

STOMACH CONTENT ANALYSIS OF SPADENOSE SHARK (*SCOLIODON LATICAUDUS*) MULLER & HENLE (1838) FROM THE COAST OF PAKISTAN

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ABSTRACT

Spadenose shark (*Scoliodon laticaudus* Muller & Henle) Family carcharinidae is the smallest tropical shark locally called as: Bamboli is the most abundant shark found along the cost of Pakistan. It is caught by bottom set gillnet throughout the year in bulk quantity. The nutritional items of stomach were analyzed using percentage of frequency method from August 2016 to July 2017. Most dominant food item were fish and shrimps shows carnivorous behavior of the species.

Key-words: Stomach content analysis, Spadenose shark, *Scoliodon laticaudus*, Coast of Pakistan

INTRODUCTION

Study of the diet based examination of stomach contents is now standard practice in fish ecology. Bottom living sharks including *Carcharhinus macroti*, *Rhizoprionodon acutus*, *R. oligolinx*, *Scoliodon laticaudus* caught by bottom set gillnet. *S. laticaudus*, Muller & Henle is the most dominant among these which mostly found in eastern creeks of Sindh and Kalmat area of Bulochistan). Species is common in tropical zone of Indian and western Pacific Ocean including East Africa, Asia and China, where its live in large schools. (Fig.1) Species is not a quick swimmer and found near seashore waters in shallow waters between 10 to 33 meter. This is a small species which locally known as “Bamboli”, meat of this shark considered high as delicacy as compare to other sharks but fins have cheaper value.

Biological studies of any shark occurring in Pakistan including spade nose shark has not been done in the past. Devadoss (1989) and Mahendra *et al.* (2013) worked on food and feeding habit of this species in India. So this effort has initiated to classify the main food stuff of this species to determine seasonal variation of the consumption of food item occurred and to determine difference in food composition in both sexes from August 2016 to July 2017 which may helpful to know the ecology of this species.

MATERIALS AND METHODS

A total of 498 samples including 203 male and 295 female randomly obtained from commercial landing of Karachi fish harbor, all of them caught from bottom set gillnet in shallow costal water. These samples analyzed in the biological laboratory of Marine Fisheries Department, Karachi.

Empty stomach has been excluded. The feeding rate determined by eye estimation and identified species /family level in different stages of food digestion on percentage of frequency based occurrence (Hynes, 1950; Hyslop, 1980; Bowen, 1996).using the formula below

$$F_i = 100 \frac{n_i}{n}$$

Where:

F_i: frequency of occurrence of the food item in the sample;

n_i: number of stomachs in which the i item is found;

n; total number of stomachs with food in the sample.

RESULT

Table 1 showing the combined discrepancy of food stuff found in the stomach of *S. laticaudus*. Table.2 showing the dominance of shrimp in the stomach. Food item arranged in pretty specifically in Table.3. Table 4 Showing detailed of male variant in food stuff found in the stomach of *S. laticaudus* followed by dominance of shrimp in Table 5 and a brief in Table 6. Table 7 showing detail food item in female of *S. laticaudus* followed by a dominance of shrimp in Table 8 and a brief in Table 9. All food items summarized into five groups namely fish, crustacean cephalopod, digested food and sand (Table 10)

Highest percentage of empty stomach were found in the month of November (78 %) and lowest in the month of January (32 %). In the month of June no landing of this species found.

Fish

This was the main principle item of the Spadenose shark which was abounded throughout the year. Combined rate was 50.51 % in view of the fact that in male it was 38.6% and in female it was 53.39%. Combined peak rate was observed in the month of December which was 8.19% and lowest in the month of October and November. In male peak rate was observed in the month of September which was 14.04% and absent from March to May. In female peak rate was observed in December which was 10.17% and a slope down was observed from August to November. Fifteen prey species from 13 families were found in the stomachs (Table 1). Sardines were dominating in the stomach with 6.82% followed by *Thryssa* spp. with 3.57%. Bombay duck, Ribbon fish, Striped piggy, Sardine, Sciaenids and Shads were found in larger specimen and rest of other fishes including *Thryssa* spp. Eel goby, Tongue sole, White sardine, Pony fish, and Mullet were found in small size species.

