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Variability in Length weight relationship of Pearlspot, *Etroplus suratensis* (Family: Cichlidae) from the Vembanad wetland system, south west coast of India

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Original Article

Abstract

Length-weight relationship of pearlspot, *Etroplus suratensis* from the Vembanad Lake, Kerala collected using two common fishing practices, gill netting and scare line fishing was illustrated. Though both these fishing practices are operated year-round, significant variations were observed in their landings. For the present study, the length-weight relationship of a total of 2945 fishes, 1723 from gill netting and 1222 from scare line fishing were estimated. The regression parameter b ranged between 2.81 and 3.03 and was observed to be high in males. The b values of fishes caught through scare line fishing were more close to the isometric value than gill netting. Monthly variations in the b values estimated for both the methods were also presented. Similar to previous studies smaller size fishes were more in gill net catches. The output of the present study will be beneficial in formulating management measures for the conservation of *Etroplus suratensis* which forms a major brackishwater fishery along the coastal wetlands of Kerala.

Keywords: *LWR, pearlspot, gill net, scare line, Vembanad Lake*

Introduction

Etroplus suratensis (Bloch, 1790), popularly known as pearlspot, is a brackishwater fish species widely distributed along the southwest coast of India. It is a high demand food and ornamental fish that fetches good price even in local markets and is designated as the 'State fish' of Kerala (Padmakumar *et al.,* 2012). The annual landings of *E. suratensis* from the riverine zones declined to about 200 t (Padmakumar *et al.,* 2002) from 1252 t reported during 1960 (Samuel, 1969). Furthermore, the increasing anthropogenic interventions in the lake aggravated the disappearance of many economically significant fish species (Kurup and Samuel, 1987; Unnithan *et al.,* 2001; Padmakumar *et al.,* 2002).

E. suratensis is a substrate spawner and is characterized by two peak breeding seasons in the Vembanad Lake (Bindu and Padmakumar, 2014). Their euryhaline nature and ability to breed in confined waters make them a potential candidate for aquaculture. The commercial fishery of *E. suratensis* in the Vembanad Lake is often carried out by gill netting and scare line fishing. The observed decline in fishery in the recent decade indicated poor natural recruitment of *E. suratensis* (Padmakumar *et al.,* 2012) in the lake, as a consequence of the environmental degradation associated with pollution from agricultural practices and tourism. The shallow regions of the lake and the adjacent wetlands, which form the major breeding grounds of this species, are most affected from human interventions. Indiscriminate dredging of the lake bottom has been reported to disturb the unique courtship behavior of the species which in turn results in low recruitment (Padmakumar *et al.,* 2012). Furthermore, the boom in brackishwater tourism and subsequent increase in demand of *E. suratensis* have also led to overfishing and unbridled exploitation.

There are several studies on this species from Vembanad wetlands (Bindu and Padmakumar, 2008, 2014, 2020; Padmakumar *et al.,* 2002, 2009, 2012; Roshni *et al.,* 2016). However, till date, not much information is available on the size variability of *E. suratensis* caught through diverse fishing methods in Vembanad Lake and also on the diurnal variability in their landings. Information on length-weight relationship (LWR), often taken as an effective indicator of their growth subjected to varied environmental conditions, are critical for the formulation of proper conservation and management measures in the Vembanad Lake. Hence, the scarcity in knowledge on the LWR of this important cichlid species of the Vembanad Lake augments the need for an extensive evaluation. The outputs generated from length-weight analysis of *E. suratensis* from gill net and scare line fishing will aid in providing baseline information needed for their effective fishery management and conservation policies.

Material and methods

Vembanad Estuary (Fig.1) is the largest estuarine ecosystem and a designated Ramsar site, along the southwest coast of India. Running parallel to the Arabian Sea, it extends 80 km from Alappuzha to Munambam (9° 30′ and 10° 12′ N & 76° 10′ and 76° 30′ E). A saltwater regulator at Thanneermukkom divides the estuary into a brackish water lagoon in the north and a freshwater lake (9° 31′ and 9° 41′ N & 76° 21′ and 76° 26′ E) in the south. The lake along with its adjacent wetlands forms the 'Vembanad wetland system', the largest floodplain wetlands on the southwest coast of India.

