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Length–weight relationship and size at maturity of the Picnic seabream, *Acanthopagrus berda* (Forsskål, 1775)

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Length-weight relationship of *Acanthopagrus berda* was investigated from 720 specimens collected from Korapuzha estuary, Calicut, India. Length-weight relationship for male, female, transitional, undifferentiated and total sample population of *A. berda* were determined as $W = 0.3994L^{2.536}$, $W = 0.1694L^{3.0584}$, $W = 0.14778L^{3.1044}$, $W = 0.12015L^{3.285}$ and $W = 0.16515L^{3.037}$, respectively. The overall mean *b* value (3.03±0.02) indicated isometric growth. Fecundity ranged from 117,821 to 2,225,243 eggs in females weighing 109.5 to 1753 g. Length at 50 % maturity was observed at 22.0 cm TL for males and 28.6 cm TL for females. Males (13 – 24 cm TL) dominated smaller length classes whereas females (25 – 43 cm TL) dominated in classes > 25 cm TL indicating protandrous hermaphroditism in *A. berda*.

[**Keywords**: *Acanthopagrus berda*, Condition factor, Fecundity, Length-weight relationship, Size at maturity]

Introduction

The Picnic sea bream or goldsilk seabream, *Acanthopagrus berda* (Forsskal, 1775) (Teleostei: Sparidae), is a commercially significant food fish[1] inhabiting coastal shallow waters; brackish water swamps or estuaries[2] throughout the tropical Indo-Pacific region[3]. This species, native to the Indian Ocean is exploited by using cast net and hook and lines by the artisanal fishers along the Indian coasts[4]. It is locally known as "Karuthaeri" along Kerala cost. This species is commonly found within a depth of 50 m along the sandy and muddy grounds in shallow coastal waters[5]. A. berda feeds on invertebrates, including worms, molluscs (oyster, clam, mussel, squid, modiolus sp.), crustaceans (barnacle, crab, shrimp), echinoderms, and small fishes[6,7]. It is reported that *A. berda* attains a maximum size of 900 mm total length[8] and a maximum body weight of 3.2 kg. Due to heavy fishing pressure, there is evidence of overfished condition for *A. berda* in few areas but is still relatively abundant elsewhere; due to this condition it is classified as least concern by the International Union for Conservation of Nature (IUCN)[9]. Thus, it is important to record all the biological information related to this species to understand its population dynamics in the region.

Three species of *Acanthopagrus* (*Acanthopagrus berda*, *A. bifasciatus* and *A. latus*) were reported from the Indian waters and *A. berda* is the only reported *Acanthopagrus* species in estuaries of Calicut[10]. In India, limited information is available on the biology of *A. berda*. Though age and growth of *A. berda* have reported from Kuwait[11], South Africa[12] and Pakistan[13], no information is available on the Length-Weight Relationship (LWR), condition factor, size at maturity and fecundity of *A. berda* from India. Thus, there is an urgent need to gather information on the same for implementing fishery management strategies for this species.

The studies on the LWR of fishes was important as they are used for estimating the fish weight corresponding to a given length; determining the condition of fish[14,15]; to determine whether somatic growth is isometric or allometric[16]; to estimate weight-at-age[14] and to compare the life histories of species between regions[14,17]. The present study would like to generate data on the LWR, size at maturity, condition factor and fecundity of *A. berda* from Korapuzha estuary which forms the first worldwide reference on the above mentioned biological aspects for the species from Indian waters. The data presented here will be useful for developing the species

management and recovery programs, breeding and conservation activities.

Materials and Methods

Study area

The study was carried out in Korapuzha estuary (Fig. 1; 11°39.858 N and 75°74.294 E), also known as Elathur river. Korapuzha estuary empties into the Arabian Sea at Elathur. This is a short river extending 40 km, with a drainage area of 624 km^2, flowing through the Kozhikode district of Kerala, India.