Shrimp

Second leading group of the food stuff, including *Parapenaeopsis styliifera* (Kiddi), *Penaeus indicus* (Indian white prawn), *Penaeus pulchricaudatus* (Kuruma shrimp) *Nematopalaemon tenuipes* (Spider shrimp) and Solenocera shrimp. Combined rate was 37.88 % whereas it was 52.63 % in male and 34.32 % in female. Peak combined rate observed in the month of August which was 7.17 % and slope down in the month of November with 1.37 %. In male peak rate was observed 12.30 % in August and was absent in the month of November and March to May. In female peak rate was 5.93 % which was observed in the month of August and slope down in the month of September to October with 1.27 %. Five kind of prey species from different families were found in the stomachs during this study (Table 1).

Others Crustacean

Third dominant class of food item found in this species including crab, and squilla. Most dominant amongst these was Squilla with 5.12% followed by crab 3.41 %.

Combined rate was 8.53 % whereas it was 3.60 % in male and 9.7% in female. In male peak combined rate observed in the month of August and February which was 1.8 % and found absent in other remaining months. In female peak rate was 2.96 % which was observed in the month of May and found absent in the month of October to January.

Cephalopod

Fourth dominant class of this fish food stuff comprising leading of Squids 2.05 % and some quantity of Cuttle fish 0.34 % which was on the whole 2.39 % of the total diet not found regularly. Peck rate was 0.68% in the month of May. In male it was 1.74 % of total diet and found only in the month of December with 1.75 %. In female it was 2.54 % of the total diet, peck in the month of May with 0.84 %. This food item found in species over 40 cm.

Digested food

It was found in very low quantity with 0.34% in joint diet composition. It was found only in the month of September in male with 1.75%.

Sand

It was very rear and found in very low quantity with 0.34% in joint diet composition. It was found only in the month of August in male with 1.75%.

DISCUSSION

For various life functions, body of a living organism needs energy which comes from food which found in environment where this organism lives. The food eaten in the stomach shows the area where the living organism seeks and indicates nature of its habits. It is normally supposed that shark as a group does not have any particular feeding pattern and they consume all living animals that come in their way (Devadoss, 1989).

One year study of food analyses shows that benthic animals were significant components of the diet of *S.laticaudus* resulting carnivorous feeding habits of this species. Carnivores need at least 45% of protein in their food, without which they become severely malnourished.

Table 1. Combined percentage of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of items	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish												
	Miscellanies Fish	1.71	2.39	1.02	2.05	4.10	3.07	2.05	2.05	4.78	2.05		2.05
	Sardines	0.34	0.34		0.34	1.02			2.73	0.68	1.02		0.34
	Thryssa			0.68		1.02	0.68	0.34	0.34				
	Cynoglossidae		0.34		0.34	0.34			0.34	0.34	0.68		0.34
	Eel goby	0.68	0.34	0.34									1.02
	<i>Lepturacanthus savala</i>						0.34		0.34		1.02		
	<i>Harpadon nehereus</i>	1.02						0.34					
	<i>Escualosa thoracata</i>		0.34			0.34		0.34					
	<i>Trypauchen vagina</i>		0.34										0.68
	Pony fish					0.68							
	Mullet		0.34										0.34
	<i>Pseudorhombus elevatus</i>	0.34											
	<i>Pomadasys stridens</i>					0.34							
	Sciaenids					0.34							
	<i>Otolithes cuvieri</i>										0.34		
	<i>Hilsa kelee</i>												0.34
2	Shrimp												
	Miscellanies Shrimp	4.44	1.71	1.71	1.37	1.02		2.05	0.34	1.71	2.39		0.68
	<i>Parapenaeopsis styliifera</i>	1.71	1.37			1.71	5.80	2.39	1.71	0.34	0.68		1.37
	<i>Penaeus indicus</i>	0.68		0.34		0.34	0.34	0.34		0.34			
	<i>Penaeus pulchricaudatus</i>	0.34											
	Solenocerid shrimp			0.34									
	<i>Nematopalaemon tenuipes</i>							0.34					
3	Crab												
	Charybdis crab	0.34	1.02					0.68			0.34		
	Crab claw	0.34	0.34										
	<i>Portunus sanguinolentus</i>								0.34				
4	Stomatapod												
	Squilla	0.34	0.68					1.37		0.68	2.05		
5	Cephalopods												
	Squid				0.34	0.34	0.34	0.34		0.34	0.34		
	Cuttle fish										0.34		
6	Digested food		0.34										
7	Sand	0.34											

