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Length-weight relationship of *Macrobrachium lar* (Fabricius, 1798), an endemic freshwater prawn in streams and ponds of Andaman and Nicobar Islands

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ABSTRACT

Macrobrachium lar (Fabricius, 1798) is a freshwater prawn species of Andaman and Nicobar Islands (A&N Islands) inhabiting streams, rivers, lakes and ponds. Length-weight relationships of this species collected from selected streams and ponds during the year 2008 were estimated. A total of 238 specimens in the size range 60-167 mm in total length (128 females and 110 males) collected from the various streams while 281 specimens in the size range 63-118 mm in total length (157 females and 124 males) caught from the ponds were examined. As there was no significant difference in the slopes and elevations of both sexes from each source, data were pooled to arrive at a common equation for each source. The combined equations of length-weight relationship of *M. lar* were $W = 0.00007\ L^{2.6695}$ for streams and $W = 0.000006\ L^{3.205}$ for ponds. The correlation coefficient 'r' was found to be 0.86 for streams and 0.89 for ponds. The regression coefficient *b* for this species was either marginally higher (ponds) or significantly lower (streams) than 3 ($p<0.01$), suggesting allometric growth. The present results indicated that prawns sampled from ponds are heavier than those from streams at any given length.

Keywords: Andaman and Nicobar Islands, Length-weight relationship, *Macrobrachium lar*, Ponds, Streams

Introduction

The length-weight relationship (LWR) of a prawn population provides a means of interpreting measures of length and weight at any given life stage. In fisheries research, length–weight relationships are important for the estimation of weight where only length data are available and as an index of the condition of the animal (King, 1995). The parameters of the functional length-weight (LW) equation are useful for a wide number of theoretical and practical applications, for instance the conversion of length of individual fish to weight, estimating the mean weight of the fish of a given length class, conversion of growth equation for length into a growth equation for weight, morphological comparisons between populations of the same species, or between species (Pauly, 1993), estimating growth rates, age structure, and other aspects of population dynamics (Kolher *et al*., 1995).

Macrobrachium lar (Tahitian prawn or monkey river prawn) is one of the large and potential aquaculture species in the insular Pacific (Atkinson, 1977). It is a remarkable freshwater species in that the larval part of the life cycle is entirely marine, after which juveniles migrate to freshwater for moulting in to adults with a restricted distribution. *M. lar* is mostly found in the Indo-Pacific from East Africa to the Ryukyu Islands and the Marquesas (introduced to Hawaii) (Holthuis, 1980). It has been reported as an endemic and native species of Andaman and Nicobar Islands by several workers (Costa, 1979; Sarangi e*t al*., 2001). There are quite a number of publication on the length-weight relationships of Palaemonid prawns *viz*., *Macrobrachium idella* (Jayachandran and Joseph, 1988); *Macrobrachium scabriculum* (Mer *et al*., 1991, Kunda *et al*., 2008); *Macrobrachium rosenbergii* (Idris *et al*., 2011); *Macrobrachium macrobrachion* (Enin, 1994; Deekae and Abowei, 2010), *Palaeomon etesafricanus* and *Demoscaris bislineata* (Gabriel *et al*., 2010) and penaeids *viz*., *Metapenaeus monoceros* (Rao, 1988, Nandakumar, 1998; Dineshbabu, 2006 ; *Metapenaeus dobsoni* (Murthy and Ramaseshaiah, 1996); *Metapenaeus barbatra* (Ramaseshaiah and Murthy, 1997); *Fenneropenaeus indicus* (Teikwal and Mgaya, 2003); *Penaeus monodon* (Prasad, 2001) and *P. semisulcatus* (Yassien, 2004), but no information is available on LWR of *M. lar* from India. The present study reports the LWR of *M. lar* collected from streams and ponds of A & N Islands.