Fish samples for the present study were collected from the landing sites of two commercial fishing methods, gill netting and scare line fishing. Scare line fishing is a unique method for *E. suratensis* fishing in the lake. In this fishing practice, fishes were scared and concentrated to the muddy bottom of shallow lake regions by moving a horizontal rope having many white polythene ribbons attached to it. Then the fishes were easily handpicked by expert divers, observing the reflection of light from the pearl like spots on their body. A total of 2945 samples, 1723 from gill netting and 1222 from scare line, were collected from 2003 to 2005. For assessing the LWR, total length (L_T) and total weight (W_T) of the fish were measured every month in the fish landing center itself. L_T was measured to the nearest centimeter (cm) using a measuring scale and W_T to the nearest gram (g) using a digital balance. As sexual dimorphism was not externally prominent, a pooled sample of 630 fishes from diverse gears including 166 from gill netting and 159 from scare lining were brought to the laboratory and the sexes were determined through subsequent dissection and observation of their gonads.

LWR was calculated by using the equation $W = aL^b$ (Le Cren, 1951), where *a* is the intercept and *b* is the slope. Logarithmic transformation of the equation was $\text{Log } W = \text{Log } a + b \text{ Log } L$ (Froese, 2006). The *b,* an exponent having values between 2.5 and 3.5 demonstrates normal growth dimensions or interpretation of relative wellbeing. For the present study, monthly and seasonal analysis were carried out. LWR is used to determine whether the growth of fish is isometric (b=3) or allometric (negative $b<3$ or positive $b>3$) (Ricker, 1973). The fits of the model studied were assessed by the determination coefficient (r^2), as it helps in determining the accuracy of the model prediction skills (Lteif *et al.,* 2016). The 95% confidence levels for the parameters *a* and *b* were also determined. In all cases, a statistical significance of 5% was adopted. Results were expressed as mean ± standard deviation. Data were

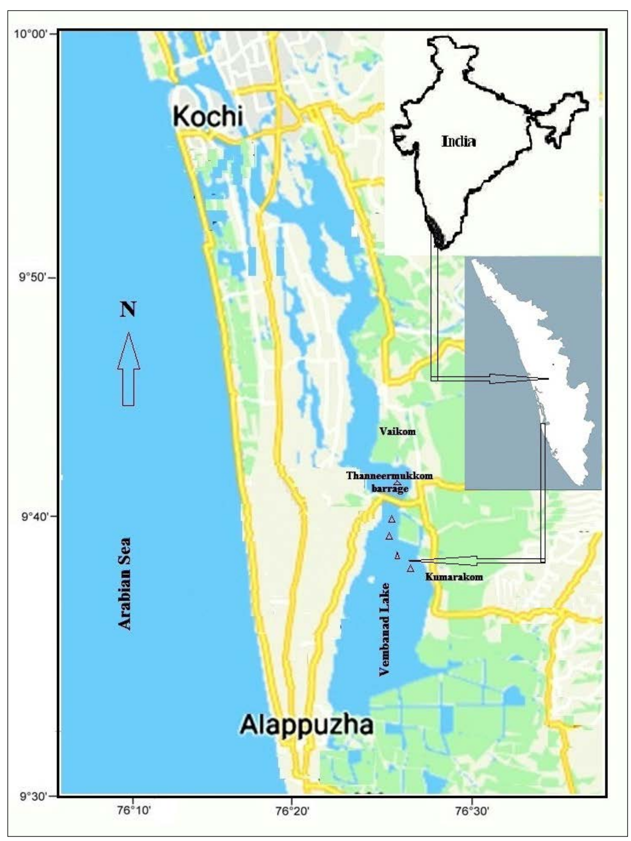

Fig. 1. Map showing the collection sites of *E. suratensis* in Vembanad Lake, Kerala (Δ collection sites)

analyzed by linear regression using statistical software SPSS version 20.

Results

Regression parameters *a* and *b,* coefficient of determination (r^2), and 95% confidence limits of male and female fishes are given in Table 1.

The mean value of *b* did not show significant variation ($P<0.05$) from the standard value of 3.0 in male fishes collected on a monthly basis. The variations in length and weight of fishes collected through both gill netting and scare lining are given in Table 2. The total length and weight ranged between 8.0-34.0 cm and 20- 900 g respectively. The values of parameter *b* ranged between 2.81 and 3.03. The estimated relationship showed negative allometry in most of the months, whereas January, February, and October showed positive allometry with *b* values of 3.08, 3.27, and 3.02 respectively. The seasonal variations are given in Table 3.