Table 2. Combined monthly percentage of different food item in the stomach of *S.laticaudus* highlighting shrimp during study from August 2016 to July 2017.

S.No	Name of group	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish	4.10	4.44	2.05	2.73	8.19	4.10	3.07	5.80	5.80	5.12		5.12
2	Shrimp	7.17	3.07	2.39	1.37	3.07	6.14	5.12	2.05	2.39	3.07		2.05
3	Crab	0.68	1.37					0.68	0.34		0.34		
4	Squilla	0.34	0.68					1.37		0.68	2.05		
5	Cephalopod				0.34	0.34	0.34	0.34		0.34	0.68		
6	Digested food		0.34										
7	Sand	0.34											

Table 3. Combined group summary of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of group	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul
1	Fish	4.10	4.44	2.05	2.73	8.19	4.10	3.07	5.80	5.80	5.12		5.12
2	Crustacean	8.19	5.12	2.39	1.37	3.07	6.14	7.17	2.39	3.07	5.46		2.05
3	Cephalopods				0.34	0.34	0.34	0.34		0.34	0.68		
4	Digested food		0.34										
5	Sand	0.34											

Table 4. Male percentage of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of items	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish												
	Miscellanies Fish	5.26	7.02	3.51			1.75	1.75					1.75
	<i>Harpadon nehereus</i>	3.51											
	Eel goby	1.75	1.75										
	Thryssa						1.75	1.75					
	<i>Pseudorhombus elevatus</i>	1.75											
	Sardine		1.75										
	Cynoglossidae		1.75										
	Mullet		1.75										
2	Shrimp												
	Miscellanies Shrimp	8.77	5.26	7.02				5.26					
	<i>Penaeus indicus</i>	1.75						1.75					
	<i>Parapenaeopsis styliifera</i>	1.75	5.26			1.75	8.77	3.51					1.75
3	Crab												
	Crab claw	1.75											
4	Stomatapod												
	Squilla							1.75					
5	Cephalopod												
	Squid					1.75							
6	Digested food		1.75										
7	Sand	1.75											

Table 5. Male monthly percentage of different food item in the stomach of *S.laticaudus* highlighting shrimp during study from August 2016 to July 2017.

S.No	Name of group	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish	12.3	14.0	3.5			3.5	3.5					1.8
2	Shrimp	12.3	10.5	7.0		1.8	8.8	10.5					1.8
3	Crab	1.8											
4	Crustacean							1.8					
5	Cephalopod					1.8							
6	Digested food		1.8										
7	Sand	1.8											

Table 6. Male group summary of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of group	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish	12.3	14.0	3.5			3.5	3.5					1.8
2	Crustacean	14.0	10.5	7.0		1.8	8.8	12.3					1.8
3	Cephalopods					1.8							
4	Digested food		1.8										
5	Sand	1.8											

