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Diversity and some life traits of shrimps of Cameroon's coastline

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Abstract
Between the 18 May and 12 July 2015, with the aim of studying the bio-characterisation of prawn species of the coast of Cameroon, a total of 200 prawns collected fresh from the different fishing zones, were weighted and measured. Along this coast, 05 species were identified (*Nematopalaemon hastatus, Parapenaeopsis atlantica*, *Penaeus duorarum notialis*, *Penaeus kerathurus*, and *Penaeus monodon*). The stocked obtained reveal that *Parapenaeopsis atlantica*, *Penaeus kerathurus* and *Penaeus monodon* are endangered and *Penaeus duorarum notialis* is overexploited. The prawns were smaller than the 26 cm recommended for consumption except for the small prawn *Nematopalaemon hastatus* which were larger, indicating their under exploitation. The marine prawns registered a condition K factor of less than 1, indicating the high stress under gone by the prawns in their natural medium. High and positive correlations exist between the morphometric characteristics of prawns. Shrimps recorded isometric growth, positive and negative allometrics growth.

Keywords: Diversity, growth, shrimp, Cameroon coast

1. Introduction
Prawns are highly positioned among the few marine species whose short to long term culture can attend high economic yields [1]. According to MINEPIA [2], prawn production is only from industrial fishing (528 tons) and artisanal fishing (15.000 tons) in Cameroon. Until 1999, prawn production from industrial catch was about 1.850 tons [3], mainly for export. Some farmed shrimp assays were carried out in the IRAD station of Kribi [4, 5, 6, 7, 8, 9]; but due to mismanagement in the structure, activity has quickly extinguished. The rapid reduction of natural resources; couple with rapid population growth and the need for food security, lead to the degradation and destruction the habitat [10], pollution [11] as well as the over exploitation of biological resources. The food requirement of the population will be met by an improvement of the productivity of resources which presents exploitable characters for culture. Studies have been carried out on the giant fresh water crayfish *Macrobrachium rosenbergii* along river Wouri [12, 13], on the biodiversity of the species of the genus *Macrobrachium* in streams of the South west region of Cameroon [14] and on marine and fresh water prawns of the Cameroon coast [15]. This study aims at completing studies on the bio-ecology of marine prawns in the Cameroon coastline, notably the diversity and life traits of marine prawns of the said coast line for the purpose of their preservation and domestication. The study aims specifically to providing information on the relative abundance, the frequency distribution on size, condition K factor and the regressions between the morphometric parameters of the different species of prawns caught in Limbe, Youpwe and Mabeta in the South west and Littoral regions of Cameroon.

2. Materials and Methods.
2.1 Study area
This study was carried out between 18 May and 12 July 2015 on the Cameroon coast line, precisely in the south west (Limbe and Mabeta) and the Littoral (Youpwe) (2° to 5° LN to 0° to 1° LE). Altitudes of the study zones are 1100 to 2000 m in the south west and 360 m in the littoral Regions. It has equatorial climate of Cameroonian type with two mark seasons: the rainy

season is from March to November and the dry season from October to February. Precipitation is 2000 to 3000 mm per year. Temperature varies from 21 ºC to 25 ºC [16]. The soil type is Andosol (black with a fine layer mud and very favourable for agriculture) and Fluvisol (favourable for aquaculture).

2.2 Animal material

A total of 200 prawns were obtained fresh from fisher men in each fishing area, 51 from Limbe, 103 from Mabeta and 46 from Youpwe. The prawns were selected basing on the presence of all the parts on the animal.

2.3 Data collection

Upon collecting the samples from each site, sexing and identification of species using key of Kuris *et al* [17], was made using a hand lens LED of enlargement 3X. Groups of prawns were then constituted base on species. The weights of prawns were taken using an electronic balance of mark EK of precision 1g with a total capacity of 5 kg and 26 Tangent of capacity 100 g and precision 10^{-2}g. Measurements were taken using tailor ruban metre (precision 1mm) and a ‘’pied a coulisse’’ of mark FF. Group, precision 0.01/0.0005inc.

2.4 Diversity and relative abundance of prawn

The relative abundance (%) is the proportion occupied by each species of shrimp caught in the total sample.