Materials and methods

Monthly samples of *M. lar* (Fig. 1) were collected from the various streams *viz*., Burmanallah (lat. 11° 35' 55.615" N and long. 92° 43' 11.539" E), Rangat (lat.12° 38' 17.196" N and long. 92° 45' 55.635"E), Lamiya Bay (lat. 13° 11' 8.007" N and long.93° 5' 38.122" E), and Pathar Nallah (lat. 7° 1' 22.302" N and long.93° 53' 29.875" E) and also from the the experimental ponds of Central Agricultural Research Institute (CARI), Andaman and Nicobar Islands between January 2008 to December 2008, using cast nets. The stocking of wild caught *M. lar* of various sizes, in the experimental ponds of CARI, Andaman had already done 3 years before the first sampling for the present study. Ponds and streams having almost similar environmental parameters were selected for the present study. The specimens caught from the CARI ponds were studied on the same day. The specimens collected from the various streams were placed immediately in plastic jars containing clove oil solution. These jars were kept in the ice box before being taken to the laboratory and were examined immediately, omce they were brought to laboratory.

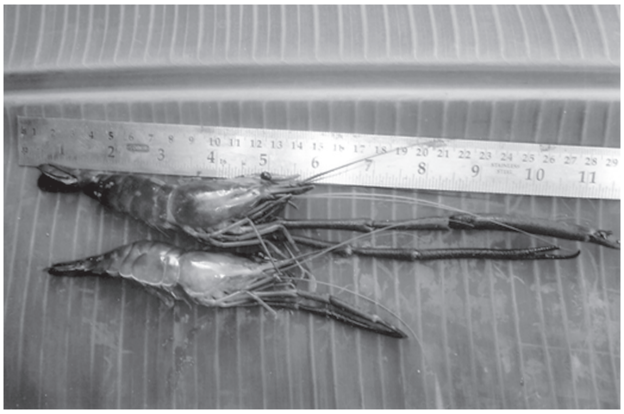

Fig. 1. Male and female of *M. lar* collected from freshwater streams of A& N Islands

The samples were sorted according to sex. Different stages of prawns from streams and ponds were observed separately.The total length (from the tip of the rostrum to the end of the telson) was measured with a vernier caliper to the nearest 0.1 mm and each prawn was then weighed with an electronic balance to the nearest 0.1g. A total of 238 specimens of *M. lar* in the range of 60 - 167 mm in total length (TL) and 9.5– 40.7 g in weight (W) (128 nos. of females and 110 males) from various streams while a total of 281 specimens in the size range of 63 -118 mm in TL and 5.6– 32.8 g in weight (157 females and 124 males) from CARI experimental ponds were measured.

The mathematical relationship between length and weight was calculated using the conventional formula $W = aL^b$ and using the logarithmic transformation, Log W = log a + b log L, where W = weight of the prawn, L= total length of the prawn and the parameters 'a' and 'b' are intercepts and regression coefficient estimated by linear regression of the log transformed variables. The observations on length and weight from each source were subjected to statistical analysis (Snedecor and Cocharan, 1968).

The exponents (b) of the length-weight relationships from two sources were tested for departure from isometry (*i.e.*, b = 3) using 't'- test as follows

$$t = \frac{b - \beta}{S_b}$$

where b is the estimated regression coefficient of LWR, $\beta = 3$, and S_b is the standard error of b. The value of b is different from 3, if t-statistic calculated is greater than the table value of t for the degree of freedom.

Results

LWR of M. lar from streams

A total of 128 females ranging in TL from 60 to 150 mm and 110 males ranging in total length from 74 to 167 mm were measured to study LWR of *M. lar* from streams. Plots of the LWR of male and female *M. lar* from the streams of A & N Islands are shown in Fig.2 and 3.

