



RESEARCH ARTICLE

SEASONAL VARIATION IN CHEMICAL COMPOSITION OF THE BLACK POMFRET
(*PARASTROMATEUS NIGER*) FROM RATNAGIRI COAST, MAHARASHTRA STATE, INDIA

* Tingote R. S., Pawar M.B. and Mane U.H.

Center for Coastal and Marine Biodiversity of Dr. Babasaheb Ambedkar Marathwada University Bhatye, Ratnagiri-415612.

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ABSTRACT

The chemical composition variations of the Black pomfret (*Parastromateus niger*) from Ratnagiri coast were investigated seasonally over the period of three year (2008-2011). Protein in female muscle from Sakhri-Natye is recorded 20.155 ± 0.309 within PFZ while from outside PFZ is 19.278 ± 0.309 as compared to male during November-December. On the other hand in March-April from female muscle is noticed 21.032 ± 0.404 for within PFZ than outside PFZ is 21.167 ± 0.710 as compared to other two fish landing centers. Glycogen level in female liver from Harnai within PFZ is 16.097 ± 0.170 whereas from outside is 15.104 ± 0.214 when validation experiment compared to all the males during November-December. From female liver value is noticed 16.550 ± 0.214 from within PFZ, as for outside PFZ 16.153 ± 0.298 as compared to male. Lipid level from female gonad Harnai region 8.813 ± 0.612 for within PFZ as for outside value is 7.108 ± 0.371 , while for Mirkarwada for within PFZ male gonad the value is observed 7.758 ± 0.486 , for outside is 7.190 ± 0.506 during November-December. In March-April from within PFZ for female gonad Harnai value is 10.03 ± 0.782 , for outside PFZ is 8.894 ± 0.612 , whereas from male gonad from Mirkarwada within PFZ region is 9.056 ± 0.371 , while for outside PFZ is 7.758 ± 0.486 as compared to other landing centers during March-April respectively. The Black pomfret fishes caught in both within and outside PFZ areas were in the size range of 25- 32cm. On the whole of it all observations made through within and outside PFZ realm it was concluded that most of the females attain first maturity at 28-32 cm whereas the males at 25-30 cm.

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INTRODUCTION

The fish catch data from satellite processed through INCOIS were received on the Electronic Digital Display Board and thereby utilized by most fishermen from all the fish landing centers. It has been validated that the search time for fish has been reduced up to 40 to 55% by the utilization of PFZ advisory. Black pomfrets form very important part and parcel of local human food diet across the Ratnagiri district. It is generally known that marine fish have seasonal variations in chemical composition. These transformations might be correlated in particular in accordance with the environmental factors such as temperature, salinity, composition of their food as well as activities (reproduction and migration) including age, sex and size of fish (Standby 1981, 1986; Ackman, 1982). Brown Pomfret, *Parastromateus niger* (Bloch) has not been studied so far, though it forms a fishery of considerable importance along the entire Indian coast and a major fishery along that of Ratnagiri coast. Juvenile pomfrets first appear in September and occur in good numbers in the trawl nets during October to December. While the adult fish are pelagic in habit, the juveniles appear to be demersal, as they are caught only in the trawl-nets and gill-nets. So for the biochemical study from both within and outside PFZ areas, November-December in winter and March-April in summer

have been selected for the study, however these pomfrets fetches high market demand.

In the present study it seems that pomfrets fishes were utilizing fat as a main source of energy sparing protein for body building. This was corroborated by findings recorded by Phillips *et al.* (1966). According to Viswanathan Nair & Suseela Mathew (2000) the biochemical composition may alter extensively relying on different components as such sex, size, maturity and several other factors too. Seasonal variations in lipid levels in fishes are fundamentally related to the reproductive cycle since most marine fishes generally accumulate large lipid deposits prior to gonadal development (Mourente *et al.*, 2002). Among the proximate composition, protein in fish is the excellent source, because of the amino acid composition and degree of digestibility (Louka *et al.*, 2004). This aspect is of dietary advantage to the consumer since it is a known fact that protein is essential for maintaining and building muscle (Bonjour, 2005). The proximate compositions of fish species greatly varies during the catching season due to physiological reasons and changes in environmental conditions (Boran and Karacam, 2011).

MATERIALS AND METHODS

Black pomfrets samples were obtained from all the fish

landing centers after landing took place by utilizing PFZ advisory in the Sea water on hiring fishing boats with the experiment validated in both within and outside PFZ zones from all the three fish landing centers whether trawl and gill net fishing operation off the Ratnagiri district coast during the period November-December 2008 to March-April 2011, packed in ice for transport to the laboratory. After each PFZ advisory validation experiment, fish catch on Black pomfret were recorded for the further study.

RESULTS AND DISCUSSION

Black pomfrets showed high protein content during late post-spawning and early pre-spawning season. Therefore it might be change in protein during spawning season of Black pomfrets too. Protein cycle and lipid cycle of muscle in Black pomfret were more or less inversely related. It seems that there is an alternative uses of the energy sources lipids and protein in these fishes. Biological information on Black pomfret is scanty and is restricted to the north east coast. The maximum size within and outside PFZ are being 25-32cm. The spawning from the first used to occur generally from June to August along Ratnagiri coast. The occurrences of pomfrets are found in the trawl catches during November-December and also in March-April. Spawning is limited to the late winter season in January -February along northeast coast, while it is rather prolonged extending from February-August with peak in April-June along the southwest coast. At other months in the year it is only landed in small quantities, and during June-August fishing is called off because of the southwest monsoon. Spawning in Bombay coast is from October to December. The following table and graph shows protein, glycogen and Lipid of *P. Niger* caught off Ratnagiri coast in trawl and gill net fishing operation.

