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Instruction To Authors

Observation On The Food And Feeding Habits Of *Cynoglossus Bilineatus* (Family: Cynoglossidae) From Karachi Coast, Pakistan

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ABSTRACT

The pattern of food and feeding habits *Cynoglossus bilineatus* was studied during the period from June 2009 to May, 2010, using points methods. The composition of food of different size groups and seasons was calculated. Analysis of fullness of stomach revealed gorged – full constituted 2.02 %, 3/4 full 2.95 %, 1/2 full 11.03 %, 1/4 full 27.64 %, barely full 53.42 % and empty 2.95 % in a year. Analysis of stomach contents showed the occurrence (in percentage) of polychaetes 17.96%, crustaceans 10.47%, mollusks 6.21%, fish 0.51%, sand-mud 9.53% and miscellaneous items 55.32%. Total points of fish were determined to be 16.89% for polychaetes, 7.71% for crustaceans, 4.92% for molluscs, 1.24% for fish, 4.30% for sand-mud and 64.94% for miscellaneous items.

Key words: Food analysis, stomach, carnivore, flat fish, Karachi coast.

INTRODUCTION

Flat fishes are excellent food fishes and these are marketed mostly fresh, frozen and also dried salts. Flat fishes are abundant in the open continental shelf and are fished on a commercial scale (Munro, 1967). *Cynoglossus* sp. mainly inhabit the soft muddy bottom, but some inhabit the areas of graved and sand.

Food and feeding habits of flat fishes have been studied by a number of workers Khan (1993), Shaukat (1994), Arndt and Nehils (1964), Braber and De-Groot (1973), De-Groot (1971), Kruuk (1963), Lande (1973), Moiser (1953), Ochiai (1966) and Bayhan et al., (2009). Only a few studies were made on the food and feeding habits of *Cynoglossus* sp. ; notably among them are Rao (1964), Seshappa and Bhimachar (1955), Kuthlingham (1957).

Howevare, taxonomical studies of this species have been carried out by Day (1878), Fisher & Bianchi (1984), Ramanathan (1977), Qureshi (1960), Ahmad and Niazi (1988), Hoda (1988) and Munro (1965).

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This paper present information on the feeding intensity and food habits of *C. bilineatus* in the months of season and at different size groups.

MATERIALS AND METHODS

A total of 644 specimens of *Cynoglossus bilineatus* were collected from commercial landing at Karachi fish Harbor during June 2009 to May 2010. Each fish in the sample were measured from the tip of the snout to the end of the caudal fin. Stomachs were removed and opened to determine the degree of fullness and examined qualitatively. Food contents were grouped into five categories such as polychaetes, molluscs, crustaceans, fishes and miscellaneous food materials.

The stomach contents were the weighed and preserved in 70 % alcohol for further analysis based on the occurrence method and points method of Hynes (1950) which was adopted with slight modification allotting the points for fullness of stomach according to an arbitrary 7 points scale : 100, 75, 50, 25, 12, 6, 0 points awarded for gorged,

full, $\frac{3}{4}$ full, $\frac{1}{2}$ full, $\frac{1}{4}$ full, little and empty stomach respectively based on inspection and estimation. The points assigned to food categories were ascertained by subdividing the total points allocated to stomach. All the points gained by each food categories were summed up and scaled down to give a percentage composition of food of all fish examined. In the "occurrence" method the number of fish in which each food item occurs is listed as percentage of total number of fish examined and calculated by ratio of number of fish feeding on particular food and number of fish examined multiplied by 100.

RESULT

Food in relation to seasons:

The data on the stomach contents of 644 specimens of *C. bilineatus* are shown in Table I and II. From Table 1 it is evident that the intensity of food out of 644 stomachs 625 (97.05 %) were with food and 19 (2.95 %) without food. Among these 13 (2.02 %) stomachs were gorged full with food, 19 (2.95 %) were $\frac{3}{4}$ full, 71 (11.03 %) were $\frac{1}{2}$ full, 178 (27.64 %) were $\frac{1}{4}$ full, 344 (53.42 %) were barely full. Fish with the highest percentage of intensity of feeding in 6 categories was marked during Spring – Summer i.e. February – May and minimum feeding in winter i.e. September – December while in other months feeding appeared normal as judged by the barely full and empty stomachs. The intensity of feeding did not vary during June, July – August and January. The type of the amount of different food groups taken by fish is shown in Table II & III.

Among the different food groups, miscellaneous items were the most dominant food group by percentage of total occurrence (55.32 %), whereas next to miscellaneous items, polychaetes were the second most important food group (17.96 %), followed by polychaetes, Crustaceans (10.47 %), sand mud (9.53 %), molluscs (6.21 %), fish (0.51 %) occupied the successive positions by percentage of total occurrence.

