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Morphometric and meristic characters and condition factor of *Acanthopagrus arabicus* (Pisces: Sparidae) from Pakistan, North Arabian Sea

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Abstract

Morphological differences among stocks of Pakistan, North Arabian Sea yellow fin sea bream, *Acanthopagrus arabicus*, including Sindh and Balochistan coasts, were examined using morphometric and meristic characters. Collections were obtained from two main fish harbors, situated in two provinces of Pakistan from September 2017 to August 2018. Twenty morphometric and eight meristic characters were documented and correlation coefficient (r) was investigated with independent variable (total length) and dependent variable (other morphometric parameters). The results confirm that majority of morphometric characters are greatly correlated to total length in all seasons. The total length ranges from 12.00 - 41.00 cm and 13.00 - 36.00 cm whereas total weight ranges from 31.00 - 1236.00 g and 34.00 - 595.00 g were recorded for *Acanthopagrus arabicus*, which were collected from Karachi fish harbor and Dam, Sonmiani fish harbor respectively. Condition factor ranged from 1.431 to 1.678 at Karachi and from 1.595 to 1.930 at Sonmiani in different seasons. Our present study in future could be useful to the students, fisheries biologist and taxonomist for the correct identification and classification of *A. arabicus* found in different location of Pakistan as well as management and conservation of this species.

Keywords:
Morphometric, Meristic count, *Acanthopagrus arabicus* North Arabian Sea, Pakistan
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Introduction

The individuals belong to family sparidae, generally recognized as sea breams and porgies, and are found mostly in temperate to tropical waters (Froese & Pauly, 2015). According to Fricke et al. (2018) family sparidae consists of 39 genera. Genus *Acanthopagrus* Peters, 1855 is the largest genus, which comprises 22 species (Froese & Pauly, 2018). Sparids are carnivorous in nature, mostly consume benthic prey and also like to eat plant materials (Tancioni et al., 2003). They are marine, brackish, and reef-associated and live in shallow waters, mostly found in coral reefs at depth ranged from 2-20 m (Sommer et al., 1996; Riede, 2004).Many species of sparidae are exploited for aquaculture purpose because of its distinctive euryhaline quality, diversity of temperatures adoptability, speedy growth and good marketable prices (Leu & Chou, 1996).

In Pakistan family sparidae is characterized by 14 species belongs to eight genera: the genus *Acanthopagrus* were known with four species, *A. berda*, *A. arabicus*, *A. sheim*, and *A. catenula* (Siddiqui et al., 2014). *Acanthopagrus arabicus* distribution is known from Middle East waters, Qatar to Southern Oman, Trivandrum to off the coast of Kuwait, and Southwestern part of India, Iran and Pakistan, excluding the Red Sea off the Gulf (Siddiqui et al., 2014).

Several authors have been documented morphological differences for different species of fishes but no information is available on the morphometric and meristic analysis of *Acanthopagrus arabicus* found in Pakistani water. It is considerably vital to record the morphological and meristic characters of different species of fishes for explaining the race problem.

It is significant from various perspectives to study fish populations comprising behavior, evolution, ecology, conservation and stock assessment (Anvarifar et al., 2011). Proper and effective management of aquatic stock will be achieved by study of genetic stocks of endemic populations as well as identification of these populations (Coad, 1980). Information on morphometric measurements are capable to recognize differences among fish populations (Bowering, 1998) and used to define the shape of each fish (Pollar et al., 2007). In addition, environmental description of morphometric variances would add to our understanding of life models followed by different local populations, therefore helping to advance a sound conservation policies (Liasko et al., 2012).

Materials and Methods

Sampling and Measurements

A total of 240 fish samples of *Acanthopagrus arabicus* were collected from two fish landing stations, one is situated in Sindh province called, Karachi fish harbor and other one located in Balochistan province called, Dam, Sonmiani fish harbor during September 2017 to August 2018. Each month 10-15 samples were selected randomly from the fish lot at the auction hall and preserved in ice boxes and transported to the laboratory for further analysis. For Identification of species generally followed Bianchi (1985) and FAO identification sheets. The counts and measurements follow Iwatsuki et al. (2006) and Iwatsuki and Heemstra (2010, 2011). Samples were then preserved in 10 % formalin. Twenty distinctive morphometric variables, Total Length (TL), Fork Length (FL), Standard Length (SL), Head Depth (HD), Head Length (HL), Body Weight (BW), Eye Diameter (ED), Pre-dorsal Length (PreDL), Pre-orbital Length (PreOL), Post-