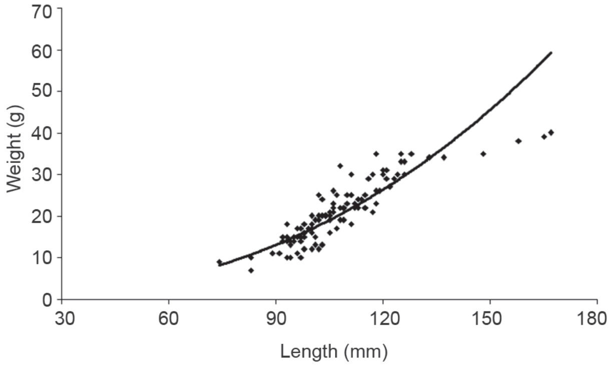

Fig. 2. Scatter plot of length *vs.* weight of male *M. lar* from the streams

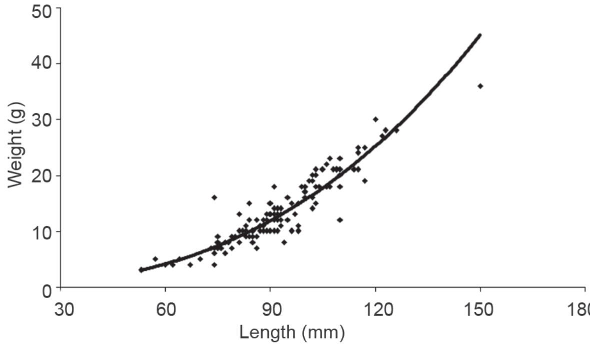

Fig. 3. Scatter plot of length *vs.* weight of female *M. lar* from the streams

Analysis of Covariance (ANCOVA) for testing LWR of males and females of *M. lar* from streams are shown in Table 1. The relationships between the prawn weight and the total length were estimated for each sex separately. The ANCOVA showed that there was no significant difference at 1% level between sexes and hence common equation was calculated for both male and female. The regression line indicated a significant relationship for pooled sex ($r^2 = 0.8554$, t-test, $p<0.001$) with the equation: $W = 0.00007\ L^{2.6695}$ However, the t-statistic revealed that the value of b = 2.67 was significantly different from 3, indicating that the growth in weight of *M. lar* in streams depart significantly from isometry. The slopes (b) of the regressions were slightly less than 3 for both the sexes, Hence growth of the individual sex in streams was found to be negative allometric, even for the pooled data.

LWR of M. lar from ponds

A total of 124 males in the size range of 69 -118 mm and 157 females in the size range of 63 - 112 mm were analysed to find out the relationship between TL and W of the monkey river prawn. LWR for male and female *M. lar* sampled from the ponds are shown in Fig. 4 and 5. The LWR of male and female was tested for significance by ANCOVA and as there was no significant difference in the slopes and elevations of both sexes, the data were pooled

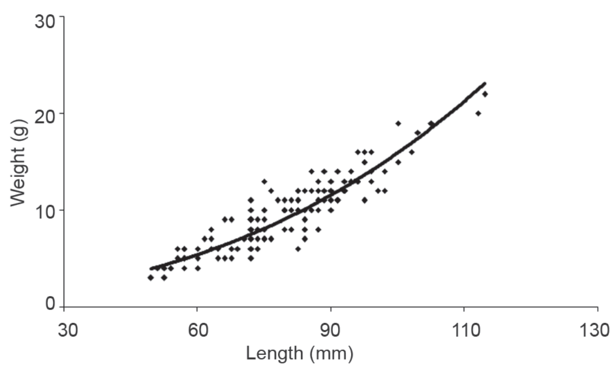

Fig. 4. Scatter plot of length vs. weight of male *M. lar* from the ponds

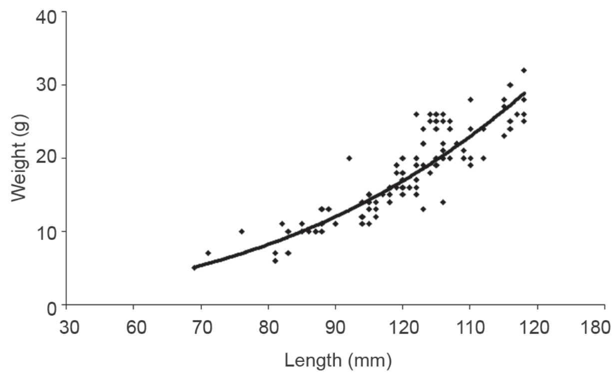

Fig. 5. Scatter plot of length *vs.* weight of female *M. lar* from the ponds

to arrive at a common formula for the species. The regression parameters are given in Table 1. The regression analysis indicated a significant correlation ($r^2 = 0.8857$, t-test, $p<0.001$) between the variables for combined sex, giving the equation: $W = 0.000006\ L^{3.205}$, However, the t-statistic revealed that the value of b = 3.205 is significantly different from 3, indicating that the LWRt of *M. lar* from ponds depart significantly from isometric. The slope (b) of the regressions was slightly greater than 3 for both sexes indicating positive allometry for the individual sex and the sexes combined.