Sampling duration

720 specimens of *A. berda* captured using cast net and hook and line operations were collected from commercial fishermen at Korapuzha estuary during January 2016 to December 2017. The fish samples of various length classes and sizes were randomly collected immediately after capture. The specimens were taken from commercial boats and brought to the laboratory within an hour. The collected specimens were identified using the FAO[5] sheets. Total length (TL) of the specimens were measured to the nearest 0.1 cm using a meter ruler on a measuring board from the tip of the snout to the tip of the caudal fin, while the total weight (TW) of fish was recorded using a sensitive scale to the nearest 0.1 g.

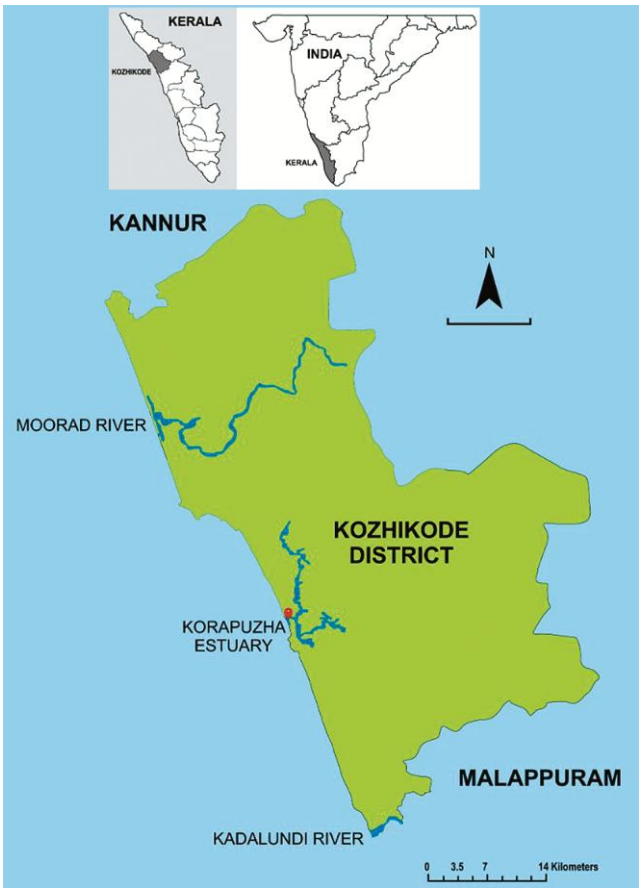

Fig. 1 — Location map showing the sampling area

Sex ratio

The sex ratio is calculated based on the proportion of the two sexes relative to one another. There are no reliable methods for determining the sex based on the external morphology of *A. berda*. Therefore, the ovotestes were dissected out and examined macroscopically to determine whether they were undifferentiated (immature), inactive male (non-milt oozing), active male (milt oozing), transitional (intersex), inactive female (maturing) and active female (ripe and running). The total number of reproductively distinguished groups (undifferentiated, inactive male, active male, transitional, inactive female, and active female) of *A. berda* in each length classes was recorded.

Length-Weight Relationship (LWR)

The LWR was analyzed using the equation $W = aL_b$[18]; where, W = total weight of the fish (g); L = Total length of the fish (cm); *a* = rate of change of weight with length; *b* = weight at unit length. The equation was log-transformed to give a linear relationship: Log W = Log a + b Log L[19,20] to estimate the parameters '*a*' and '*b*'. The above equation is equivalent to the regression equation; y = a + b*x. Here, *y* is equivalent to ln W, '*a*' represents the y-intercept of the regression line which is equivalent to ln q, *b* is the slope of the line and *x* is equivalent to ln L. By taking the antilog of '*a*' *q* of the original LWR (*q* = exp '*a*'; where exp is the inverse of ln, the base of the natural system of logarithms and equal to 2.718282) can be calculated. The degree of relationship between length and weight was computed by the determination coefficient, r^2. The *b* value was compared to 3 using student's *t*-test to confirm whether species grow isometrically or not[21]. This was achieved by using the formula; ts = b − 3/sb[22]; where, *ts* = student's *t*-test, *b* = slope, and *sb* = standard error of the slope.