Discussion

The value of *b* in the present study specifies that LWR in *E. suratensis* exhibited slight variations from the isometric value indicating negative allometric growth along monthly sampling. Except in December, the values were mostly in the expected interval of 2.5 and 3.5 (Froese, 2006). A similar variation for cube law was also reported for this species in Veli Lake (Jayaprakas *et al.,* 1990), although a more extreme and significant variation was indicated for the female fishes. Roshni *et al.* (2016) reported *b* value of 2.67 for this species from 194 specimens collected from the Vembanad lake whereas in Chilika Lake, the *b* value ranged between 2.99 and 3.13 (Karna *et al.,* 2012, 2020). This might have happened either due to the seasonal or regional fluctuations (Milton *et al.,* 1990) or through biological influences such as stomach fullness, diseases, and parasitic infestation (Bagenal, 1978). But along a seasonal scale, the *b* value of this species did not show much evident variability. The r^2 showed higher values during all the seasons.

For fishes collected through the scare line method, the *b* values were slightly higher compared to those collected using gill nets. Serious departures from isometric growth are rare and can be attributed to environmental factors or condition of the fish (Beverton and Holt, 1957). In *E. suratensis, b* value was more or less similar in both the sexes and was only marginally higher in the case of males, whereas in

Table 1. Estimated parameters of Length-weight relation of *E. suratensis* from Vembanad Lake, Kerala (*a, b*: parameters of Length-weight relationship; *n:* sample size; r^2: coefficient of determination)

	Sex*	*n*	Total length (cm)		Total weight (g)		*a*	*b*	*CL* of *a*	*CL* of *b*	r^2 ($P<0.05$)**
			Range	Mean±SD	Range	Mean±SD					
Combined	M	352	13.0-34.0	19.9±3.6	50-1150	211.73±135.34	0.232	2.880	0.208-0.259	2.794-2.966	0.925
	F	278	8.0-30.0	18.6±3.1	15-570	169.44±84.93	0.221	2.915	0.19-0.257	2.797-3.034	0.894
	P	630	8.0-34.0	19.3±3.4	15-1150	192.08±116.64	0.225	2.902	0.206-0.246	2.833-2.972	0.914
Gillnet	M	88	13.0-33.5	19.1±3.6	50-900	188.41±134.94	0.227	2.895	0.179-0.287	2.712-3.079	0.919
	F	78	8.0-24.0	17.1±2.8	15-380	129.62±63.09	0.248	2.814	0.19-0.324	2.596-3.031	0.896
	P	166	8.0-33.5	18.2±3.4	15-900	160.78±111.02	0.231	2.878	0.195-0.273	2.744-3.012	0.916
Scare line	M	81	13.0-31.0	21.6±3.9	50-750	274.88±160.62	0.193	3.026	0.158-0.235	2.878-3.174	0.954
	F	78	15-30.0	20.3±3.1	90-570	213.27±102.51	0.245	2.833	0.176-0.342	2.578-3.088	0.864
	P	159	13.0-31.0	21.0±3.6	50-750	244.65±138.34	0.207	2.967	0.173-0.248	2.831-3.103	0.921

*M: Male, F: Female, P: Pooled ** Significant at $\alpha = 0.05$

Table 3. Seasonal variations in length-weight parameters in *E. suratensis* (N= 2945) from Vembanad Lake, Kerala (PRM: pre-monsoon, MS: monsoon, PTM: post -monsoon; CL: Confidence Level)

	Sea-son	n	a	b	CL of a	CL of b	r^2 ($P<0.05$)**
Gillnet	PRM	527	0.412	2.416	0.355- 0.478	2.296-2.535	0.750
	MS	460	0.207	2.962	0.177- 0.243	2.832-3.092	0.813
	PTM	736	0.269	2.764	0.248- 0.292	2.697-2.830	0.901
Scare line	PRM	424	0.259	2.823	0.226- 0.296	2.720-2.927	0.873
	MS	439	0.279	2.771	0.252- 0.306	2.691-2.850	0.914
	PTM	359	0.302	2.688	0.254- 0.360	2.549-2.827	0.801

** Significant at $\alpha = 0.05$

Table 2. Monthly variations in length-weight parameters in *E. suratensis* (N= 2945) from Vembanad Lake, Kerala (*a, b*: parameters of Length-weight relationship; *df*: degrees of freedom; r^2: coefficient of determination)