Table 1 Protien content of *P. niger* during November-December

Tissue	Sex	Mirkarwada		Harnai		Sakhri-Natye	
		Within PFZ	Outside PFZ	Within PFZ	Outside PFZ	Within PFZ	Outside PFZ
Muscle	Male	18.941	16.984	17.659	17.186	18.198	16.917
		0.818	0.607	0.650	0.535	0.350	0.710
	Female	18.468	17.119	19.480	19.278	20.155	19.278
		0.509	0.618	0.509	0.309	0.309	0.309
Gonad	Male	13.948	12.463	15.162	13.340	14.622	13.138
		0.607	0.650	0.202	0.404	0.509	0.809
	Female	14.960	12.868	20.965	18.266	17.119	15.432
		0.535	0.509	0.710	0.509	0.818	0.421
Liver	Male	11.586	10.169	14.285	12.936	12.733	11.114
		0.509	0.421	0.421	0.607	0.607	0.350
	Female	10.372	9.089	16.647	14.960	15.702	13.813
		0.509	0.202	0.421	0.404	0.509	0.116

Mean value of 3 sample size with \pm SD, * = P<0.05, ** = P<0.01, *** = P<0.001, ns = P> 0.05 non- significant

Protein content from *Parastromateus niger* from Mirkarwada

Muscle

The protein in the male muscle within PFZ value

Table 2 Protien content of *P. niger* during March-April

Tissue	Sex	Mirkarwada		Harnai		Sakhri-Natye	
		Within PFZ	Outside PFZ	Within PFZ	Outside PFZ	Within PFZ	Outside PFZ
Muscle	Male	20.762	18.806	18.536	17.119	20.425	19.413
		0.818	0.535	0.421	0.618	0.535	0.404
	Female	18.738	18.064	19.548	17.929	21.032	21.167
		0.710	0.618	0.618	0.618	0.404	0.710
Gonad	Male	17.321	14.960	17.929	16.242	19.548	16.984
		0.710	0.607	0.618	0.116	0.710	0.809
	Female	16.782	14.960	17.524	16.849	18.671	17.389
		0.535	0.404	0.710	1.018	0.710	0.809
Liver	Male	13.610	12.328	14.690	12.936	16.647	15.230
		0.650	0.607	0.710	0.809	0.818	0.467
	Female	14.218	12.463	16.647	14.757	16.512	14.757
		0.509	0.42	0.116	0.607	0.309	0.202

Mean value of 3 sample size with \pm SD, * = P<0.05, ** = P<0.01, *** = P<0.001, ns = P> 0.05 non- significant

(18.941 \pm 0.818) was observed which is non-significant (P<0.05) whereas from outside PFZ study comparatively showed dwindled (16.984 \pm 0.607) in Nov-Dec. An increase in the male muscle protein from within PFZ value was (20.762 \pm 0.818) which is non-significant (P<0.05) on the other hand comparatively from outside PFZ study (18.806 \pm 0.535) in the month of March-April. The protein in the female muscle from within PFZ value was represented (18.468 \pm 0.509) which is non-significant (P<0.05) and comparative analysis of the study from outside PFZ showed (17.119 \pm 0.618) in Nov-Dec. The protein in female muscle from within PFZ value was somewhat increased to (18.738 \pm 0.710) which is non-significant (P>0.05) and as compared to outside PFZ study value (18.064 \pm 0.618) during March-April.

Gonad

The protein in the male testis from within PFZ was observed (13.948 \pm 0.607) which is non-significant (P>0.05) while analysis at outside PFZ showed (12.463 \pm 0.650) in Nov-Dec. The protein in male testis for within PFZ value was observed increased (17.321 \pm 0.710) which is less significant (P<0.01) on the other side at outside PFZ comparative study (14.960 \pm 0.607) in the month of March-April. The protein in the female ovary from within PFZ was noticed (14.960 \pm 0.535) which is non-significant (P<0.05) as compared to outside PFZ study (12.868 \pm 0.509) during Nov-Dec. The protein in the female ovary from within PFZ was observed (16.782 \pm 0.535) which is non-significant (P>0.05) and comparative study at outside PFZ showed value (14.960 \pm 0.404) in March-April.

Liver

The protein in the male liver from within PFZ value was expressed (11.586 \pm 0.509) which is non-significant (P<0.05) and simultaneous study at outside PFZ (10.169 \pm 0.421) in Nov-Dec. whereas from within PFZ the male liver protein was (13.610 \pm 0.650) which is non-significant (P>0.05) whereas comparative study from outside PFZ (12.328 \pm 0.607)