Condition factor

The condition factor indicating the degree of well-being of the fish in their habitat was determined by the equation[23], K = 100W/ L^b, where *K* = condition factor; *W* = total weight of the fish (g); *L* = total length of the fish (cm); *b* = value obtained from the length-weight equation. The significance of the

regression was assessed by ANOVA, and the *b*-value was tested by *t*-test to verify that it was significantly different from the predictions for isometric growth ($b = 3$)[24].

Length-at- maturity (L_{50})

Size at sexual maturation was determined by expressing the proportion of reproductively active male (ripe, running, spent) and female fish (mature, running, spent) collected during the spawning season as a percentage of the total number of fish in each size class. L_{50} was defined as the total length at which 50 % of fishes were mature. L_{50} was estimated by fitting a logistic equation of the form: Y = 1/ (1+exp (-(X_{mid} . $X_{0.5}$)/δ); where, *Y* = proportion of mature fish in length class *X*, X_{mid} = midpoint of the class interval, $X_{0.5}$ = length at 50 % maturity and δ = length of maturity ogive[25]. Accordingly, the analysis was made separately for female and male fishes. The proportion of mature fish (P) was estimated as:

$$P = \frac{\text{Number of mature fish}}{\text{Number of immature + number of mature fish}} \quad \ldots (1)$$

A logistic function was fitted to the fraction of mature fish against length interval. The logistic equation is described[26] as:

$$P = \frac{1}{(1+\exp(a+L))} \quad \ldots (2)$$

Where, "P" is the proportion of mature fish in length class L, "a" is an intercept, "b" is the slope and "L" is the total length. The probability of being mature at a given value of the explanatory variable (L) was computed as:

$$P = \frac{e^{a+bL}}{1+e^{a+b}} \quad \ldots (3)$$

The length at which 50 % of the fish population has reached maturity was computed as:

$$L = \frac{-a}{b} \quad \ldots (4)$$

The logistic regression was fitted in Excel-solver statistical program in Excel micro software (Windows 2010) with the general linear model procedure.

Estimation of fecundity

From each lobe of ripe ovaries small pieces were weighed to the nearest 0.1 mg and were introduced to Gilson's fluid and periodically shaken to release oocytes from the ovarian tissue. Each sub-sample was distributed evenly over a cell counting chamber divided into 100 squares, each square measuring 5 mm × 5 mm. The numbers of mature ova in 20 randomly chosen squares were counted using a binocular microscope and were recorded. The absolute fecundity[27] and relative fecundity[27] were calculated using the following formulae:

$$F = \frac{C \times GW}{SW} \quad \ldots (5)$$

where, F - absolute fecundity, C - number of eggs in sub-sample, SW - weight of sub-sample and GW - weight of ovary.

$$RF = \left(\frac{F}{TW}\right) 1000 \quad \ldots (6)$$

where, RF - relative fecundity (per kg total body weight), F - absolute fecundity, and TW - total weight of the fish (g).

Results

Sex-ratio

The macroscopic study of ovotestes showed that out of the 720 specimens examined, 276 (38.33 %) were males, 334 (46.38 %) were females, 40 (5.55 %) were transitional and 70 (9.72 %) were undifferentiated individuals (Table 1). The overall sex-ratio obtained is 1:1.21 (M:F). Active (13 – 24 cm TL) and inactive (15 – 24 cm TL) males dominated the smaller length classes whereas, active (25 – 43 cm TL) and inactive (25 – 37 cm TL) females were most abundant in length classes > 25 cm TL (Table 1). Though males dominated smaller length classes, few males were observed in the larger length classes (25 – 38 cm TL) and few females were recorded in the smaller length classes (16 – 24 cm TL; Table 1). The transitional individuals were most frequent between 18 cm and 27 cm TL (Table 1). The smallest active male (13.5 cm TL) was obtained during the month of October and the largest active female (43.2 cm TL) was obtained during October (Tables 1 & 2).