Table 7. Female percentage of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of items	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish												
	Miscellanies Fish	0.85	1.27	0.42	2.54	5.08	3.39	2.12	2.54	5.93	2.54		2.12
	Sardine	0.42			0.42	1.27			3.39	0.85	1.27		0.42
	Thryssa			0.85		1.27	0.42		0.42				
	Cynoglossidae				0.42	0.42			0.42	0.42	0.85		0.42
	Eel goby	0.42		0.42									1.27
	<i>Lepturacanthus savala</i>						0.42		0.42		1.27		
	<i>Escualosa thoracata</i>		0.42			0.42		0.42					
	<i>Harpadon nehereus</i>	0.42						0.42					
	Pony fish					0.85							
	<i>Trypauchen vagina</i>		0.42										0.85
	<i>Pomadasys stridens</i>					0.42							
	Sciaenids					0.42							
	<i>Otolithes cuvieri</i>										0.42		
	<i>Hilsa kelee</i>												0.42
	Mullet												0.42
2	Shrimp												
	<i>Parapenaeopsis stylifera</i>	1.69	0.42			1.69	5.08	2.12	2.12	0.42	0.85		1.27
	Miscellanies Shrimp	3.39	0.85	0.42	1.69	1.27		1.27	0.42	2.12	2.97		0.85
	<i>Penaeus indicus</i>	0.42		0.42		0.42	0.42			0.42			

	<i>Penaeus pulchricaudatus</i>	0.42											
	Solanasora shrimp			0.42									
	<i>Nematopalaemon tenuipes</i>							0.42					
3	Crab												
	Charybdis crab	0.42	1.27								0.42		
	Crab claw		0.42										
	<i>Portunus sanguinolentus</i>								0.42				
4	Stomatopod												
	Squilla	0.42	0.85					1.27		0.85	2.54		
5	Cephalopods												
	Squid				0.42		0.42	0.42		0.42	0.42		
	Cuttle fish										0.42		
6	Digested food												
7	Sand												

Table 8. Female monthly percentage of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of group	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Fish	2.12	2.12	1.69	3.39	10.17	4.24	2.97	7.20	7.20	6.36		5.93
2	Shrimp	5.93	1.27	1.27	1.69	3.39	5.51	3.81	2.54	2.97	3.81		2.12
3	Crab	0.42	1.69					0.85	0.42		0.42		
4	Crustacean	0.42	0.85					1.27		0.85	2.54		
5	Cephalopods				0.42		0.42	0.42		0.42	0.85		

Table 9. Female group summary of different food item in the stomach of *S.laticaudus* during study from August 2016 to July 2017.

S.No	Name of group	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
1	Fish	2.12	2.12	1.69	3.39	10.17	4.24	2.97	7.20	7.20	6.36		5.93
2	Crustaceans	6.78	3.81	1.27	1.69	3.39	5.51	5.93	2.97	3.81	6.78		2.12
3	Cephalopods				0.42		0.42	0.42		0.42	0.85		

Table 10. Summary of the total food items.

S.No	Name of group	Male %	Female %	Combined %
1	Fish	38.6	53.39	50.51
2	Crustacean	56.14	44.07	46.42
3	Cephalopods	1.75	2.54	2.39
4	Digested food	1.75		0.34
5	Sand	1.75		0.34

Table 11. Percentage of size.

S.No	Size in cm	Male %	Female %
1	21-30	4.84	4.17
2	31-40	37.10	16.67
3	41-50	50.00	47.92
4	51-60	8.06	31.25

Prey of the shark very much depends on the teeth structure and on bite force. This species has 25–33 tooth series in the upper jaw and 24–34 tooth series in the lower jaw; each tooth has a single slender, blade-like, slanting cusp without serrations (Fig.2) due to it, various selection of crushed food stuff of soft tissue mainly of fish and shrimp were found in the stomach of this species in different months. (Fig.3)

S. laticaudus is mainly a coastal species which is found in warm temperature water, mostly reported from Eastern creeks area of Sindh and Kalamat of Baluchistan. Only once an off shore species of *Solenocerid* shrimp was found in its stomach of a female in October 2016 shows the approaches of species to deeper water or entrance of solenocerid shrimp in creeks area.