Figure 1 Protein content in *P. niger* during November-December at Mirkarwada

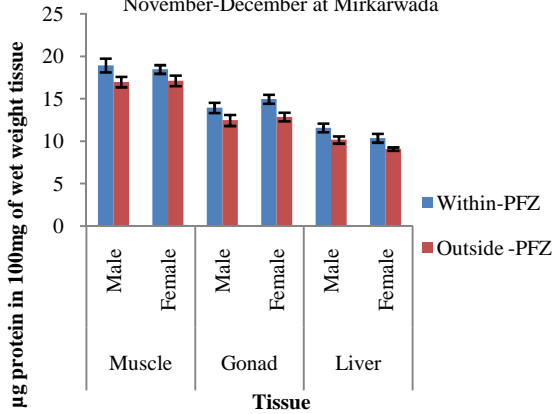


Figure 2 Protein content in *P. niger* during March-April at Mirkarwada

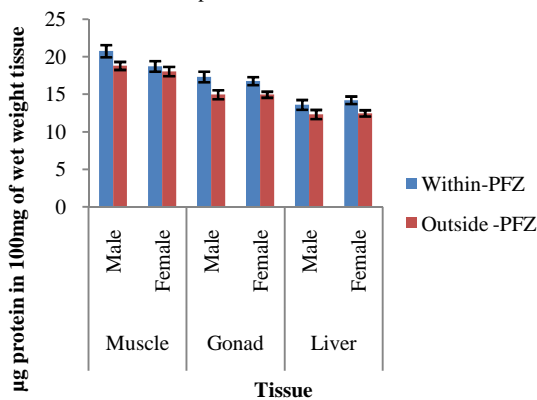


Figure 3 Protein content in *P. niger* during November-December at Harnai

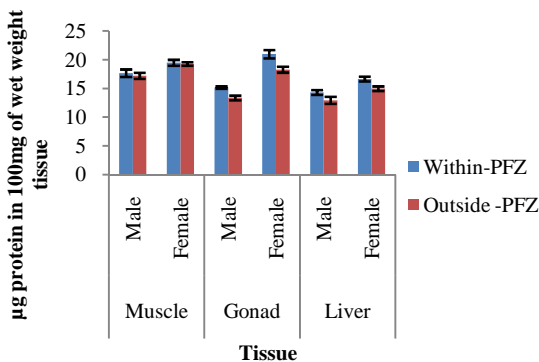


Figure 4 Protein content in *P. niger* during March-April at Harnai

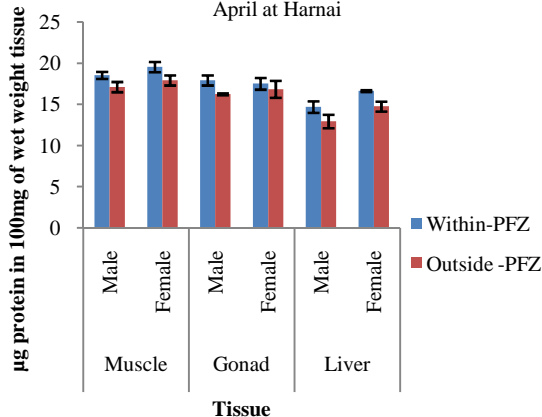


Figure 5 Protein content in *P. niger* during November-December at Sakhri-Naty

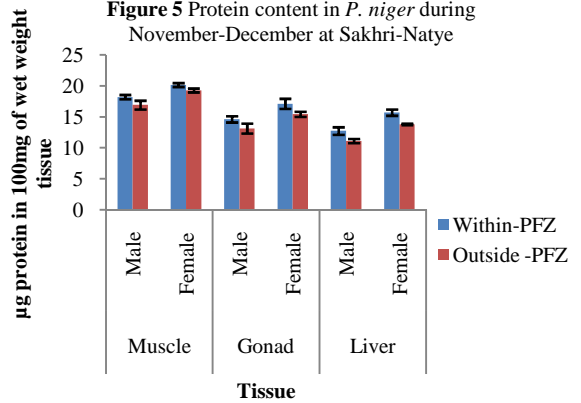
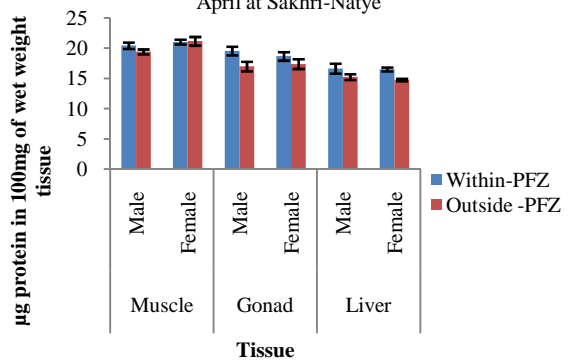


Figure 6 Protein content in *P. niger* during March-April at Sakhri-Naty



during March-April. The protein in the female liver from within PFZ showed (10.372 ± 0.509) which is non-significant ($P < 0.05$) while comparative study conducted from outside PFZ value showed (9.089 ± 0.202) in Nov-Dec. The protein in the female liver increased from within PFZ was observed (14.218 ± 0.509) which is less significant ($P < 0.01$) and from data calculated from outside PFZ (12.463 ± 0.421) in March-April.

Protein content from *Parastromateus niger* from Harnai

Muscle

The protein in the male muscle from within PFZ value (17.659 ± 0.650) was observed which is non-significant ($P > 0.05$) whereas from calculated study from outside PFZ showed (17.186 ± 0.535) in Nov-Dec. respectively. Slightly increase in male muscle protein from within PFZ value was (18.536 ± 0.421) which is non-significant ($P > 0.05$) and on the other hand comparative study from outside PFZ (17.119 ± 0.618) in the month of March-April. The protein in the female muscle from within PFZ value was represented (19.480 ± 0.509) which is non-significant ($P > 0.05$) and from the comparative study of an outside PFZ (19.278 ± 0.309) in Nov-Dec. The protein in the female muscle from within PFZ value was (19.548 ± 0.618) which is non-significant ($P > 0.05$) and from outside comparative study (17.929 ± 0.618) during March-April.

Gonad

The protein in the male testis from within PFZ was observed (15.162 ± 0.202) which is non-significant ($P < 0.05$) and calculated study from outside PFZ (13.340 ± 0.404) in Nov-

Dec. The protein in male testis for within PFZ value was observed increased (17.929±0.618) which is non-significant (P>0.05) when comparatively studied from outside PFZ (16.242±0.116) in the month of March-April. The protein in the female ovary from within PFZ was noticed(20.965±0.710) which is less significant (P<0.01) and study from outside PFZ showed (18.266±0.509) during Nov-Dec. The protein in the female ovary from within PFZ was observed as (17.524±0.710) which is non-significant (P>0.05) on the other hand from outside PFZ (16.849±1.018) respectively in March-April.

Liver

The protein in the male liver from within PFZ value was showed (14.285±0.421) which is non-significant (P>0.05) and when comparative study made from outside PFZ (12.936±0.607) in Nov-Dec. whereas from within PFZ the male liver protein was (14.690±0.710) which is non-significant (P>0.05) as compared with outside PFZ (12.936±0.809) during March-April. The protein in the female liver from within PFZ showed (16.647±0.421) which is less significant (P<0.01) while comparatively data analysis from outside PFZ (14.960±0.404) in Nov-Dec. The protein in the female liver from within PFZ was observed (16.647±0.116) which is highly significant (P<0.001) and from outside PFZ study (14.757±0.607) in March-April.

Protein content from *Parastromateus niger* from Sakhri-Natye

Muscle

The protein in the male muscle within PFZ value (18.198±0.350) was observed which is non-significant (P>0.05) whereas from outside PFZ showed dwindled (16.917±0.710) in Nov-Dec. respectively. An increase in the male muscle protein from within PFZ value was (20.425±0.535) which is non-significant (P>0.05) as compared to outside PFZ (19.413±0.404) in the month of March-April. The protein in the female muscle from within PFZ value was represented (20.155±0.309) which is non-significant (P>0.05) when comparatively from outside PFZ (19.278±0.309) in Nov-Dec. The protein in female muscle from within PFZ value was somewhat increased (21.032±0.404) which is non-significant (P>0.05) while comparatively study made from outside PFZ (21.167±0.710) during March-April.

Gonad

The protein in the male testis from within PFZ was observed (14.622±0.509) which is non-significant (P>0.05) when compared with outside PFZ (13.138±0.809) in Nov-Dec. The protein of male testis for within PFZ value was observed increased (19.548±0.710) which is less significant (P<0.01) while outside PFZ study (16.984±0.809) in the month of March-April. The protein in female ovary from within PFZ was noticed (17.119±0.818) which is non-significant (P<0.05) as compared to outside PFZ (15.432±0.421) during Nov-Dec. The protein in the female ovary from within PFZ was observed as (18.671±0.710) which is non-significant (P>0.05) when compared with outside PFZ (17.389±0.809) respectively in March-April.