orbital Length (PostOL), Dorsal Fin Length (DFL), Dorsal Fin Base (DFB),Ventral Fin Length (VFL),Ventral Fin Base (VFB), Anal Fin Length (AFL), Anal Fin Base (AFB), Pectoral Fin Length (PFL), Pectoral Fin Base (PFB), Body Depth (BD) and Body Girth (BG) (Fig. 1) and eight meristic counts, Dorsal Fin Hard Rays, Dorsal Fin Soft Rays, Anal Fin Hard Rays, Anal Fin Soft rays, Ventral Fin hard Rays, Ventral Fin Soft Rays, Pectoral Fin Rays and Lateral Line Scales of the *A. arabicus* were measured.

Condition Factor

The Fulton's condition factor (K) for each experimental fish has been calculated using the formula:

$K= (W/L^3)*100$

Where, K is the Condition factor, W is the weight of the fish, L is the total length of fish (cm).

Statistical Analysis

The primary statistics of all morphometric variables (comparative to total length, TL) and meristic counts were estimated. The allometric coefficients of the morphometric parameters and their relationships with fish length (TL) were calculated using power function formula and linear regression formula respectively. The type of allometry was assessed by confirming the significance of the allometric coefficient (b) (b=1, isometric, b<1, negative allometry and b>1, positive allometry) that represents as standard for the degree of differential increase in the morphological characters relative to a definite reference length.

To compare the data for seasonal variations, the months between December to February and June to September represented as winter and summer, respectively. The months between March to May and October to November represents the transitional time between the two seasons, hence referred as spring and autumn, respectively.

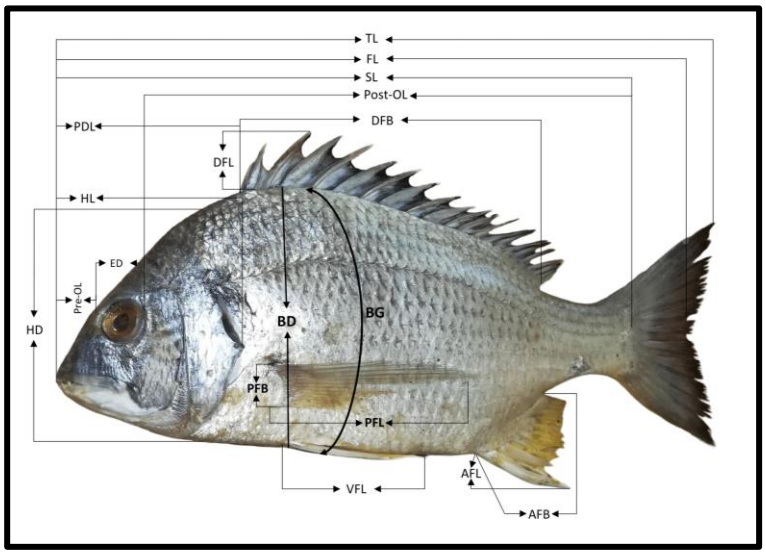

Figure 1. Morphometric measurements of the Total Length (TL), Fork Length (FL), Standard Length (SL), Head Depth (HD), Head Length (HL), Eye Diameter (ED), Pre-dorsal Length (PDL),

Pre-orbital Length (PreOL), Post-orbital Length (PostOL), Dorsal Fin Length (DFL), Dorsal Fin Base (DFB),Ventral Fin Length (VFL), Anal Fin Length (AFL), Anal Fin Base (AFB), Pectoral Fin Length (PFL), Pectoral Fin Base (PFB), Body Depth (BD) and Body Girth (BG).

Results

Twenty morphometric and eight meristic characters were measured and statistically analyzed from total of 240 specimens of Arabian yellowfin sea bream (*Acanthopagrus arabicus)* species which were collected from two different fish harbors of Pakistan that is, Karachi Fish Harbor and Dam, Sonmiani Fish Harbor, situated along the coast of Sindh and Balochistan provinces respectively.

