and pooled data sets can evaluate (Noori et al. 2015). In this study, all the considered dependent and independent variables classified into pooled, female, and male data sets were determined to fit the power regression equation.

Carapace length/width-weight relationship and condition factor

The analysis on WT-CW relationship of pooled samples revealed a strong relationship between two variables (R^2: 0.9229), and this relationship was significant ($P<0.001$). The 'b' value (0.3695) for WT-CW pooled samples showed a negative allometric growth pattern. When the WT-CW relationship was evaluated for female and male data sets, a similar pattern was observed. There was a strong WT-CW relationship noted for female data (R^2: 0.9197) and this relationship was significant ($P<0.001$). A strong WT-CW relationship again for male data (R^2: 0.9259) and this relationship was significant ($P<0.001$). The 'b' value for WT-CW for both female and male data displayed a negative allometric growth pattern as well. However, it was noted that 'b' value for male data (0.3740) is slightly higher than 'b' value for female data (0.3602).

Table 3. Allometric length/width-weight power equations and the linearized form showing the corresponding R^2 value and P value for pooled, female, and male data set

Relationship	Samples	Power function	Linearized power function	R^2 value	P value
WT-CW	Pooled	y = 12.574x0.3695	log WT = - 2.6642 + 2.4980 log CW	0.9229	P<0.001
WT-CW	Female	y = 12.787x0.3602	log WT = - 2.7419 + 2.5535 log CW	0.9197	P<0.001
WT-CW	Male	y = 12.487x0.3740	log WT = - 2.6342 + 2.4754 log CW	0.9259	P<0.001
WT-CL	Pooled	y = 12.617x0.3378	log WT = - 2.7994 + 2.6456 log CW	0.8938	P<0.001
WT-CL	Female	y = 12.405x0.3514	log WT = - 2.7244 + 2.5806 log CW	0.9069	P<0.001
WT-CL	Male	y = 12.549x0.3349	log WT = - 2.8857 + 2.7157 log CW	0.9095	P<0.001

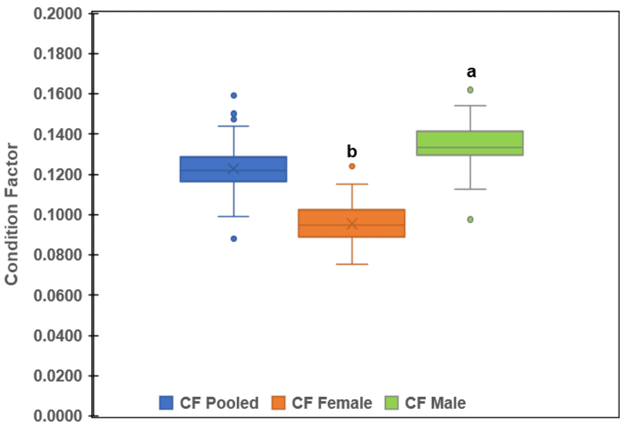

Figure 5. Comparison on the condition factor of female, and male data sets using Kruskal Wallis test indicated by means of different letters are significant at P<0.001

Similarly, the analysis on WT-CL relationship of pooled samples also indicated a strong relationship (R^2: 0.8938) and this relationship is significant (P<0.001). The 'b' value (0.3378) for WT-CL pooled data depicted a negative allometric growth pattern. The WT-CL relationship was also strong for female data sets (R^2: 0.9069), which is significant at P<0.001. For male data sets, the WT-CL relationship was strong (R^2: 0.9095) and significant at P<0.001. The 'b' value for WT-CL of females (0.3514) was slightly higher than 'b' value for males (0.3349).

Modified Fulton's formula was implemented to compare the condition factor (CF) among the pooled, female, and male data sets. The WT-CW was used as it gave a high coefficient of determination R^2 value (0.9229) for pooled data sets compared to WT-CL with R^2 value of 0.8938. Only WT-CW was considered as it would be redundant to include the WT-CL relationship in computing the condition factor. The mean CF for pooled data was 0.1229±0.0117 standard deviation (SD). The mean CF for females was 0.0956±0.0095 SD, while the mean CF for males was 0.1347±0.0123 SD. The CF for female and male data sets were compared using the Kruskal-Wallis test (P<0.001). The result showed that CF was high for males than females CF values (Figure 5).

The length/width-weight relationship was evaluated only on the collected marketable size samples. It could be the reason for the negative allometric growth was detected for pooled, female, and male data sets. However, the data was consistent in showing a highly significant strong relationship of the compared variables, as indicated by the coefficient of determination and the one-way ANOVA values. Generally, the growth of crustaceans in nature is hard to measure (In *V. litterata*, the carapace length and width tend to be smaller relative to the weight, an indication of negative allometry growth. Negative allometric growth was also observed in studies of *Thalamita crenata* sampled in Panjang Island Banten, Indonesia (Susanto and Irnawati 2014); *Callinectes* sp. in Niger Delta, Nigeria; *Pachygrapsus marmoratus* and *Carcinus aestuarii* in North of Turkey; *Clibanarius signatus* from the northern coast of the Persian Gulf, Iran; and *Charybdis callianassa* crab in Mumbai coastal water, India (Wanjari et al. 2021). On the contrary, crab species with positive allometric growth for both sexes are observed in *Callinectes danae* in Santa Cruz Channel, Brazil (Araujo and Lira 2012) and Panulirus argus on the Caribbean coast of Mexico.

The CF value was higher in males than in females using the WT-CW data. This observation is similar in a separate study conducted on *Portunus segnis* crabs from Gulf of Gabes, Tunisia (Hajjej et al. 2016; Hamida and Hamida 2019). The CF is influenced by the environmental and inherent characteristics of crabs which may vary across populations and over periods of time (Froese 2006). In the case of molting stages, the CF would tremendously drop for both sexes, while females will have higher CF during the gonadal development (Pinheiro and Fiscarelli 2009). Evaluation on sexual dimorphism using CF values proved to be a good parameter for studying the biology of crabs (Noori et al. 2015). In this study, sexual dimorphism could be due to weight differences to males and females at the period of sampling.

Most results presented in the study provided new information on *V. litterata* from Mindanao Island, Philippines. The occurrence of the natural population is reported here as a new distribution record in Hubo River, Surigao del Sur province. This would extend the biogeographical distribution of the species from its previously known record, which is important in future conservation actions. The data on morphometry, length/width-weight relationship, and condition factor is rarely conducted for the species, thus considered as valuable data. This could be used for comparing similar studies in other areas, genetic analysis, source of stocks for aquaculture, and understanding the population dynamics of crab species.

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