Length-Weight Relationship (LWR)

The total body weight and total length of the collected specimens ranged from 34 to 1753 g (419.37±10.19 g) and 13 to 43.2 cm (26.47±0.18 cm), respectively (Table 2). LWR for male, female, transitional, undifferentiated and total sample population were determined as $W = 0.3994L^{2.536}$, $W = 0.1694L^{3.0584}$, $W = 0.14778L^{3.1044}$, $W = 0.12015L^{3.285}$ and $W = 0.16515L^{3.037}$, respectively (Table 2). The monthly LWR of *A. berda* presented in Table 2 shows that the calculated allometric coefficients vary between 2.224 (January) and 3.181 (November) in males, and between 2.443 (December)

Table 1 — Percentage availability of male, female, transitional and undifferentiated groups of *A. berda* in various total length classes

Length class (cm)	Active male		Inactive male		Active female		Inactive female		Transitional		Undifferentiated		Total
	N	%	N	%	N	%	N	%	N	%	N	%	
13-13.9	1	25.0	0	0	0	0	0	0	0	0	3	75.0	4
14-14.9	9	81.8	0	0	0	0	0	0	0	0	2	18.2	11
15-15.9	8	72.7	1	9.1	0	0	0	0	0	0	2	18.2	11
16-16.9	5	41.7	1	8.3	0	0	3	25.0	0	0	3	25.0	12
17-17.9	10	58.8	0	0.0	2	11.8	4	23.5	0	0	1	5.9	17
18-18.9	9	39.1	3	13.0	0	0.0	3	13.0	6	26.1	2	8.7	23
19-19.9	16	41.0	5	12.8	0	0.0	2	5.1	8	20.5	8	20.5	39
20-20.9	8	20.5	6	15.4	4	10.3	8	20.5	3	7.7	10	25.6	39
21-21.9	10	22.2	10	22.2	6	13.3	12	26.7	4	8.9	3	6.7	45
22-22.9	36	48.6	12	16.2	12	16.2	6	8.1	5	6.8	3	4.1	74
23-23.9	18	32.1	8	14.3	6	10.7	14	25.0	4	7.1	6	10.7	56
24-24.9	13	23.2	15	26.8	12	21.4	8	14.3	2	3.6	6	10.7	56
25-25.9	3	7.5	7	17.5	9	22.5	11	27.5	6	15.0	4	10.0	40
26-26.9	9	23.7	3	7.9	17	44.7	5	13.2	0	0.0	4	10.5	38
27-27.9	10	22.2	5	11.1	17	37.8	8	17.8	2	4.4	3	6.7	45
28-28.9	5	17.9	3	10.7	11	39.3	5	17.9	0	0	4	14.3	28
29-29.9	3	8.8	1	2.9	18	52.9	12	35.3	0	0	0	0	34
30-30.9	7	22.6	0	0.0	18	58.1	6	19.4	0	0	0	0	31
31-31.9	5	13.5	0	0.0	16	43.2	10	27.0	0	0	6	16.2	37
32-32.9	3	13.0	1	4.3	9	39.1	10	43.5	0	0	0	0	23
33-33.9	4	40.0	0	0	2	20.0	4	40.0	0	0	0	0	10
34-34.9	1	5.9	0	0	14	82.4	2	11.8	0	0	0	0	17
35-35.9	0	0	0	0	6	75.0	2	25.0	0	0	0	0	8
36-36.9	0	0	0	0	8	100	0	0.0	0	0	0	0	8
37-37.9	0	0	0	0	4	66.7	2	33.3	0	0	0	0	6
38-38.9	2	100	0	0	0	0	0	0	0	0	0	0	2
39-39.9	0	0	0	0	0	0	0	0	0	0	0	0	0
40-40.9	0	0	0	0	0	0	0	0	0	0	0	0	0
41-41.9	0	0	0	0	4	100	0	0	0	0	0	0	4
42-42.9	0	0	0	0	0	0	0	0	0	0	0	0	0
43-43.9	0	0	0	0	2	100	0	0	0	0	0	0	2
	195		81		197		137		40		70		720