Table 3 Glycogen content of *P. niger* during November-December

Tissue	Sex	Mirkarwada		Harnai		Sakhari-Natye	
		Within PFZ	Outside -PFZ	Within PFZ	Outside -PFZ	Within PFZ	Outside-PFZ
Muscle	Male	11.163	10.086	11.900	11.078	12.751	11.277
		0.147	0.214	0.298	0.255	0.343	0.129
		**	*		***		
	12.581	11.447	13.913	12.751	13.460	12.864	
Female	0.298	0.177	0.214	0.177	0.170	0.255	
	***		***	ns	ns		
Gonad	Male	12.014	10.965	13.942	12.751	13.261	12.099
		0.225	0.259	0.129	0.298	0.298	0.340
		**	**		**		
	13.999	13.006	12.411	12.212	13.913	12.638	
Female	0.049	0.259	0.343	0.214	0.259	0.177	
	**		ns		***		
Liver	Male	13.431	12.212	15.927	14.452	15.331	14.112
		0.129	0.214	0.2551	0.298	0.255	0.177
	***		***		***		
	15.558	14.169	16.097	15.104	16.068	14.396	
Female	0.098	0.343	0.170	0.214	0.214	0.225	
	***		**		***		

Mean value of 3 sample size with ± SD, *= P<0.05, **= P<0.01, ***= P<0.001, ns= P> 0.05 non- significant

Liver

The protein in the male liver from within PFZ value was showed (12.733±0.607) which is non-significant (P<0.05) while comparatively study made with outside PFZ (11.114±0.350) in Nov-Dec. whereas from within PFZ the male liver content protein was (16.647±0.818) which is non-significant (P>0.05) as compared to outside PFZ (15.230±0.467) during March-April. The protein in the female liver from within PFZ showed (15.702±0.509) which is highly significant (P<0.001) while in outside PFZ study (13.813±0.116) in Nov-Dec. The protein in the female liver from within PFZ was observed (16.512±0.309) which is less significant (P<0.01) and from outside PFZ showed (14.757±0.202) in March-April.

Table 4 Glycogen content of *P. niger* during March-April

Tissue	Sex	Mirkarwada		Harnai		Sakhari-Natye	
		Within PFZ	Outside PFZ	Within PFZ	Outside PFZ	Within PFZ	Outside PFZ
Muscle	Male	14.254	12.836	15.444	14.792	14.934	14.622
		0.259	0.177	0.214	0.049	0.214	0.129
		***	*		ns		
	14.310	13.034	15.700	14.764	15.416	14.112	
Female	0.170	0.225	0.049	0.298	0.147	0.298	
	***		**		***		
Gonad	Male	12.978	12.014	13.204	12.240	14.480	12.949
		0.129	0.306	0.306	0.129	0.340	0.340
		*	*		***		
	15.303	14.424	14.027	13.403	14.622	13.658	
Female	0.177	0.196	0.177	0.298	0.436	0.298	
	*		ns		*		
Liver	Male	14.424	13.29	16.153	15.104	15.785	14.480
		0.177	0.340	0.129	0.259	0.214	0.340
	**		**		***		
	16.437	15.189	16.550	16.153	15.558	14.509	
Female	0.255	0.383	0.214	0.298	0.343	0.298	
	**		ns		*		

Mean value of 3 sample size with ± SD, *= P<0.05, **= P<0.01, ***= P<0.001, ns= P> 0.05 non- significant

Glycogen content from *Parastromateus niger* from Mirkarwada

Muscle

The glycogen in the male muscle from within PFZ value

(11.163±0.147) was observed which is less significant (P<0.01) whereas from outside PFZ showed somewhat dwindled (10.086±0.214) in Nov-Dec. respectively. An increase in the male muscle glycogen from within PFZ value was observed (14.254±0.259) which is highly significant (P<0.001) whereas comparatively from outside PFZ study (12.836±0.177) in the month of March-April. The glycogen content of the female muscle from within PFZ value was represented (12.581±0.298) which is highly significant (P<0.001) and outside PFZ value slightly decreased (11.447±0.177) in Nov-Dec. The glycogen in female muscle from within PFZ value was increased (14.310±0.170) which is highly significant (P<0.001) whereas compared with outside PFZ (13.034±0.225) during March-April.

Figure 7 Glycogen content in *P. niger* during November-December at Mirkarwada

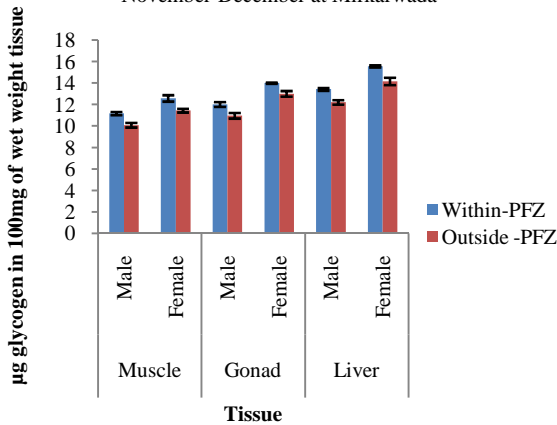


Figure 8 Glycogen content in *P. niger* during March-April at Mirkarwada

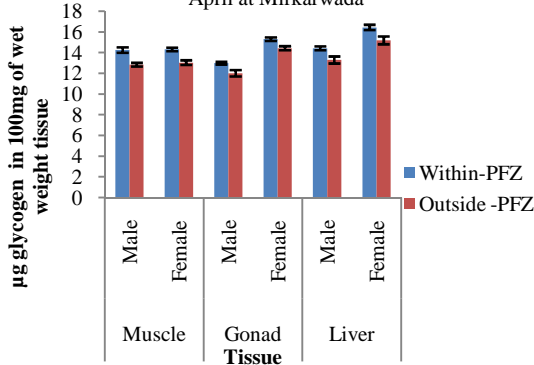
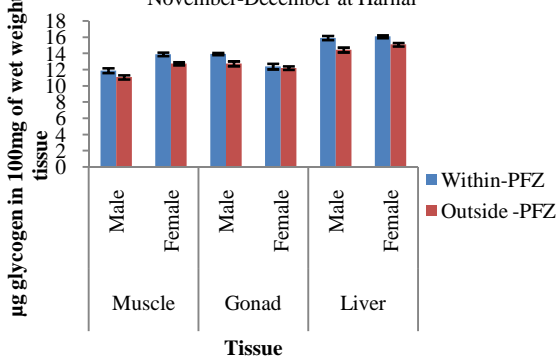