2.5 Growth performances

- Size structure or distribution of shrimp size frequency
- The length-weight relationship was calculated by the method of least squares using the parabolic equation suggested by Le Cren [18] and using by Adelugba and Edah [19], which is $W = a\,TL^b$, where W = weigth (g) ; TL = Total length (cm) ; a is a coefficient related to body form and b is the slope of the regression line or allometric coefficient.
- The total length - carapace length relationship was calculated by method of least square using the parabolic equation suggest by Missaoui and Zaouali [20], which is $LCP = a \times TL^b$ with LCP = Cephalothoraxic length (cm); TL = Total length (cm); a =Regression constants and b = Allometric coefficient;
- The total length - carapace length relationship was established in Form: $R = \frac{LC}{TL} \times 100$ where R = Ratio, TL = Total length (cm) and LC = Carapace length (cm);
- Condition factor K expresses the well-being of individuals within the population in their living environment. Condition factor K was calculated using Gayanilo and Pauly [21] formula : $K(\%) = \frac{100PT}{L^3}$ with W= weigth (g), TL = Total length (cm).

2.6 Statistical analysis

Descriptive statistic was used for calculation of means and standard error. Means were separated and compared at the significant level of 5% and 1% using Duncan and Student’s tests. Correlations and regressions were computed between parameters. The SPSS software (version 20.0) was used for analysis.

3. Results

3.1 Relative abundance of prawn species per fishing zone

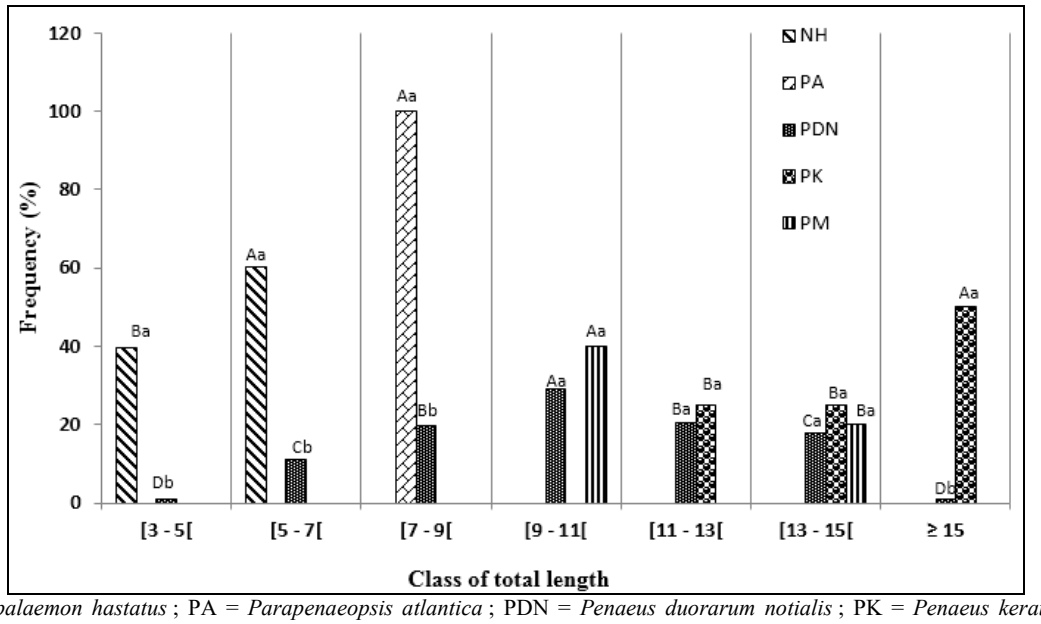
In this study 200 prawns were selected, 51 from Limbe, 103 from Mabeta and 46 from Youpwe. As indicated in table 1, 05 species sea prawns were identified (*Nematopalaemon hastatus, Parapenaeopsis atlantica, Penaeus duorarum notialis, Penaeus kerathurus* and *Penaeus monodon).* The rose prawns *Penaeus duorarum notialis* and *Nematopalaemon hastatus* were more abundant (53.50% and 41.50% respectively). The Guinea prawn *Parapenaeopsis atlantica* was least represented (0.50%). All the 05 species were identified in Mabeta compared to the other two zones. Further, the samples were more abundant in Mabeta.