The mean with standard deviation and the range of morphometric characters of *Acanthopagrus arabicus* measured in different seasons during the present study are given in Table 1 & 2. The total length ranges from 13.00 - 36.00 cm whereas total weight ranges from 34.00 - 595.00 g were recorded for *Acanthopagrus arabicus*, which were collected from Dam, Sonmiani fish harbor while total length ranges from 12.00 - 41.00 cm and total weight ranges from 31.00 - 1236.00 g documented for *Acanthopagrus arabicus*, collected from Karachi fish harbor.

Intra specific morphometric variations have been observed seasonally within species collected from same site as well as between the two sampling sites. The Highest mean of total length of *A. arabicus* was observed 27.15±3.48 cm in autumn 2017 from Sonmiani, however in the same season highest mean of total length 30.76±5.21cm from Karachi was also observed (Table 1 & 2). Highest mean of total weight 365.15±105.52g and 433.60±257.77g was also recorded in autumn 2017 from Sonmaini as well as from Karachi harbor's collection, respectively (Table 1 & 2).

Table 1. Seasonal Descriptive statistics for the Morphometric parameters of *Acanthopagrus arabicus* collected from Dam, Sonmiani fish harbor

Variable	Autumn 2017		Winter 2017-18		Spring 2018		Summer 2018	
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
TL	18.50-30.50	$27.15\pm^{3.48}$	20.50-29.50	$25.04\pm^{2.40}$	13.00-36.00	$17.93\pm^{6.31}$	13.80-30.00	$19.03\pm^{5.42}$
FL	17.10-28.50	$25.11\pm^{3.23}$	19.40-27.30	$23.08\pm^{2.15}$	12.00-32.80	$16.38\pm^{6.07}$	12.00-28.30	$17.25\pm^{5.22}$
SL	15.90-25.50	$22.54\pm^{2.63}$	17.50-24.50	$21.02\pm^{2.12}$	10.90-31.60	$14.89\pm^{5.52}$	11.00-24.00	$15.49\pm^{4.41}$
HD	5.80-10.00	$8.36\pm^{1.08}$	6.10-9.50	$8.06\pm^{0.90}$	4.00-11.30	$6.06\pm^{2.00}$	4.30-9.50	$6.14\pm^{1.62}$
HL	5.40-8.30	$7.35\pm^{0.83}$	5.20-8.60	$6.86\pm^{0.99}$	3.70-10.00	$5.00\pm^{1.75}$	3.60-8.20	$5.16\pm^{1.48}$
BW	218.00-507.00	$365.15\pm^{105.52}$	191.00-395.00	$260.03\pm^{55.55}$	34.00-595.00	$132.53\pm^{151.83}$	40.00-468.00	$134.48\pm^{124.17}$
ED	1.40-2.20	$1.87\pm^{0.24}$	0.90-2.00	$1.71\pm^{0.34}$	1.00-2.30	$1.43\pm^{0.37}$	1.00-2.20	$1.52\pm^{0.33}$
Pre DL	7.00-11.30	$9.96\pm^{1.17}$	0.00-11.10	$8.82\pm^{1.98}$	5.00-13.30	$6.67\pm^{2.27}$	1.50-11.20	$6.89\pm^{2.05}$
Pre OL	1.80-3.60	$2.90\pm^{0.47}$	1.90-3.50	$2.62\pm^{0.56}$	1.00-4.00	$1.86\pm^{0.81}$	0.20-3.60	$1.92\pm^{0.82}$
Post OL	13.00-22.30	$18.70\pm^{2.55}$	0.00-21.40	$16.81\pm^{3.93}$	8.90-25.70	$12.25\pm^{4.47}$	8.80-22.20	$12.87\pm^{3.88}$
DFL	2.40-4.60	$3.38\pm^{0.55}$	2.80-3.50	$3.20\pm^{0.21}$	1.50-5.20	$2.56\pm^{0.91}$	1.50-4.60	$2.51\pm^{0.75}$
DFB	8.00-14.30	$12.33\pm^{1.70}$	10.00-13.80	$11.77\pm^{1.05}$	5.90-16.00	$8.00\pm^{2.87}$	5.60-14.40	$8.53\pm^{2.72}$
VFL	4.20-6.70	$5.33\pm^{0.61}$	3.40-5.90	$4.85\pm^{0.66}$	2.50-8.00	$3.82\pm^{1.33}$	2.30-6.90	$3.68\pm^{1.02}$
VFB	1.30-2.00	$1.69\pm^{0.26}$	1.00-2.00	$1.59\pm^{0.37}$	0.70-2.30	$1.15\pm^{0.37}$	0.60-2.00	$1.05\pm^{0.44}$