Figure 9 Glycogen content in *P. niger* during November-December at Harnai



Gonad

The glycogen in the male testis from within PFZ was

Figure 10 Glycogen content in *P. niger* during March-April at Harnai

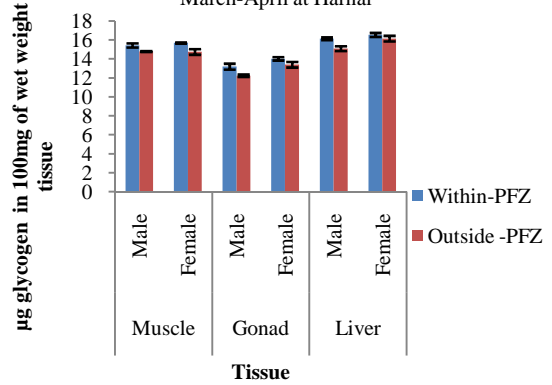


Figure 11 Glycogen content in *P. niger* during November-December at Sakhri-Natye

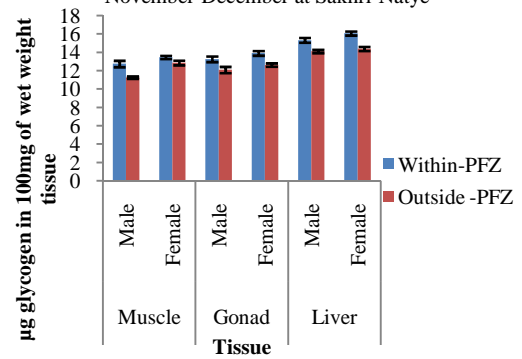
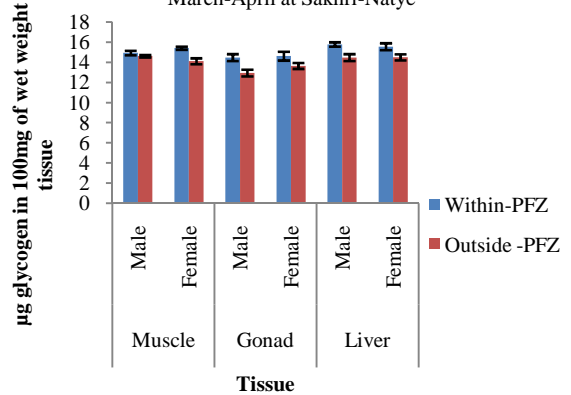


Figure 12 Glycogen content in *P. niger* during March-April at Sakhri-Natye



observed (12.014±0.225) which is less significant (P<0.01) as compared to outside PFZ (10.965±0.259) in Nov-Dec. The glycogen in case of male testis for within PFZ value was observed (12.978±0.129) which is non-significant (P<0.05) and outside PFZ (12.014±0.306) in the month of March-April. The glycogen of the female ovary from within PFZ was noticed (13.999±0.049) which is less significant (P<0.01) and compared to outside PFZ (13.006±0.259) during Nov-Dec. The glycogen in the female ovary from within PFZ was observed as (15.303±0.177) which is non-significant (P<0.05) and comparatively from outside PFZ (14.424±0.196) respectively in March-April.

Liver

The glycogen in the male liver from within PFZ value was showed (13.431±0.129) which is highly significant (P<0.001) while from outside PFZ study (12.212±0.214) in Nov-Dec.

whereas from within PFZ the male liver content of glycogen was (14.424±0.177) which is less significant (P<0.01) and outside PFZ decreased (13.29±0.340) during March-April. The glycogen in the female liver from within PFZ showed (15.558±0.098) which is highly significant (P<0.001) while in outside PFZ (14.169±0.343) in Nov-Dec. The glycogen in the female liver increased from within PFZ was observed (16.437±0.255) which is less significant (P<0.01) and from outside PFZ comparatively analyzed (15.189±0.383) in March-April.

Glycogen content from *Parastromateus niger* from Harnai

Muscle

The glycogen in the male muscle within PFZ value (11.900±0.298) was observed which is non-significant (P<0.05) whereas from outside PFZ showed (11.078±0.255) in Nov-Dec. respectively. An increase in male muscle glycogen from within PFZ value was (15.444±0.214) which is non-significant (P<0.05) and slightly decreased at outside PFZ (14.792±0.049) in the month of March-April. The glycogen in the female muscle from within PFZ value was represented (13.913±0.214) which is highly significant (P<0.001) and comparatively outside PFZ (12.751±0.177) in Nov-Dec. The glycogen in female muscle from within PFZ value was somewhat increased to (15.700±0.049) which is less significant (P<0.01) as compared to outside PFZ (14.764±0.298) during March-April.

Gonad:

The glycogen in the male testis from within PFZ was observed (13.942±0.129) which is less significant (P<0.01) as compared with outside PFZ (12.751±0.298) in Nov-Dec. The glycogen in the male testis for within PFZ value was observed (13.204±0.306) which is non-significant (P<0.05) and comparatively decreased from outside PFZ (12.240±0.129) in the month of March-April. The glycogen of the female ovary from within PFZ was noticed (12.411±0.343) which is non-significant (P>0.05) and slightly decreased from outside PFZ (12.212±0.214) during Nov-Dec. The glycogen in the female ovary from within PFZ was bserved increased (14.027±0.177) which is non-significant (P>0.05) while study conducted for outside PFZ (13.403±0.298) respectively in March-April.

Liver

The glycogen in the male liver from within PFZ value was showed (15.927±0.255) which is highly significant (P<0.001) while as compared to outside PFZ (14.452±0.298) in Nov-Dec. whereas from within PFZ the male liver content of glycogen was increased (16.153±0.129) which is less significant (P<0.01) when studied difference from outside PFZ (15.104±0.259) during March-April. The glycogen in the female liver from within PFZ showed (16.097±0.170) which is less significant (P<0.01) while from outside PFZ (15.104±0.214) in Nov-Dec. The glycogen in the female liver from within PFZ was observed (16.550±0.214) which is non-significant (P>0.05) and from outside PFZ (16.153±0.298) in March-April.

Glycogen content from *Parastromateus niger* from Sakhri-Natye

Muscle

The glycogen in the male muscle within PFZ value

(12.751±0.343) was observed which is highly significant (P<0.001) whereas from outside PFZ showed somewhat dwindled (11.277±0.129) in Nov-Dec. respectively. An increase in male muscle glycogen from within PFZ value was (14.934±0.214) which is non-significant (P>0.05) and comparatively from outside PFZ (14.622±0.129) in the month of March-April. The glycogen content of the female muscle from within PFZ value was represented (13.460±0.170) which is non-significant (P>0.05) and from outside PFZ (12.864±0.255) in Nov-Dec. The glycogen in female muscle from within PFZ value was increased to (15.416±0.147) which is highly significant (P<0.001) and experiment conducted from outside PFZ (14.112±0.298) during March-April.