and 3.376 (November) in females. The '*b*' value for male *A. berda* (*b* = 2.536) showed negative allometry whereas '*b*' value for female *A. berda* (*b* = 3.0584) showed isometric growth pattern. The regression slopes or growth coefficients, *b*, ranged from 2.224 to 3.377 with a mean value of 3.037±0.02. The results of the *t*-test showed that the growth exponent, *b* was not significantly different ($p > 0.05$) from 3 (Table 2) which indicated that the overall growth pattern of the species is isometric. The coefficient of correlation (r^2) ranged between 0.89 – 1 for males and 0.81 – 0.99 for females. The scatter plot or regression graph of the total length and body weight relationships of the species is shown in Figure 2 which reflects an exponential growth in weight with increasing length. The value of condition factor (*k*) showed in the present study is about 2.2 which indicate the good healthy condition of the fish.

Length at 50 % maturity

The length at 50 % maturity recorded for males was 22.0 cm TL (Fig. 3a) and 28.6 cm TL for females (Fig. 3b).

Fecundity

The fecundity of *A. berda* ranged from 117,821 to 2,225,243 eggs in females measuring between 17.8 cm and 43.2 cm TL with weight varying from 109.5 to 1753 g. The average annual absolute fecundity and relative fecundity estimated for *A. berda* is about 522569 and 885, respectively.

Table 2 — Length-weight relationship of different reproductively distinguished groups of *Acanthopagrus berda*