Table 1 : Relative abundance of shrimp species caught by catch area

Shrimp species	Relative abundance (%)			Total
	Limbé	Mabéta	Youpwe	
Nematopalaemon hastatus	/	41.50	/	41.50a
Parapenaeopsis atlantica	/	0.50	/	0.50b
Penaeus duorarum notialis	25.00	8.50	20.00	53.50a
Penaeus kerathurus	/	0.50	1.50	2.00b
Penaeus monodon	0.50	0.50	1.50	2.50b
Total	25.50b	51.50a	23.00b	100

3.2 Size frequency distribution of shrimp based on species.

The distribution of size frequency as illustrated in figure 1 reveals that: the size of prawns varies as a function of species, from 3 cm to 15 cm. Large sizes (± greater than 15 cm) are observed in *Penaeus kerathurus* et *Penaeus monodon*. All identified specimens of *Nematopalaemon hastatus* were of small sizes (3 cm to less than 7 cm). Only the pink prawn *Penaeus duorarum notialis* were of both small and large sizes whereas *Parapenaeopsis atlantica* is abundant in only one class [7-9[cm.



NH = *Nematopalaemon hastatus* ; PA = *Parapenaeopsis atlantica* ; PDN = *Penaeus duorarum notialis* ; PK = *Penaeus kerathurus* ; PM = *Penaeus monodon* ; a, b : in class size and A, B, C, D : for the same species the bars affected by the same letter are not significantly different at the 1%; % = Percentage.

Fig 1: Size frequency distribution of shrimp according to the species

3.3 Condition K factor relative to the species and the fishing area of the prawns.

Table 2 below present condition K factor basing on the species and zone of the prawn caught. It comes out that the K factor varied from 0.38 to 0.59. In general, it was less than 1 regardless the species and fishing area considered. Also, K factor was comparable (P<0.05) between species or captured area.

Table 2 : K factor by shrimp species and capture zone

Shrimp species	K factor			Total
	Limbé	Mabéta	Youpwe	
Nematopalaemon hastatus	/	0.45±0.09	/	0.45±0.09a
Parapenaeopsis atlantica	/	0.38±0.00	/	0.38±0.00a
Penaeus duorarum notialis	0.50±0.06	0.42±0.08	0.53±0.07	0.47±0.08a
Penaeus kerathurus	/	0.58±0.00	0.60±0.14	0.59±0.12a
Penaeus monodon	0.50±0.00	0.51±0.00	0.45±0.06	0.47±0.05a
Total	0.44±0.06a	0.44±0.09a	0.53±0.08a	0.46±0.09

3.4 Weight – length, total length – cephalothoraxic length and carapace length – total length relationships of prawns caught in the coastline of Cameroon depending on species and capture zone.

Table 3 illustrate the length - weight relationship, total length – cephalothoraxic length and length of carapace – total length of prawns caught in the coastline of Cameroon as a function species and zone of capture. It reveals that the coefficient of determination of the length – weight relationship were significantly high (> 0.8) for all the species and the fishing zone considered. Equally, a highly significant (P<0.01) correlation was registered for all the species and fishing zones. For the length - weight relationship, total length – cephalothoraxic length, the allometric coefficient b varied from 2.64 for *Nematopalaemon hastatus* to 3.19 for *Penaeus kerathurus*. Prawns registered a negative allometric growth for *Penaeus duorarum notialis.* The length of carapace – total length varied from 10.24% (*Penaeus kerathurus*) to 18.42% (*Penaeus duorarum notialis*) and was comparable (P>0.05) between the captured zones. The correlation between the two characteristics was high (r >50%) whatever the parameters considered.

3.5 Weight – length, total length – cephalothoraxic length and carapace length – total length relationships based on capture zone, sex, and stage of development of shrimps caught in the coastline of Cameroon.

The effect of the zone of fishing, sex and stage of development on weight – total length relationship, the type of growth of prawns caught as presented in table 4, reveals that:

- Independently of the fishing zone and except young females that indicate and isometric growth, all the prawns showed a positive allometric growth (P<0.01).
- Considering sex and stage of development, prawns from Youpwe presented a positive allometric growth (P<0.01), different from the isometric growth of prawns from Limbe and Mabeta.