Gonad

The glycogen in the male testis from within PFZ was observed (13.261±0.298) which is less significant (P<0.01) and from outside PFZ study (12.099±0.340) in Nov-Dec. The glycogen in the male testis for within PFZ value was observed increased (14.480±0.340) which is highly significant (P<0.001) and compared with outside PFZ (12.949±0.340) in the month of March-April. The glycogen of the female ovary from within PFZ was noticed (13.913±0.259) which is highly significant (P<0.001) and comparatively data analysis from outside PFZ (12.638±0.177) during Nov-Dec. The glycogen in the female ovary from within PFZ was observed as (14.622±0.436) which is non-significant (P<0.05) and outside PFZ (13.658±0.298) respectively in March-April.

Liver

The glycogen in the male liver from within PFZ value was showed (15.331±0.255) which is highly significant (P<0.001) and comparative study from outside PFZ (14.112±0.177) in Nov-Dec. whereas from within PFZ the male liver glycogen was (15.785±0.214) which is highly significant (P<0.001) and study from outside PFZ area (14.480±0.340) during March-April. The glycogen in the female liver from within PFZ

Table 5 Lipid content of *P. niger* during November-December

Tissue	Sex	Mirkarwada		Harnai		Sakhari-Natye	
		Within PFZ	Outside PFZ	Within PFZ	Outside PFZ	Within PFZ	Outside-PFZ
Muscle	Male	5.972	4.106	6.054	4.674	3.781	3.132
		0.281	0.243	0.243	0.506	0.371	0.243
			***	**	ns	ns	
	Female	6.540	5.648	6.054	4.755	6.378	5.323
0.243		0.281	0.243	0.281	0.612	0.486	
		ns	*	ns	ns		
Gonad	Male	7.758	7.190	6.297	5.404	5.891	4.674
		0.486	0.506	0.243	0.140	0.506	0.506
			ns	*	*	*	
	Female	8.488	7.027	8.813	7.108	8.731	7.271
0.243		0.243	0.612	0.371	0.486	0.486	
		*	**	*	*		
Liver	Male	3.132	2.077	3.700	3.132	2.240	1.591
		0.243	0.281	0.371	0.243	0.281	0.140
			**	ns	ns	ns	
	Female	3.619	3.376	3.781	3.376	2.483	1.347
0.243		0.486	0.854	0.486	0.506	0.371	
		Ns	Ns	Ns	ns		

Mean value of 3 sample size with ± SD, * = P<0.05, ** = P<0.01, *** = P<0.001, ns = P> 0.05 non-significant

showed (16.068±0.214) which is highly significant (P<0.001)

while in outside PFZ (14.396±0.225) in Nov-Dec. The glycogen in the female liver from within PFZ was observed (15.558±0.343) which is non-significant (P<0.05) and from outside PFZ (14.509±0.298) in March-April.

Table 6 Lipid content of *P. niger* during March-April

Tissue	Sex	Mirkarwada		Harnai		Sakhri-Natye	
		Within PFZ	Outside-PFZ	Within PFZ	Outside-PFZ	Within PFZ	Outside PFZ
Muscle	Male	6.703	5.323	6.540	5.486	6.378	5.242
		0.371	0.486	0.243	0.371	0.612	0.854
	ns		ns		ns		
	6.865	6.054	6.946	5.729	6.540	5.080	
Female	0.140	0.243	0.371	0.371	0.421	0.644	
	Ns		*		**		
Gonad	Male	9.056	7.758	7.19	6.054	6.946	5.242
		0.371	0.486	0.371	0.243	0.371	0.506
	*		*		**		
	9.786	8.082	10.03	8.894	9.786	8.245	
Female	0.371	0.281	0.782	0.612	0.612	0.486	
	*		Ns		*		
Liver	Male	3.944	3.213	4.106	3.132	3.376	2.970
		0.743	0.371	0.421	0.243	0.486	0.140
	ns		ns		ns		
	4.593	3.863	4.593	4.187	4.755	3.863	
Female	0.243	0.486	0.644	0.281	0.506	0.486	
	ns		ns		ns		

Mean value of 3 sample size with ± SD, *= P<0.05, **= P<0.01, ***= P<0.001, ns= P> 0.05 non- significant

Lipid content from *Parastromateus niger* from Mirkarwada

Muscle

The lipid content in the male muscle within PFZ value (5.972±0.281) was observed which is highly significant (P<0.001) whereas from outside PFZ showed somewhat dwindled (4.106±0.243) in Nov-Dec. respectively. Slightly increase in male muscle lipid from within PFZ value was (6.703±0.371) which is non-significant (P>0.05) & comparative analysis from outside PFZ (5.323±0.486) in the month of March-April. The lipid in the female muscle from within PFZ value was represented (6.540±0.243) which is non-significant (P>0.05) study from data analysis for outside PFZ (5.648±0.281) in Nov-Dec. The lipid in the female muscle from within PFZ value was somewhat increased to (6.865±0.140) which is non-significant (P>0.05) and study from outside PFZ value showed (6.054±0.243) during March-April.

Gonad

The lipid in the male testis from within PFZ was observed (7.758±0.486) which is non-significant (P>0.05) and outside (7.190±0.506) in Nov-Dec. The lipid in the male testis for within PFZ value was observed increased (9.056±0.371) which is non-significant (P<0.05) and outside (7.758±0.486) in the month of March-April. The lipid of the female ovary from within PFZ was noticed (8.488±0.243) which is non-significant (P<0.05) and study from outside PFZ (7.027±0.243) during Nov-Dec. The lipid in the female ovary from within PFZ was observed as (9.786±0.371) which is non-significant (P<0.05) and outside (8.082±0.281) respectively in March-April.