AFL	2.10-5.30	3.64±0.90	1.50-4.00	3.05±0.74	2.20-5.70	3.06±0.84	2.10-5.30	2.96±0.68
AFB	2.70-5.10	3.64±0.69	1.60-5.00	3.65±0.65	1.60-5.00	2.54±0.89	1.00-4.50	2.54±0.71
PFL	4.80-10.20	8.34±1.44	2.90-9.10	7.20±1.53	4.00-11.00	5.58±1.89	4.00-10.20	5.93±1.71
PFB	1.30-2.10	1.73±0.25	1.20-2.00	1.66±0.33	0.90-2.50	1.35±0.40	0.80-2.20	1.28±0.32
BD	6.50-13.00	10.57±2.20	5.00-12.50	9.10±2.82	5.50-15.00	7.82±2.60	5.00-13.00	7.70±1.95
BG	13.00-26.00	21.24±4.46	10.00-25.00	18.19±5.65	11.00-30.00	15.63±5.20	10.00-26.00	15.39±3.90

Lowest mean of total length was documented 17.93 ± 6.31cmand 23.42 ± 8.43cm from Sonmiani and Karachi fish harbors, respectively in spring 2018. Lowest mean of total weight was recorded 132.53 ± 151.83g from Dam fish harbor in spring 2018, while from Karachi fish harbor lowest mean of total weight was reported 268.28± 262.81g in summer 2018 (Table 1 & 2).

Table 2. Seasonal Descriptive statistics for the Morphometric parameters of *Acanthopagrus arabicus* collected from Karachi fish harbor

Variable	Autumn 2017		Winter 2017-18		Spring 2018		Summer 2018	
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD
TL	25.00-41.00	30.76±5.21	19.00-30.50	26.69±2.97	12.50-40.50	23.42±8.43	12.00-40.50	23.60± 8.14
FL	22.80-39.20	28.68±5.19	17.00-28.60	24.60±2.94	11.30-39.40	21.69±8.35	11.00-38.90	21.80±7.83
SL	20.60-33.30	25.53±3.98	15.50-26.70	22.13±2.83	10.00-44.00	20.10±8.42	10.00-33.30	19.70±6.56
HD	7.50-13.40	09.76±1.85	6.00-11.00	8.33±1.20	4.20-13.50	7.91±2.92	4.00-13.00	7.58±2.47
HL	6.50-12.50	8.65±1.83	5.00-9.20	7.13±1.07	3.50-14.00	11.19±24.48	3.50-12.60	6.50±2.49
BW	230.00-1111.00	433.60±257.77	118.00-473.00	314.67±93.02	31.00-1092.00	298.87±316.65	35.00-1236.00	268.28±262.81
ED	1.80-2.30	2.02±0.12	1.30-2.00	1.76±0.28	1.00-2.60	1.75±0.45	1.00-2.30	1.68±0.38
Pre DL	9.00-15.50	11.06±2.03	7.00-11.60	9.90±1.15	5.00-15.50	8.68±3.11	4.50-15.20	8.52±2.93
Pre OL	2.30-5.00	3.41±0.62	2.00-3.70	2.99±0.51	1.10-5.00	2.48±1.12	1.00-4.70	2.52±1.01
Post OL	16.00-30.50	21.33±3.98	13.50-23.00	18.90±2.40	8.50-28.00	16.33±5.96	8.80-30.50	16.52±5.77
DFL	2.50-5.80	3.68±1.11	2.80-4.60	3.44±0.50	1.50-5.30	3.26±1.11	1.50-5.90	2.96±1.11
DFB	11.20-19.00	14.11±2.48	8.50-14.00	12.19±1.34	6.00-19.00	10.63±3.94	5.40-18.80	10.72±3.86
VFL	4.00-9.00	6.14±1.61	4.00-6.80	5.29±0.72	2.50-8.40	4.82±1.70	2.00-9.00	4.67±1.90
VFB	1.20-2.90	1.94±0.46	1.00-2.50	1.66±0.50	0.70-2.60	1.57±0.57	0.60-2.70	1.46±0.58
AFL	2.80-6.80	4.11±1.30	2.80-5.10	3.45±0.70	2.20-6.00	3.80±1.21	2.40-6.70	3.50±1.15
AFB	3.00-6.00	4.09±0.90	2.80-4.60	3.43±0.49	1.70-5.80	3.33±1.20	1.80-5.90	3.19±1.10
PFL	7.50-13.50	9.67±2.06	5.60-10.30	8.01±1.12	3.90-13.00	7.40±2.74	3.80-13.50	7.42±2.73
PFB	1.40-2.90	1.89±0.44	1.20-2.00	1.59±0.25	1.00-3.00	1.70±0.52	1.00-2.70	1.54±0.46
BD	7.20-18.00	11.28±2.74	8.50-12.50	10.80±1.20	5.90-17.00	9.98±3.26	6.00-18.00	9.29±2.72
BG	14.40-36.00	22.61±5.49	17.00-25.00	21.69±2.17	11.80-34.00	19.97± 6.53	12.00-36.00	18.59±5.43