Months	Sex	n	Length characteristics				Relationship parameters		
			L range (cm)	Mean L (± SE)	Weight range (g)	Mean weight (± SE)	*a*	*b*	r^2
January	M	30	17.90-27	21.47±0.58	122.50-300.5	197.92± 11.71	-0.676	2.224	0.958
	F	36	19.2-37	29.75±0.99	170.5-1500	685.69±78.17	-1.987	3.228	0.93
	T	8	27-27.1	27.1±0.1	406.5-408	407.25±0.01	-1.902	3.106	0.99
February	M	19	19.2-30.6	23.73±0.43	146-536	287.34±14.45	-1.1095	2.585	0.906
	F	20	24.1-34.5	28.85±0.92	281-1142	576.88±64.52	-2.003	3.241	0.91
	T	9	18.5-18.7	18.6±0.1	129-130	129.5±0.1	-1.922	3.146	1
March	M	8	19-21.3	20.150.57	142.5-201.5	172±14.75	-1.723	3.032	1
	F	10	23.1-34.4	28.83±1.79	225.5-769.5	498.83±86.02	-1.869	3.105	0.992
	T	6	19-23	21±1.00	125.5-228.5	177±25.75	-1.812	3.036	1
	UD	19	18-25.4	23.6±1.17	120-822	276.13±17.54	-1.601	2.904	0.992
April	M	20	21.3-26.8	24.82±1.18	138.2-289.5	186±67.36	-0.774	2.484	0.89
	F	22	21-41.4	29.43±1.10	190.5-1411	542.125±65.51	-1.242	2.682	0.934
	UD	9	13-25.2	20.2±0.46	34-376	176±24.43	-2.119	3.285	0.98
May	M	10	20-21.5	21.150.57	140.5-221.5	182±12.75	-1.823	3.132	1
	F	16	23.2-37.7	29.95±0.93	246-1108	569.31±61.25	-1.726	3.018	0.975
	T	10	23.1-24.5	23.8±0.1	226-232	229±0.44	-1.86	3.106	0.992
	UD	12	22.7-25.1	24±1.02	203-396	309.75±37.14	-3.638	4.377	0.938
June	M	20	24.1-26.2	25.15±0.56	356-401.5	392.25±14.99	-1.02	2.31	1
	F	38	20.1-43.0	27.02±0.02	172-1800	490.575±8.13	-1.992	3.222	0.987
	T	7	25.6-26	25.6±0.91	312.5-315	313.75±52.84	-1.91	3.128	1
	UD	20	19.8-24.1	20.1±2.20	155-576.5	296.38±82.86	-1.5799	2.904	0.991
July	M	8	27.1-27.2	27.15±0.46	366-398.5	382.25±16.99	-1.22	2.61	0.923
	F	26	17.0-35.5	27.55±0.95	100.4-1050	448.11±62.97	-2.3404	3.433	0.989
	UD	10	19.2-31.4	20.57±0.25	139-598	295.5±1.06	-1.6599	2.958	0.9995
August	M	32	21.2-24.7	22.74±1.16	175.5-314	238.4±50.39	-1.598	2.566	0.924
	F	42	17.8-41.2	27.93±0.72	109.5-1753	510.31±32.06	-2.033	3.226	0.992
September	M	24	20.7-32.7	26.64±1.05	170.5-667	356.45±59.71	-1.029	2.494	0.639
	F	28	21-41.4	29.43±0.1	190.5-1411	542.125±0.1	-1.242	2.682	0.934
October	M	58	13.5- 34.6	25.003±0.52	49-859	334.98±21.70	-1.7439	3.026	0.98703
	F	60	21.8-43.2	28.19±0.49	219.5-1060.5	497.98±27.50	-1.743	3.043	0.94348
November	M	22	20.3-38.6	25.94±0.75	146-1300.5	393.14±37.84	-1.9442	3.181	0.92071
	F	16	27.5-37.5	31.4±1.17	375-1224.5	704.83±88.46	-2.2381	3.376	0.97636
December	M	25	19.4-30.6	23.94±0.62	151-526	285.35±0.63	-1.2398	2.664	0.93953
	F	20	26.8-35.5	30.54±2.85	409-952	572.875±43.46	-0.8834	2.443	0.81502
Overall	M	276	13.5-38.6	24.18±0.18	49-859	283.4± 5.53	-0.9176	2.536±0.04	0.91271
	F	334	17.0-43.2	29.07±0.81	100.4-1753	553.3±17.10	-1.775	3.0584±0.02	0.94815
	T	40	18.7-27.1	23.1±0.45	125.5-406.5	250.2±11.52	-1.912	3.1044±0.01	1
	UD	70	13-31.4	18.69±0.55	34-822	310.752±22.05	-2.119	3.285±0.1	0.98
Total		720	13-43.2	26.47±0.18	34-1753	419.37±10.19	-1.7403	3.0307±0.02	0.9402

*M - male; F - female; T - Transitional; UD - Undifferentiated; L - Total length

Discussion

This study mainly focuses on the biology of wild-caught *A. berda* from Korapuzha estuary, Calicut, India. The present study reported a total length range of 130 mm to 432 mm of *A. berda* from Indian waters with very few specimens above 400 mm TL. Garratt[28] reported that length range of 450 mm to 750 mm have recorded for *A. berda* in Japan, Kuwait and South Africa, but only few specimens of *A. berda* exceeded 400 mm TL in South African waters[12].

In case of *A. berda*, males dominated the smaller length classes whereas females were most abundant in classes > 25 cm TL. Earlier studies on *A. berda* also clearly stated that males are smaller in size and

dominating the smaller length classes whereas females dominated the larger length classes[2,12]. In the present study, males (b = 2.56) showed negative allometric growth whereas females (b = 3.0584) showed isometric growth and this may be due to the difference in their fish body conditions. Similarly, Riaz *et al*.[29] reported negative allometric growth in *A. arabicus* in Pakistan waters in all the seasons except positive allometric growth observed in the males during autumn (2012 – 2013) and isometric growth observed only in the males during spring (2011) and in both male and female during spring (2012). Further, Hussain *et al*.[13] reported isometric growth (b = 3.092) in *A. berda* from Pakistan. Similarly, the present study showed overall isometric growth (b = 3.06) in *A. berda* from India. On the contrary, Hameed *et al*.[30] reported results of negative allometric growth in *A. berda* from Pakistan. Isometric growth is exhibited in fishes when their length increases in equal proportions with body weight from constant specific gravity[31,32]. Earlier studies stated that the differences in 'b' value can be attributed to several factors like the physical condition of water, diet, stomach fullness, sex, gonad maturity, growth phase, season, specimen number and habitat[33-37].