Figure 13 Lipid content in *P. niger* during November-December at Mirkarwada

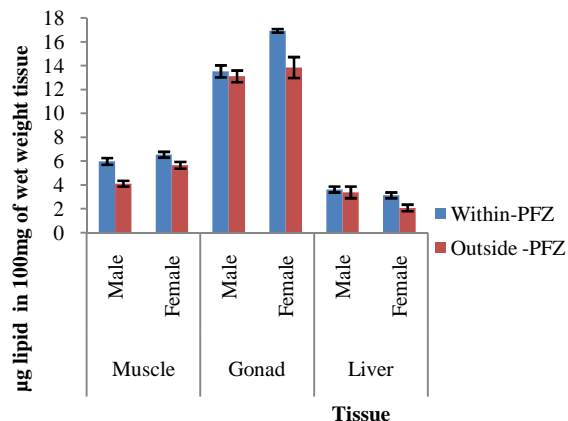


Figure 14 Lipid content in *P. niger* during March-April at Mirkarwada

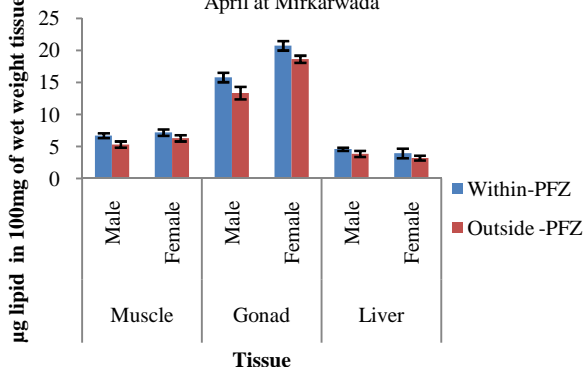


Figure 16 Lipid content in *P. niger* during March-April at Harnai

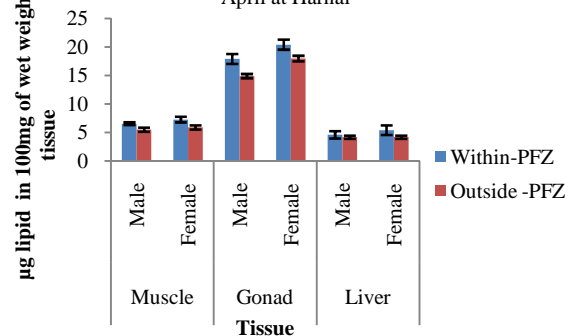
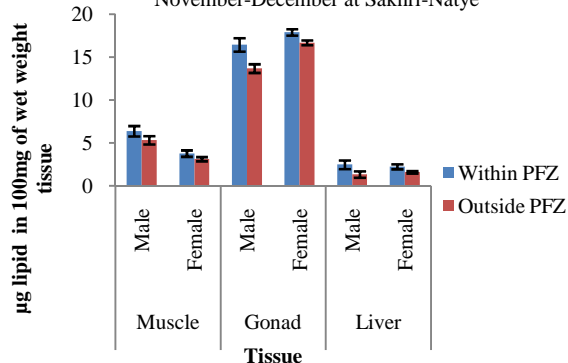


Figure 17 Lipid content in *P. niger* during November-December at Sakhri-Natye

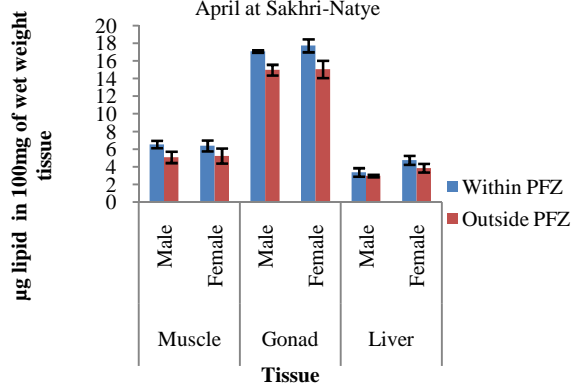


Liver

The lipid in the male liver from within PFZ value was showed

(3.132±0.243) which is less significant (P<0.01) and outside (2.077±0.281) in Nov-Dec. whereas from within PFZ the male liver content of lipid was (3.944±0.743) which is non-significant (P>0.05) and when compared with outside PFZ (3.213±0.371) during March-April. The lipid in the female liver from within PFZ showed (3.619±0.243) which is non-significant (P>0.05) while in outside PFZ (3.376±0.486) in Nov-Dec. The lipid in the liver from female within PFZ was observed (4.593±0.243) which is non-significant (P>0.05) and from outside PFZ (3.863±0.486) in March-April.

Figure 18 Lipid content in *P. niger* during March-April at Sakhri-Natye



Lipid content from *Parastromateus niger* from Harnai

Muscle

The lipid in the male muscle within PFZ value (6.054±0.243) was observed which is less significant (P<0.01) whereas from outside PFZ showed (4.674±0.506) in Nov-Dec. respectively. Increase in male muscle protein from within PFZ value was (6.540±0.243) which is non-significant (P>0.05) and outside (5.486±0.371) in the month of March-April. The lipid in the female muscle from within PFZ value was represented (6.054±0.243) which is non-significant (P<0.05) and comparative study from outside PFZ (4.755±0.281) in Nov-Dec. The lipid in the female muscle from within PFZ value somewhat increased to (6.946±0.371) which is non-significant (P<0.05) and when compared to outside (5.729±0.371) during March-April.

Gonad

The lipid in the male testis from within PFZ was observed (6.297±0.243) which is non-significant (P>0.05) and outside (5.404±0.140) in Nov-Dec. The lipid in the male testis for within PFZ value was observed increased (7.19±0.371) which is non-significant (P<0.05) and study from outside PFZ (6.054±0.243) in the month of March-April. The lipid in the female ovary from within PFZ was noticed (8.813±0.612) which is less significant (P<0.01) and outside (7.108±0.371) during Nov-Dec. The lipid in the female ovary from within PFZ was observed as (10.03±0.782) which is non-significant (P>0.05) and outside (8.894±0.612) respectively in March-April.

Liver

The lipid in the male liver from within PFZ value was showed (3.700±0.371) which is non-significant (P>0.05) and outside (3.132±0.132) in Nov-Dec. whereas slightly increased from

within PFZ the male liver content of lipid was (4.106±0.421) which is non-significant (P>0.05) and outside (3.132±0.243) during March-April. The lipid in the female liver from within PFZ showed (3.781±0.854) which is non-significant (P>0.05) while for outside PFZ (3.376±0.486) in Nov-Dec. The lipid in the female liver increased from within PFZ was observed (4.593±0.644) which is non-significant (P>0.05) and from outside PFZ (4.187±0.281) in March-April.