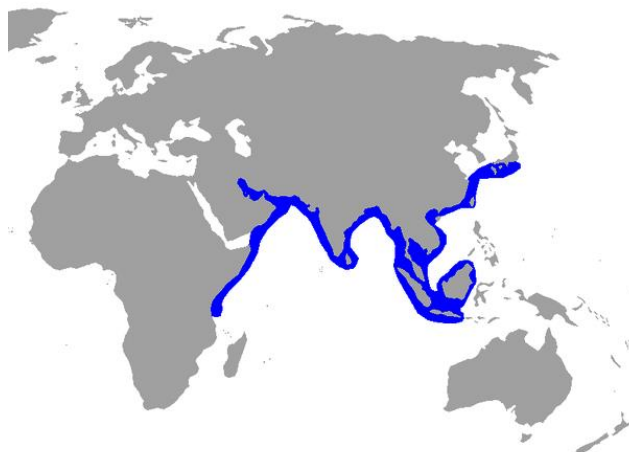
Devadoss (1989) in his brief study from July 1977 to April 1981 at Kalicut India and Mahendra *et al.* (2013) in their brief description from March 2009 to April 2010 from Saurashtra, Gujrat, India, describe the feeding habits of *S. laticaudus* that fish has carnivorous habits, dominant diet depend on crustacean, fish and cephalopod. The majority food items of present study are almost similar apart from of few items in different composition, it is dominated by crustacean in their study, low salinity could be a reason which provide better environment for crustacean in that area. In the present study it is dominated by fish, crustacean, cephalopods, digested material and sand. Dominated food items found in both sexes are different, female dominating with fish and then crustacean whereas male were dominating with crustacean and then fish because female over 51 cm were 31.25 % as compare to male which has just 8.06 % (Table 11) to allow female to prey on faster moving fish species like Sardine, Ribbon fish and Bombay duck etc. This analyses shows that favorite food item of young shark are slow moving crustacean and as they attain larger size the feeding gradually shifted to fish which are fast moving. Dominant of sardine in the larger shark shows that larger species also comes in pelagic zone of the area and prefer this pelagic fish in the diet as compare to early growing time when species could not move fast and depend on bottom living crustacean and slow moving fish species like Tongue sole etc.

Parsons (1987) also observed slow growth of male in a shark species *Sphyrna tiburo* at a shorter length than females.

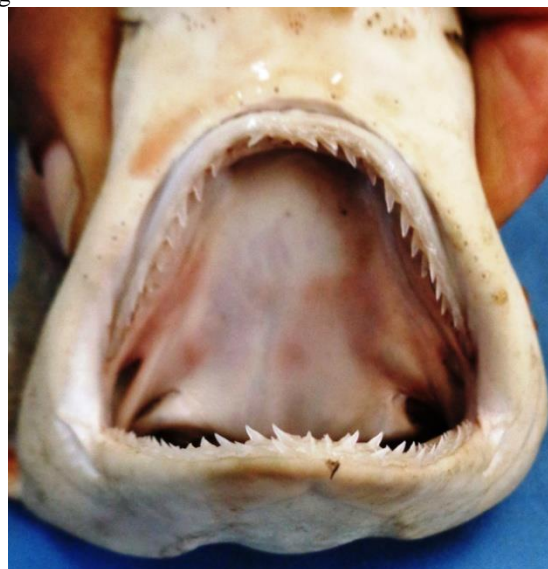
Medved *et al.* (1988) Stillwell and Kohler (1993), Ellis (2003). during study of sandbar shark (*Carcharhinus plumbeus*) stated that with improved size, where crustaceans dominant the diet of young sharks occupying nursery places, compared with the supremacy of teleost and elasmobranch prey in bigger size classes

Jenkins and Green (1977) studied on fish feeding habits and described that if outcome show lack of feeding discontinuity, it does not essentially mean that feeding is constant with time, because differences in feeding movement may not for all time be reflected by stomach content.

Cortes *et al.* (1996) in study of feeding of Bonnethead shark *Sphyrna tiburo* described that diet feeding movement is a multifaceted procedure resulting from relations among different biotic and abiotic factors working on behavioral and physiological processes associated to feeding



Plat.1 Distribution map of *Scoliodon laticaudus*.
Blue area shows the occurrence of this species



Plat.2. Jaw

(https://en.wikipedia.org/wiki/Spadenose_shark#/media/File:Scoliodon_laticaudus_distmap.png)



Plate.3. Food variety of different months.

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