The relationship between the morphometric parameters (dependent variable) and total length of fish (independent variable) were greatly defined by the linear regression equations (Table 3 & 4).

Table 3. Descriptive statistics and regression parameters (total length on other morphometric parameters) for *Acanthopagrus arabicus* collected from Dam, Sonmiani fish harbor

Para Meter	SPRING (N = 30)		SUMMER(N = 40)		AUTUMN(N = 20)		WINTER(N = 30)	
	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r
TL	-		-		-		-	
FL	0.810 + 1.040TL	0.99**	0.831 + 1.028TL	0.99**	0.933 + 0.997TL	0.99**	1.196 + 0.919TL	0.95**
SL	0.769+ 1.026TL	1.00**	0.900+ 0.966TL	0.97**	1.187 + 0.074TL	0.99**	0.952 + 0.961TL	0.91**
HD	0.385 + 0.955TL	0.98**	0.436 + 0.898TL	0.97**	0.444 + 0.889TL	0.91**	0.441 + 0.902TL	0.75**
HL	0.321 + 0.951TL	0.98**	0.287 + 0.980TL	0.98**	0.532 + 0.795TL	0.93**	0.114 + 1.270TL	0.84**
BW	0.022+ 2.904TL	0.99**	0.027+ 2.815TL	0.97**	5.607+ 1.256TL	0.59	0.570 + 1.898TL	0.92**
ED	0.171 + 0.736TL	0.90**	0.190 + 0.708TL	0.85**	0.295 + 0.558TL	0.59	0.007 + 1.690TL	0.71**
Pre DL	0.436 + 0.945TL	0.98**	0.325 + 1.033TL	0.79**	0.568 + 0.867TL	0.97**	0.254 + 1.112TL	0.90**
Pre OL	0.061 + 1.180TL	0.94**	0.037 + 1.318TL	0.68**	0.068 + 1.141TL	0.91**	0.004 + 2.039TL	0.93**
Post OL	0.641 + 1.022TL	0.99**	0.636 + 1.020TL	0.98**	0.669 + 1.008TL	0.97**	0.402 + 1.168TL	0.85**
DFL	0.136 + 1.016TL	0.96**	0.148 + 0.960TL	0.92**	0.225 + 0.819TL	0.72**	0.722 + 0.462TL	0.66**
DFB	0.436 + 1.008TL	0.99**	0.348 + 1.084TL	0.98**	0.388 + 1.048TL	0.95**	0.824 + 0.826TL	0.90**
VFL	0.229 + 0.974TL	0.98**	0.307 + 0.842TL	0.90**	0.884 + 0.544TL	0.68**	0.398 + 0.775TL	0.51
VFB	0.099 + 0.850TL	0.91**	0.032 + 1.172TL	0.96**	1.722 + -0.010TL	0.01	0.005 + 1.783TL	0.68**
AFL	0.350 + 0.753TL	0.93**	0.478 + 0.619TL	0.81**	0.510 + 0.588TL	0.32	0.111 + 1.019TL	0.35
AFB	0.156 + 0.966TL	0.96**	0.196 + 0.867TL	0.83**	0.297 + 0.757TL	0.59	0.731 + 0.494TL	0.23
PFL	0.350 + 0.959TL	0.99**	0.409 + 0.907TL	0.90**	0.232 + 1.083TL	0.78**	0.174 + 1.149TL	0.41
PFB	0.146 + 0.773TL	0.86**	0.131 + 0.773TL	0.84**	0.177 + 0.689TL	0.67**	0.025 + 1.303TL	0.60**
BD	0.544 + 0.923TL	0.96**	1.021 + 0.685TL	0.81**	0.444 + 0.956TL	0.59	0.003 + 2.431TL	0.65**
BG	1.088+ 0.923TL	0.96**	2.043+ 0.685TL	0.81**	0.844 + 0.972TL	0.60	0.007 + 2.431TL	0.65**