Month	Gill net							Scare line							n
	Total length Range (Mean±SD)	Total weight Range (Mean±SD)	*a*	*b*	*CL* of *a*	*CL* of *b*	r^2 ($P<0.05$)**	Total length Range (Mean±SD)	Total weight Range (Mean±SD)	*a*	*B*	*CL* of *a*	*CL* of *b*	r^2 ($P<0.05$)**	
January	11.0-28.3 (16.7±3.3)	35-480 (124.2±24.6)	0.322	2.602	0.266-0.391	2.444-2.761	0.856	14.2-24.5 (17.6±2.1)	60-350 (141.0±60.4)	0.182	3.077	0.135-0.244	2.842-3.313	0.848	299
February	12.8-33.5 (18.5±3.6)	60-850 (164.9±129.5)	0.228	2.878	0.198-0.262	2.768-2.990	0.970	14.0-29.0 (19.3±3.1)	50-700 (197.7±107.6)	0.143	3.265	0.113-0.180	3.085-3.446	0.925	189
March	1 2.3-28.0 (18.8±2.9)	55-400 (161.6±70.9)	0.336	2.569	0.281-0.401	2.429-2.709	0.866	14.5-29.0 (18.5±2.8)	70-640 (176.0±91.0)	0.278	2.761	0.221-0.348	2.582-2.942	0.894	315
April	10.0-26.5 (18.7±3.7)	20-450 (146.2±79.1)	0.471	2.263	0.298-0.596	2.077-2.627	0.545	14.0-27.0 (18.4±2.8)	80-540 (186.2±94.8)	0.361	2.575	0.258-0.504	2.310-2.841	0.777	211
May	9.5-27.4 (16.4±2.6)	30-560 (137.9±69.3)	0.311	2.697	0.253-0.380	2.530-2.865	0.882	13.4-26.0 (18.2±3.3)	60-490 (188.1±101.9)	0.270	2.812	0.224-0.327	2.662-2.962	0.934	236
June	12.9-26.8 (18.1±2.9)	50-500 (167.9±83.1)	0.322	2.647	0.246-0.421	2.433-2.862	0.885	14.0-25.3 (18.7±2.3)	90-435 (183.1±73.5)	0.249	2.855	0.206-0.301	2.706-3.004	0.932	186
July	10.8-24.2 (17.3±2.6)	25-390 (142.9±63.4)	0.245	2.854	0.185-0.325	2.625-3.084	0.888	14.0-32.0 (19.1±3.1)	70-550 (191.9±93.7)	0.299	2.700	0.254-0.354	2.571-2.829	0.912	245
August	11.5-29.0 (17.1±2.5)	40-590 (127.6±69.6)	0.199	2.984	0.151-0.265	2.756-3.212	0.774	14.5-25.8 (18.3±2.8)	80-430 (180.8±89.3)	0.292	2.736	0.230-0.370	2.549-2.925	0.915	275
September	11.0-30.5 (16.8±3.6)	30-680 (123.7±112.6)	0.205	2.939	0.146-0.286	2.665-3.213	0.814	14.5-31.5 (19.1±2.9)	90-840 (217.4±112.2)	0.253	2.874	0.211-0.302	2.736-3.012	0.952	193
October	9.9-30.5 (17.9±4.7)	30-670 (157.4±119.9	0.189	3.015	0.161-0.221	2.888-3.143	0.953	14.1-29.5 (18.7±2.9)	70-600 (194.7±97.3)	0.299	2.721	0.234-0.384	2.527-2.917	0.906	191
November	8.0-30.7 (18.1±3.3)	15-660 (163.8±88.1)	0.260	2.801	0.227-0.298	2.693-2.910	0.919	15.1-24.0 (17.5±1.7)	90-325 (145.8±49.1)	0.310	2.667	0.209-0.461	2.349-2.986	0.792	306
December	12.0-33.0 (18.1±3.2)	60-900 (162.8±85.5)	0.438	2.390	0.139-0.509	2.270-2.510	0.877	14.0-33.0 (19.2±3.4)	70-900 (196.6±114.1)	0.569	2.198	0.370-0.875	1.862-2.534	0.682	299

**Significant at $\alpha = 0.05$

the case of juveniles, the value was very much lower than the isometric value (Bindu, 2006). Since the species is an asynchronous spawner with two peak breeding season in the lake, one from February to April and the other from June to October (Bindu and Padmakumar, 2014), there might be no significant variation in *b* values during the breeding (2.2- 3.0 in gill net and 2.6-3.3 in scare line) and non-breeding season (2.4- 2.8 in gill net and 2.2-3.1 in scare line).

With a boom in backwater tourism and subsequent high demand for *E. suratensis,* overfishing is on the increase and is often exploited to the maximum. This is evident from the decline in the average size of this species in catches. The information generated on the LWR of this economically significant fish species will be useful for formulating management policies aimed at their conservation such as the implementation of the minimum catch size limit and also fishing regulations to reduce overfishing and exploitation of Vembanad estuarine system on the southwest coast of India.

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