Comparison of length-weight relationships of both sex in the streams and ponds of A&N islands are presented in Table 1. These relationships provide a useful index for estimating the weight of prawns from each location, given their total length. The LWRs are practically identical for males and females within each source, but differ between streams (and ponds when both sexes are combined.

Discussion

The investigations on the LWR of some penaeid prawns *M. monoceros* (Rao, 1988; Nandakumar, 1998) and *M. barbata* (Ramaseshaiah and Murthy, 1997) exhibited significant difference between males and females and hence, separate equations were calculated for each sex. In

Table 1. Comparison of LWR parameters of each sex of *M. lar* from streams with those from the ponds

	Total length (mm)			Weight (g)		Regression parameters		
Source/Sex	n	min	max	min	max	a	b	r^2
Stream								
Male	110	74	167	9.5	40.7	0.0002	2.4533	0.7696
Female	128	60	150	5.1	36.3	0.00008	2.6222	0.8392
Pooled	238					0.00007	2.6695	0.8554
Pond								
Male	124	69	118	7.4	32.8	0.000005	3.2417	0.8315
Female	157	63	112	5.6	22.3	0.00001	3.205	0.8138
Pooled	281					0.000006	3.205	0.8857

contrast, the present study revealed that there was no significant difference between the sexes and hence common formula was given. A similar observation has been reported by Murthy and Ramaseshaiah (1996) in *M. dobsoni* and Karpusamy and Menon (2004) in *Oplophorus typus*. In fish and shrimp, when value of *b* is close to 3, it indicates isometric growth, while values significantly different from 3 indicate allometric growth (Amin and Zafar, 2004; Amin *et al*., 2008). Wootton (1992) stated that allometric growth is negative (b<3) if the fish gets relatively thinner as it grows larger, and positive (b>3) if it gets plumber as it grows larger. The exponent b value for the streams in this study was 2.67 which is to some extent less than 3 indicating marked departure in the growth pattern from isometric or negative allometric while the b value for pond source was 3.2 which was marginally more than 3 indicating positive allometric growth or marked departure from isometric growth. In both the sources, the results indicated that *M. lar* changes shape as it grows larger. Gabriel *et al*. (2010) estimated b=2.19 and 1.79 for the MU River (Nigeria) population of *Palaeomonetes africanus* and *Demoscaris bislineata* respectively. This is lesser than the present estimate (b=2.67), but slightly different from the estimate (b=2.81) of Yassien (2004) in case of *Penaeus semisulcatus* in Lagoon (Egypt). Positive allometric growth in the farming system was also recorded by Mer *et al.* (1991), Kunda *et al.* (2008) and Idris *et al.* (2011) in *M. rosenbergii*. The two typee of allometric pattern of growth was also reported in several other freshwater prawns (Jaychandran and Joseph, 1988; Enin, 1994; Deekae and Abowei, 2010) as well as in penaeid and non-penaeid prawns (Murthy and Ramaseshaiah, 1996; Karpusamy and Menon, 2004; Yassien, 2004). Teikwal and Mgaya (2003) reported that, though *F. indicus* and *P. monodon* maintained dimensional equality with b value of 3 indicating isometric growth, deviation from isometric growth is often observed, as most animals change their body shape as they grow (*i.e*., allometric growth). Two different types of growth pattern observed in the two sources may be possibly due to the differential diet; availability of food; foraging behavior and other environmental conditions. Medina-Reyna (2001) in *Litopenaeus vannamei* and Prasad (2001) in *P. monodon* reported that LWR of a species could vary according to locality and season resulting in slight variation of 'b' and 'r' values. Lowe-McConnell (1987) reported that many factors could be responsible for the changes in growth of fish such as differences of habitat, fish activities, food habits and seasonal growth rates. Smith (1996), grouped the animals into light (b<3), heavy (b>3) and isometric (b=3) indicating poor, over and symmetric growths in length and weight respectively based on their scores of growth exponents (b value). The present study exhibited that the prawns from the ponds are heavier (b >3) than those of streams. It is often assumed that heavier prawns of a given length are in better condition. The results of the present study also indicated that the dynamics of *M. lar* cannot be analysed using the conventional fish population dynamics models as they assume mostly isometry in growth (Pauly, 1984).

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