Still considering sex and stage of development of prawns, adult female from Mabeta had a positive allometric growth (P<0.01). Correlation was very high for all relations considered (>0.9). As the entire population, juveniles presented a high cephalothoraxic growth. The length of carapace – total length varied from 10.63% (adult males from Limbe) to 19.43% (Juveniles females from Mabeta) and is comparable (P>0.05) among the fishing zone. In the total population, it varied from 14.36% (female juvenile) to 20.36% male adult.

Table 3 : Weight-length, total length- cephalothoracic and total length-carapace length relationships depending on shrimp species and fishing area

Fishing area	Species	N	Weight-length **Relationship Parameters**					**Total length –cephalothorac length relationship Parameters**				**Total length – carapace length relationship Parameters**		
			Equation	**R^2**	**r**	**α**	**Type of growth**	**Equation**	**r**	**Type of growth**	**α**	**R (%)**	**r**	**α**
Limbé	P.D.N.	50	$W=0.008TL^{2.75}$	0.81	0,89**	0.00	A-	$LCP=0.670TL^{0.81}$	0.69**	Min	0,00	14,05±1,75[b]	0.66**	0.00
	P.M.	1	/				/	/				10,63±0,00[b]		
	Total	51	$W=0.010TL^{2.75}$	0.86	0,89**	0.00	A-	$LCP=0.670TL^{0.81}$	0.68**		0,00	13,99±1,79[A]	0.70**	0.00
Mabéta	N.H.	83	$W=0.008TL^{2.64}$	0.84	0,90**	0.00	A-	$LCP=0.272TL^{1.25}$	0.93**	Maj	0.00	14.07±2.53	0.54**	0 ;00
	P.D.N.	17	$W=0.003TL^{3.16}$	0.98	0,96**	0.00	A+	$LCP=0.698TL^{0.75}$	0.90**	Min	0.00	18.42±9.65[a]	0.47	0.06
	P.K.	1	/				/	/				10.24±0.00[b]		
	P.A.	1	/				/	/				15.13±0.00		
	P.M.	1	/				/	/				10.96±0.00[b]		
	Total	103	$W=0.004TL^{2.99}$	0.92	0,93**	0.00	I	$LCP = 0.44TL^{0.96}$	0.92**	Min	0.00	14.73±4.76[A]	0.50**	0.03
Youpwè	P.D.N.	40	$W=0.004TL^{3.08}$	0.89	0.91**	0.00	I	$LCP=0.695TL^{0.76}$	0,79**	Min	0.00	14.21±2.36[b]	0.62**	0.00
	P.K.	3	$W=0.004TL^{3.19}$	0.94	0.98**	0.05	A+	$LCP=0.953TL^{0.68}$	0.98	Min	0.11	16.46±3.63[a]	0.49	0.67
	P.M.	3	$W=0.007TL^{2.82}$	0.95	0.99	0.05	A-	$LCP=0.936TL^{0.64}$	0.99**	Min	0.02	15.68±2.94[a]	0.80	0.41
	Total	46	$W=0.004TL^{3.9}$	0.94	0.99**	0.02	I	$LCP=0.495TL^{0.89}$	0.93**	Min	0.07	14.45±2.49[A]	0.64**	0.60

PDN = *Penaeus duorarum notialis* ; PA = *Parapenaeopsis atlantica* ; PK = *Penaeus kerathurus* ; PM = *Penaeus monodon* ; NH = *Nematopalaemon hastatus* ; N = Sample size ; W = Total weigth ; LT = Total length ; A- = Negative allometric growth ; A+ = Positive allometric growth ; I =Isometric growth ; LCP = Cephalothoracic length ; LC= Carapace length ; Maj = Majorante ; Min = Minorante ; R = Ratio LC/LT ; R^2 = coefficient of determination, r = coefficient of corrélation, α = Level of significance, a.b : in the same species of the same area and A : for totals, the values assigned the same letter are not significantly different at the 1%

Table 4 : Weight-length, total length- cephalothoracic and total length-carapace length relationships depending on sex, stage of development and fishing area