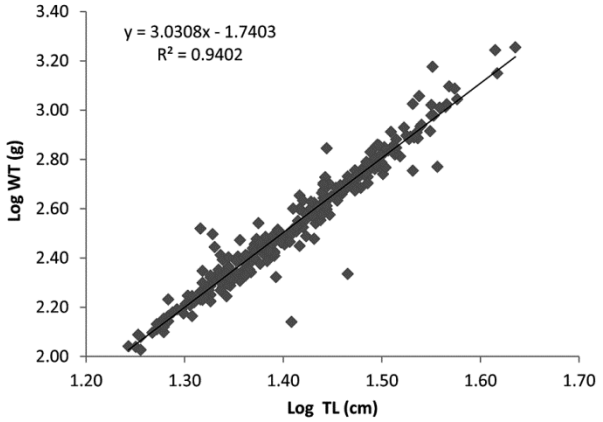

Fig. 2 — Length–weight relationship of *Acanthopagrus berda*

The mean condition factor of 2 (k = 2.2) for *A. berda* obtained in the present study indicated that the fishes were in good condition. The value of

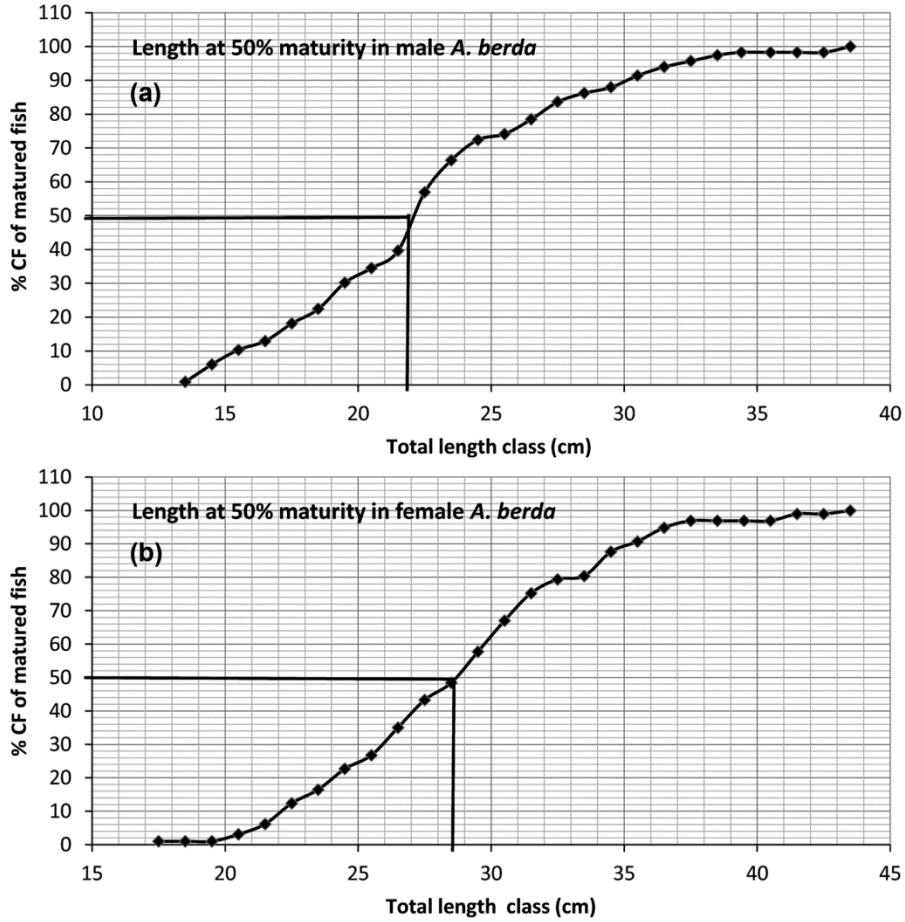

Fig. 3 — Logistic ogive showing length-class at 50 % maturity of *Acanthopagrus berda*: (a) L_{50} for male *A. berda*, and (b) L_{50} for female *A. berda*