Lipid content from *Parastromateus niger* from Sakhri-Natye

Muscle

The lipid in the male muscle within PFZ value (3.781±0.371) was observed which is non-significant (P>0.05) whereas from outside PFZ showed somewhat dwindled (3.132±0.243) in Nov-Dec. respectively. An increase in male muscle lipid from within PFZ value was increased (6.378±0.612) which is non-significant (P>0.05) and comparative study from outside PFZ (5.242±0.854) in the month of March-April. The lipid in the female muscle from within PFZ value was represented (6.378±0.612) which is non-significant (P>0.05) and study from outside PFZ (5.323±0.486) in Nov-Dec. The lipid in the female muscle from within PFZ value was increased to (6.540±0.421) which is less significant (P<0.01) and comparative study outside PFZ (5.080±0.644) during March-April.

Gonad

The lipid in the male testis from within PFZ was observed (5.891±0.506) which is non-significant (P<0.05) and comparative analysis from outside PFZ (4.674±0.506) in Nov-Dec. The lipid in the male testis for within PFZ value was observed increased (6.946±0.371) which is less significant (P<0.01) and analysis from outside PFZ (5.242±0.506) in the month of March-April. The lipid content of the female ovary have been increased from within PFZ was noticed (8.731±0.486) which is non-significant (P<0.05) and study from outside PFZ (7.271±0.486) during Nov-Dec. The lipid in the female ovary from within PFZ was observed as increased (9.786±0.612) which is non-significant (P<0.05) and from comparative outside PFZ (8.245±0.486) respectively in March-April.

Liver

The lipid in the male liver from within PFZ value was showed (2.240±0.281) which is non-significant (P>0.05) and outside (1.591±0.140) in Nov-Dec. whereas from within PFZ the male liver content of lipid was expressed (3.376±0.486) which is non-significant (P>0.05) and comparatively analysis from outside PFZ (2.970±0.140) during March-April. The lipid in the female liver from within PFZ showed (2.483±0.506) which is non-significant (P>0.05) while in outside PFZ (1.347±0.371) in Nov-Dec. The lipid in the female liver increased from within PFZ was observed (4.755±0.506) which is non-significant (P>0.05) and from outside PFZ study (3.863±0.486) in March-April.

DISCUSSION

The lipid content very less in liver shows during in both the season late in post-spawning and early in pre-spawning period and generally it shows lower level in gonads throughout the study period. It indicates that liver might be accumulating to some extent lipids and supplying lipid to the ovary during maturing period even though it maintains low level throughout the study period. Increase in ovarian total lipids in relation to sexual maturity has been reported by some workers (Wada, 1955; Nomura, 1963; Varghese, 1976). It is also suggested that the ovarian total lipids depleted during spawning. The lipid content in testis of Black pomfrets increases during late post-spawning and early pre-spawning period and gradually increases during early period of pre-spawning i.e., March-April. An increase in level of lipid testis during early period of pre-spawning may be correlated with the maturation of sperms in testis. The lipid content in testis of Black pomfret gradually increases during post-spawning till the end early pre-spawning period. An increased level in total lipid in testis during post-spawning and early pre-spawning period suggesting the active metabolites processes and mobilization of essential metabolites towards gonads during early pre-spawning period.

The testicular lipids increase during the period of gametogenesis from November-December to March-April in the *P.niger* from within and outside PFZ zone. During peak of spawning, the testicular lipids are increased and the value of lipids from liver and then muscles fall in early pre-spawning period, fall in testicular lipids in post-spawning period has been recorded in *Pampus argenteus* and *Parastromateus niger* by (Varghese, 1976). But in the present study increase in testicular lipids in both the season viz. late post spawning and early pre-spawning from within and outside PFZ validation experiment for Black pomfrets species have been recorded off Ratnagiri coast. In the present study, variations in the major biochemical parameters namely, protein, glycogen and lipid have been analyzed from the mature fishes of these pomfrets size (25 to 32cm) selected for the biochemical study caught within and outside PFZ upon validation of PFZ advisory from the Harnai, Mirkarwada and Sakhri-Natye in Ratnagiri district coast.

In *parastromateus niger* male and female fish when comparative analysis made with other tissue the following tissue results are expressed. In the present study the glycogen level between from within PFZ in male muscle 11.16 to 12.75 whereas from outside male muscle glycogen 10.08 to 11.27 during November-December. In March-April male muscle glycogen showed within PFZ 14.25 to 15.44 whereas for outside PFZ 12.83 to 14.79. The glycogen from female muscle varies from within and outside PFZ 12.58 to 13.91 and 11.44 to 12.86 in November-December on the other side for within and outside PFZ 14.31 to 15.70 and 13.03 to 14.76 in March- April. The results represent male testis glycogen level for within and outside PFZ ranges 12.01 to 13.94 and 10.96 to 12.75 in November- December whereas for within and outside PFZ from the male testis 12.97 to 14.48 and 12.01 to 12.94 respectively in March-April. From female ovary from lowest to highest value for within and outside PFZ ranges 13.91 to 13.99 and 12.21 to 13.00 during November-December. The lowest to highest value for within and outside PFZ value represent 14.02 to 15.30 and 13.40 to 14.42 in

March-April. The male liver content glycogen from lowest to highest value for within and outside PFZ 13.43 to 15.92 and 12.21 to 14.45 during November-December on the other side ranges for within and outside PFZ 14.42 to 16.15 and 13.29 to 15.10 during March- April. The female liver glycogen for within and outside PFZ value recorded 15.55 to 16.09 and 14.16 to 15.10 during November-December whereas from within and outside PFZ from female glycogen 15.55 to 16.55 and 14.50 to 16.15 in March-April.

CONCLUSION

The protein forms major component of the fish body. The results obtained in the present study with regards to carbohydrates showed average in liver, muscle and gonad which falls well from within and outside PFZ zone validation experiment is performed in the sea water from Ratnagiri coast. Protein and fats are the major nutrient groups supplied by fish. Fish generally attain very little carbohydrates but in case of Black pomfrets is found. Fish has between 15 and 23% protein which accounts for 80 to 90% of the energy content of the fish. The protein found in fish is of high biological value which means that fish can be used as the sole source of protein in the diet. The lipid content of fish varies depending upon the type of fish, the time of year and what the fish feed on. The maturation and the enrichment of gonads in lipid coincided with a decline of the lipid content in muscles and liver. In the present study the more intense reduction in the lipid content in the muscle and liver of males compared to female's pomfrets indicate that the reproductive cost is higher in females than in males in all the Black pomfret fishes collected from the within and outside PFZ validation experiment conducted in the open sea.

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