Fishing area	Sex	S.D.	N	**Weight-length Relationship parameters**				**Total length–cephalothorac length relationship Parameters**				**Total length – carapace length relationship Parameters**		
				Equation	**r**	**α**	**Type of growth**	**Equation**	**r**	**α**	**Type of growth**	**R**	**r**	**α**
Limbé	F	J	23	$W = 0.010TL^{2.64}$ $R^2 = 0.79$	0.90**	0.00	I	$LCP = 0.93TL^{0.68}$	0.52*	0.01	Min	13.99 ± 1.71[a]	0.68**	0.00
		A	/	/	/	/	/	/	/	/	/	/	/	/
	M	J	27	$W = 0.010TL^{2.80}$ $R^2 = 0.82$	0.89**	0.00	I	$LCP = 0.52TL^{0.91}$	0.85**	0.00	Min	14.11 ± 1.81[a]	0.65**	0.00
		A	1	/	/	/	/	/	/	/	/	10.63 ± 0.00[b]	/	/
Total			51	$W = 0.010TL^{2.75}$ $R^2 = 0.81$	0.89**	0.00	I	$LCP = 0.67TL^{0.81}$	0.69**	0.00	Min	13.99 ± 1.79[B]	0.83**	0.00
Mabéta	F	J	14	$W = 0.001TL^{3.00}R^2 = 0.95$	0.89**	0.00	I	$LCP = 0.29TL^{1.21}$	0.98**	0.00	Maj	19.43 ± 10.87[a]	0.82**	0.00
		A	44	$W = 0.001TL^{3.08}$ $R^2 = 0.98$	0.98**	0.00	A+	$LCP = 0.55TL^{0.85}$	0.99**	0.00	Min	13.40 ± 2.36[c]	0.97**	0.00
	M	J	23	$W = 0.001TL^{2.85}$ $R^2 = 0.95$	0.96**	0.00	I	$LCP = 0.38TL^{1.07}$	0.85**	0.00	Maj	15.54 ± 2.36[b]	0.48*	0.02
		A	22	$W = 0.020TL^{2.25}$ $R^2 = 0.71$	0.84**	0.00	A-	$LCP = 0.26TL^{1.4}$	0.86**	0.00	Maj	13.75 ± 2.48[bc]	0.60**	0.60
Total			103	$W = 0.001TL^{2.99}$ $R^2 = 0.96$	0.95**	0.00	I	$LCP = 0.44TL^{0.96}$	0.96**	0.00	Min	14.73 ± 4.76[B]	0.79**	0.00
Youpwe	F	J	26	$W = 0.010TL^{2.94}$ $R^2 = 0.75$	0.86**	0.00	I	$LCP = 0.18TL^{1.35}$	0.85**	0.00	Maj	14.13 ± 2.49[b]	0.69**	0.00
		A	2	/	/	/	/	/	/	/	/	16.24 ± 5.10[a]	/	/
	M	J	18	$W = 0.010TL^{2.96}$ $R^2 = 0,92$	0.95**	0.00	I	$LCP = 0.75TL^{0.70}$	0.89**	0.00	Min	14.72 ± 2.28[b]	0.81**	0.00
		A	/	/	/	/	/	/	/	/	/	/	/	/
Total			46	$W = 0.001TL^{3.09}$ $R^2 = 0.94$	0.92**	0.00	A+	$LCP = 0.49TL^{0.89}$	0.93**	0.00	Min	14.45 ± 2.49[B]	0.81**	0.00
Total	F	J	63	$W = 0.001TL^{3.00}$ $R^2 = 0.98$	0.95**	0.00	I	$LCP = 0.38TL^{1.03}$	0.94**	0.00	Maj	14.36 ± 2.46[b]	0.87**	0.00
		A	46	$W = 0.001TL^{3.61}$ $R^2 = 0.90$	0.97**	0.00	A+	$LCP = 0.48TL^{0.94}$	0.93**	0.00	Min	16.02 ± 5.19[b]	0.75**	0.00
	M	J	68	$W = 0.001TL^{3.04}$ $R^2 = 0.98$	0.95**	0.00	A+	$LCP = 0.42TL^{0.99}$	0.96**	0.00	Min	15.52 ± 5.25[b]	0.80**	0.00
		A	23	$W = 0.001T\ L^{3.89}$ $R^2 = 0.92$	0.93**	0.00	A+	$LCP = 0.33TL^{1.14}$	0.91**	0.00	Maj	20.36 ± 6.58[a]	0.73**	0.00
TOTAL			200	$W = 0.001TL^{3.31}$ $R^2 = 0.88$	0.78**	0.00	A+	$LCP = 0.41TL^{1.01}$	0.94**	0.00	Maj	16.59 ± 5.58	0.71**	0.00