(**) correlation is significant at the 0.01 level.

The occurrence of seasonal variations in the morphometric characters of *Acanthopagrus arabicus* were examined with regards to their type of growth, that is, their form of allometry. Most of the morphometric characters of the *Acanthopagrus arabicus* presented isometric growth and showed significant correlations among each other in different seasons at both collecting sites (Table 3 & 4). The correlation coefficient (r) was ranges from 0.01 to 1.00 and0.38 to1.00 at Sonmiani and Karachi respectively.

Table 4. Descriptive statistics and regression parameters (total length on other morphometric parameters) for *Acanthopagrus arabicus* collected from Karachi fish harbor

Para Meter	SPRING (N = 30)		SUMMER (N = 40)		AUTUMN (N = 20)		WINTER (N = 30)	
	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r
TL	-		-		-		-	
FL	0.794+ 1.048TL	0.98**	0.846 + 1.027TL	1.00**	0.766 + 1.057TL	1.00**	0.806 + 1.041TL	0.98**
SL	0.624+ 1.098TL	0.99**	0.912+ 0.973TL	1.00**	1.168 + 0.901TL	0.98**	0.681 + 1.060TL	0.94**
HD	0.331 + 1.005TL	0.99**	0.464 + 0.884TL	0.97**	0.222 + 1.103TL	0.99**	0.413 + 0.913TL	0.76**
HL	0.324 + 0.991TL	0.52	0.252 + 1.026TL	0.98**	0.144 + 0.194TL	0.97**	0.240 + 1.032TL	0.82**
BW	0.019+ 2.955TL	1.00**	0.052+ 2.622TL	0.98**	0.199+ 2.218TL	0.78**	0.065 + 2.575TL	0.93**
ED	0.212 + 0.672TL	0.93**	0.296 + 0.551TL	0.82**	1.239 + 0.143TL	0.38	0.209 + 0.646TL	0.45
Pre DL	0.425 + 0.957TL	0.99**	0.433 + 0.942TL	0.99**	0.300 + 1.052TL	0.98**	0.417+ 0.964TL	0.94**
Pre OL	0.069 + 1.129TL	0.96**	0.065 + 1.152TL	0.94**	0.142 + 0.927TL	0.85**	0.189 + 0.139TL	0.81**
Post OL	0.672 + 1.011TL	1.00**	0.727 + 0.988TL	0.99**	0.588 + 1.048TL	0.96**	0.045 + 0.759TL	0.94**
DFL	0.165 + 0.946TL	0.96**	0.191 + 0.865TL	0.91**	0.013 + 1.635TL	0.92**	2.663 + 0.113TL	0.67**
DFB	0.480 + 0.982TL	0.99**	0.398 + 1.041TL	1.00**	0.407 + 1.035TL	0.99**	8.848 + 0.421TL	0.93**
VFL	0.236 + 0.957TL	0.98**	0.179 + 1.027TL	0.93**	0.041 + 1.457TL	0.93**	0.736 + 0.203TL	0.84**
VFB	0.075 + 0.964TL	0.94**	0.044 + 1.102TL	0.94**	0.035 + 1.170TL	0.81**	0.078 + 0.104TL	0.61**
AFL	0.246 + 0.871TL	0.99**	0.450 + 0.647TL	0.82**	0.013 + 1.668TL	0.91**	6.169 + 0.100TL	0.42
AFB	0.176 + 0.931TL	0.95**	0.203 + 0.869TL	0.92**	0.076 + 1.160TL	0.90**	3.627 + 0.108TL	0.65**
PFL	0.315+ 1.000TL	0.99**	0.299 + 1.015TL	0.99**	0.144 + 1.227TL	0.98**	0.163 + 0.330TL	0.88**
PFB	0.151 + 0.769TL	0.95**	0.188 + 0.665TL	0.84**	0.021 + 1.309TL	0.96**	4.292 + 0.036TL	0.43
BD	0.612 + 0.887TL	0.99**	1.231 + 0.640TL	0.84**	0.958 + 0.715TL	0.49	20.150 + 0.356TL	0.88**
BG	1.224+ 0.887TL	0.99**	2.456+ 0.640TL	0.84**	1.942+ 0.711TL	0.49	59589.127+0.634TL	0.87**