condition factor less than 1 shows bad condition whereas one or greater than one indicates the good condition of fish[38,39]. *k* value was influenced by various parameters like season[40], sex[41], type of food[42], age of fish[31], amount of fat reserved[43] and environmental conditions[44].

The fecundity of *A. berda* ranged from 117,821 to 2,225,243 eggs in females measuring between 17.8 cm and 43.2 cm total length with weight varying from 109.5 to 1753 g. Fecundity estimates for other *Acanthopagrus* species namely, *A. latus*, 27.5 – 31.8 cm, ranged from 13,62,137 to 21,52,993 and estimates for *A. cuvieri*, 47.1 – 63.5 cm, ranged from 3,08,273 to 16,93,365[(ref. 45)]. The fecundity studies on various *Acanthopagrus* species suggest that they are multiple spawners with varying fecundity with respect to species and geographic locations[45,46].

The length at 50 % maturity observed for male and female *A. berda* were at 22.0 cm TL and 28.6 cm TL, respectively. An earlier study by Wallace[47] also reported that 22 cm total length is the size at which 50 % of *A. berda* mature. Length at 50 % sexual maturity for other Sparid fishes like *A. latus*[48] (24.40 cm), *Diplodus argenteus*[49] (females - 20.3 cm total length) are also reported within the similar range.

In the present study, males dominated the smaller length classes whereas females were most abundant in length classes > 25 cm TL indicating protandrous hermaphroditism in *A. berda* which changes sex from male to female[50]. Tobin *et al.*[51] reported that *A. berda* in Australia measuring less than 16 cm were mostly males and James *et al.*[12] observed male dominance in less than 18 cm in South Africa, reporting *A. berda* as protandrous hermaphrodite. However, results of this study confirmed that not all males and females change[12] sex since few primary males (26 – 38 cm TL) were observed in larger length classes and few primary females (16 – 24 cm TL) were also observed in smaller length classes.

Therefore, the present study concludes that *A. berda* which mature as male acts initially as male and then change their sex to female, but very few without any sex reversal continue to function as male throughout their life span. In the case of females, the individual which mature as female remain as functional females throughout their life cycle indicating digynous protandrous hermaphroditism. Earlier report based on the macroscopic and histological studies of the ovotestes of *A. berda* of full size range from each season in Korapuzha estuary, Calicut, Kerala also demonstrated that this species exhibits digynous protandrous hermaphroditism in Indian waters[2]. A similar style of reproductive behavior has been reported in other sparid fishes like *Diplodus argenteus*[49]; *Acanthopagrus australis*[52]; *Diplodus sargus*[53] and *Salpa salpa*[54].

Conclusion

The present study provided the data on LWR and K value for *A. berda* collected from the estuarine area of Korapuzha, Calicut, Kerala, India. LWR showed a negative allometric growth for male and isometric growth for female *A. berda* which might be attributed to the morphological characteristics specific to each sex. K value greater than 2 indicated an overall state of wellbeing of *A. berda* in their natural habitat. The data presented in the current study might constitute valuable information for developing future biometric studies for *A. berda* collected throughout the Indian coastal line.

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Conflict of Interest

There is no conflict of interest.

Ethical Statement

All the applicable international, national and institutional guidelines for the care and use of animals were followed by the authors.

Author Contributions

Conceptualization, data analysis, manuscript writing: MTS; Writing-review & editing, resources and supervision: NKC, PPS, PKA, KV; and Review & editing: PBS, RA.

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