*: Significant ($P< 0,05$), **: Highly significant ($P< 0,01$), F= female, M = male, A = adulte, J= juvenile N = Sample size ; W = Total weigth ; LT = Total length ; A- = Negative allometric growth ; A+ = Positive allometric growth ; I =Isometric growth ; LCP = Cephalothoracic length ; LC= Carapace length ; Maj = Majorante ; Min = Minorante ; R = Ratio LC/LT ; R^2 = coefficient of determination, r = coefficient of corrélation, a et b : in the same species of the same area and A,B : for totals, the values assigned the same letter are not significant ($P>0,01$)

4. Discussion

The different species of sea prawns per ratio, inhabiting the waters of the coast of Cameroon as reported by ACP Fish II [22] are *Penaeus duorarum notialis*, *Nematopalaemon hastatus*, *Penaeus monodon*, *Penaeus kerathurus* and *Parapenaeopsis atlantica.* This report indicate that all these species are still present in Cameroon's water, though the species like *Parapenaeopsis atlantica* is endangered since their catch is scanty. This species registered a low percentage in relative abundance.

The maximum observed size (MOS) > 15 cm in the males of *Penaeus kerathurus and Penaeus monodon* indicates that the species can be domesticated. According to Fontaine *et al* [23] and Tiogué [24], this biological characteristic is a good indicator of culture performances susceptible of being exploited in culture medium. Generally the maximum size of a species is an indicator of it great rate and the largest species presents the best adaptation potential for different medium [12]. According to Doumé *et al* [12], distribution and abundance of macro-invertebrates such as prawns in water is relative the specific exigency of different taxa and environmental characteristics of different parts of rivers as well as the availability of food items and natural substrate. On the other hand, the small prawn (*Nematopalaemon hastatus*) with a length of 5 to 7 cm is larger than that studied in Nigeria [25], whereas *Penaeus duorarum notialis* is smaller than that demanded by Calvas [26] for marketing. This signifies that the species are caught at the same stage of development, hence they are over exploited. All sea prawns caught had a coefficient K condition less than 1 [15], portraying the level of stress of prawns in this zone. This further confirms the high pressure exerted by fishing activities in the coast of Cameroon.

All sea prawns had isometric growth; this is concomitant with the findings of Pauly and Moreau [27]. *Penaeus duorarum notialis* and *Penaeus kerathurus* had a positive allometric growth, different from the isometric growth for *Penaeus notialis* obtained by Adelugba and Edah [19] in Nigeria.

Except the result obtained by Abdallah *et al* [28] on *Metapenaeus monoceros,* all the prawns caught showed that the cephalothorax develops in an allometry manner, apart from *Nematopalaemon hastatus*. This is probably due to the difference between the species studied. The proportion of carapace in captured prawns in Cameroon's maritime zone is almost stable, for example in *Penaeus duorarum notialis* where it covers 14% of the body length, contrary to 29% in prawns of the same species [19]. This may be due to environmental effect on genetic performances of the species.

5. Conclusion

The improvement of the production of animal proteins in Cameroon can only be achieved by mastering the characteristics of each of the animal resources such as prawns. For example, the present study shows that there exist at least 05 species of sea prawns in Cameroon that are under threat of extinction due to over exploitation, they include *Penaeus duorarum notialis*, *Nematopalaemon hastatus*, *Penaeus monodon*, *Penaeus kerathurus* and *Parapenaeopsis atlantica.* A part of *Penaeus duorarum notialis* in Youpwé, all the others had an allometric growth. The head grow more slowly relative to the body and correspond to 14% of the later. However, all the prawns possess exploitable aquaculture potentials. It is thus desirable that these species be domesticated in order to preserve them for sustainability.

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