Certain meristic characters ranges and mean with standard deviation of *Acanthopagrus arabicus* are given in Table 5. No variations were found between the meristic characters of *A. arabicus* species, collected from two different coastal fish harbors.

Table 5. Certain meristic characters of *Acanthopagrus arabicus* collected from North Arabian Sea (Balochistan & Sindh), Pakistan

CHARACTERS	DAM (BALOCHISTAN)		KARACHI (SINDH)	
	Mean ± SD	RANGE	Mean ± SD	RANGE
Dorsal Fin Hard Rays	11.60± 0.49	11.00 – 12.00	11.60± 0.49	11.00 – 12.00
Dorsal Fin Soft Rays	10.40 ± 0.49	10.00 – 11.00	10.40 ± 0.49	10.00 – 11.00
Anal Fin Hard Rays	3.00 ± 0.00	3.00 – 3.00	3.00 ± 0.00	3.00 – 3.00
Anal Fin Soft rays	8.18 ± 0.38	8.00 – 9.00	8.18 ± 0.38	8.00 – 9.00
Ventral Fin hard Rays	1.00 ± 0.00	1.00 – 1.00	1.00 ± 0.00	1.00 – 1.00
Ventral Fin Soft Rays	5.00 ± 0.00	5.00 – 5.00	5.00 ± 0.00	5.00 – 5.00
Pectoral Fin Rays	14.25 ± 0.66	13.00 – 15.00	14.25 ± 0.66	13.00 – 15.00
Lateral Line Scales	44.03 ± 0.86	42.00 – 45.00	44.03 ± 0.86	42.00 – 45.00

Condition factor ranged from 1.431 to 1.678 at Karachi and from 1.595 to 1.930 at Sonmiani in different seasons (Figure 2). Condition factor was not significantly different between different seasons at both study sites (P> 0.001). The lowest mean K value was recorded in autumn 2017 (1.431) and in summer 2018 (1.595) at Karachi and Sonmiani samples respectively. The mean condition factor in spring 2018 and in autumn 2017 was comparatively higher than other seasons at Karachi and Sonmiani respectively. Overall the condition factor K was better at Sonmiani than Karachi (Figure 2).

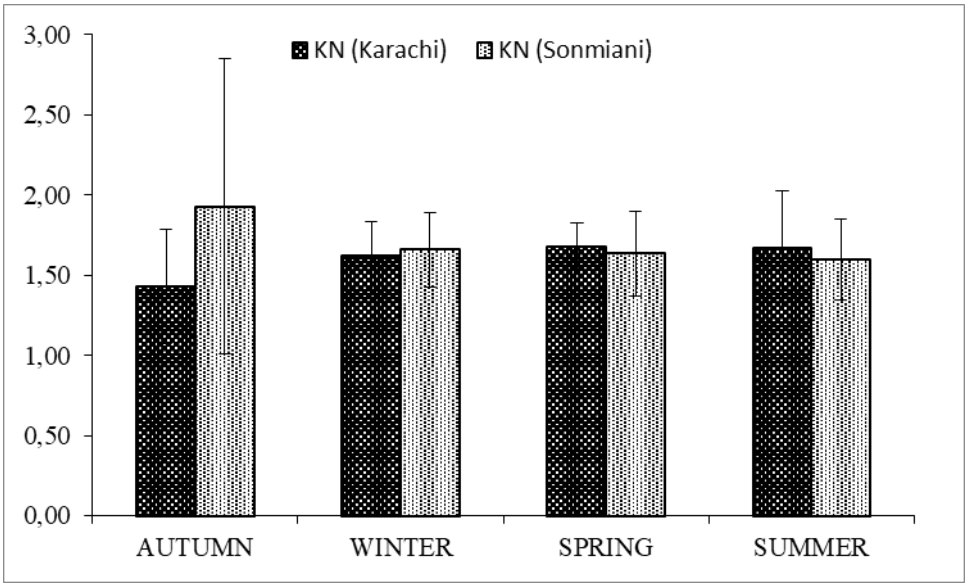

Figure 2. Condition factor (K) of *Acanthopagrus arabicus* in different seasons of year 2017-18.

Discussion

Fishes of sparidae family are commonly considered appropriate for aquaculture because of their euryhaline properties, adaptation to a range of temperatures, speedy growth and are commercially important (Leu & Chou, 1996). Except from this, sparid fishes are also dominant in commercially landed fishes of Pakistan (WWF, 2005). The present study on morphometric and meristic characters of *Acanthopagrus arabicus,* will be valuable for the identification and phylogenetic study of Arabian yellowfin sea bream in North Arabian Sea.

During the year round sampling in the present study, it was noticed that morphometric measurements of various body parts vary in different seasons in population of *A. arabicus* found in Pakistan. But specially the standard deviation calculated for the *A. arabicus* was higher in spring season as compare to other seasons for all variables except, Ventral fin base, Anal fin length and Body depth at Sonmiani and Ventral fin length, Ventral fin base and Anal fin length at Karachi. Morphology of fish is dependent on environmental conditions (Ryman et al., 1984; Cheverud, 1988), suggesting that *A. arabicus* population may have experienced different environmental conditions in different seasons in the study locations or due to unidentified reasons that may be impacting negatively on the fish species.

No significant differences were found in meristic counts of *A. arabicus* collected from two locations. Meristic characteristics are affected by substantial changes in environmental elements

such as temperature, radiation, salinity and dissolved oxygen (Lindsey, 1988). Substantial changes in environmental conditions usually take place as a result of differences in geographical region. Population of *A. arabicus* inspected in this study lives in the same geographical area and practice similar environmental conditions, which explain the similar meristic characteristics.

In this present research correlation was highly significant between total length and body weight (r = 0.89) (Riaz et al., 2017), total length and standard length (r = 0.98), dorsal fin length and body weight (r = 0.87) and between head depth and body depth (r = 0.83) of *A. arabicus* in North Arabian Sea. Same results was found for *Acanthopagrus bifasciatus* from Southern Red Sea, Egypt (Mahmoud et al., 2013) and for Indian mackerel, *Rastrelliger kanagurta* from Baluchistan, Pakistan (Roonjha et al., 2019). The results strongly shows that the growth of one part of body of the *A. arabicus* is linked to the growth in another body part of the fish.

It is well-known that due to environmental fluctuations, the morphometrics characters can display high phenotypic plasticity and these environmental factors include temperature and food richness. Generally, fishes as compare to any other vertebrates in the world shows noticeable variations in morphological characters both between and within populations and they were more susceptible to environmentally produced variations in morphological traits (Wainwright and Reilly, 1994; Swain et al., 2005).

In the present study the number of spines and rays of dorsal fin of *A. arabicus* being XI, 11 or XII, 10, anal fin III, 8-9, ventral fin I, 5 and pectoral fin rays 13 – 15, which are similar with outcomes of other study on a same species reported from Iraq (Ali et al., 2018). However according to Al-Hassan (1990) meristic differences may consider as environmental effects.

Similar to the majority of the studies on condition factor proposing that if, value of condition factor is around or equals to 1 it shows wellness or fine condition of the species, present study also found similar results on condition factor 'K' in *Acanthopagrus arabicus* in different seasons from Pakistan (Sindh and Balochistan). The value of 'K' for male and female *A. arabicus* was also observed more than 1 from Karachi coast, Pakistan, from January 2011 to December 2013 collection study (Riaz et al., 2017).

The present study could be useful for the students, fisheries biologist and taxonomist for the correct identification and classification of *A. arabicus* found in different location of Pakistan as well as the results of this study can be combined with information got from other morphological, chemical, and genetic studies to further confirm the identification of this fish.

Author Contributions

All author contributions are equal for the preparation research in the manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

Conflict of Interest

The authors declare that they have no conflict of interest.

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