Polychaetes occurred (in abundance) very frequently in all the seasons of the year except May and varying

between June (9.41 %) to December (31.29 %). Crustaceans, like the Polychaetes, occurred in all the seasons, contributing minimum to August (3.57 %) and maximum to November and July (15.20-17.07). Molluscs formed the third in the rank of food categories (absent in August) of *C. bilineatus*. Fish item ranked fourth in the food constituents of *C. bilineatus* and occurred in small quantities in June, August-October and March-April. Sand-mud were frequently found in small quantities except in July, February and May. Miscellaneous food items (50-64 %) occurred in all the seasons except July (43.90 %) and December (46.26 %).

Food in relation to fish size:

The intensity of feeding appeared less in lower size groups up to 291-300 mm and slowly increased between 301-310 mm group after which barely full and empty stomachs were practically absent exhibiting high intensity of feeding in larger samples. Full stomachs were high above 371-390 mm TL (16.67-18.18%) (Table IV). Polychaetes occurred in all size groups (Table V). Crustaceans did not occur till 211-220 mm except 201-210 mm TL (11.11%) and the mollusks were not found in the stomachs of *C. bilineatus* less than 221-230 mm, fishes were found in samples measuring 241-250 mm (2.17%), 251-260 mm (2.33%), 291-300 mm (0.81%) and 401-410 mm (33.33%), which might have regurgitated. Total points of fish were determined to be 16.89% for polychaetes, 7.71% for crustaceans, 4.92% for molluscs, 1.24% for fish, 4.30% for sand-mud and 64.94% for miscellaneous items (Table VI).

Food contents of fourlined tonguesole, *C. bilineatus* 6 categories : 1. Polychaetes, 2. Crustaceans, 3. Molluscs, 4. Fish, 5. Sand-mud, 6. Miscellaneous. The details of food contents are shown in Appendix 1.

APPENDIX 1

Food Contents of *C. bilineatus*

- Polychaetes : Dioptra sp., Polynoids sp., Orbiniids sp.

- Crustaceans : Squilla empusa, Philyra globbosa, Copepods, Mysis, Parapenaeops , Isopods.

- Molluscs : Gastropods shells, Bivalve shell Solen sp., Mytilus sp., Pholladidea sp.

- Fish : Cynoglossus sp.

- Sand-mud : Sand grains, Pebbles, gravel and mud.

- Miscellaneous : Eyes, head, appendages, chelae, carapace and antennae of crabs and shrimps (crustacean), Scales and eggs of fish, Elytra and remains of tubiculous (Polychaetes) Pieces of shells (Molluscs), Small fragment of plants Holothurians, pieces of star fish (Echinoderms), Semidigested and unidentified specimens.

Miscellaneous

It occupied the first place in food contents and has 55.32%. The maximum amount (64.71%) was observed in the month of June. It occurred in high percentage in all months of the year.

Polychaetes

This item ranked second in importance as constituent of *C. bilineatus* (Table II). The maximum amount of polychaetes (26.39% and 31.29%) was recorded in the month of December and May. The minimum amount (5.04 % and 9.41 %) was in the month of June and May.

Crustaceans

Occupied third position in the diet of *C. bilineatus* and having composition 3.57 % - 17.07 %. The maximum amount (15.20 % and 17.07 %) was observed in the month of July and November. The lowest frequency of occurrence of crustacean was noted in the month of August (3.57 %) (Table II).

Sand and mud

Ranked fourth position in all food items. Sand and mud occurred throughout the month of the year. It was the main component of diet. The composition ranging from 4.00 % 13.16 % (Table II).

Molluscs

Molluscs were fifth in ranked. Its percentage occurrence was 6.21. They were not obvious in large quantities through out the months. The composition ranging from 2.44 % - 15.13 % (Table II).

Fish

Fish showed small percentage and occupied six position in food items. It not occurred in all months and absent in the month of November and May.

Table I. Season of the year and percentage of intensity of feeding *C. bilineatus* from Karachi coast in different months (N-644)2

Year	Month	Stomach Examined	Gorged-full	3/4 full	1/2 full	1/4 full	Barely full	Empty	
2009	June	60	3.33	5.00	13.33	26.67	36.67	15.87	
	July	19	-	-	10.53	36.84	52.63	-	
	August	39	2.56	5.13	5.13	33.33	48.72	5.13	
	September	69	-	-	1.45	10.15	86.96	1.45	
	October	78	1.28	3.85	1.28	16.67	75.64	1.28	
	November	69	-	-	1.45	23.19	75.36	-	
	December	67	2.99	-	22.39	40.30	34.83	-	
	2010	June	65	-	-	9.23	32.31	56.93	1.54
		February	37	5.41	2.70	27.03	27.03	37.84	-
		March	39	7.69	12.82	20.51	33.33	20.51	5.13
		April	39	-	5.13	12.82	38.64	38.46	5.13
		May	63	3.17	4.76	19.09	31.75	39.68	1.59
% Occurrence		644	2.02	2.95	11.03	27.64	53.42	2.95	

Table II. Percentage occurrence of various groups of food items in the stomach of *C. bilineatus* from Karachi coast in different months (N-644).

Year	Month	Stomach Examined	Poly-chaetes	Crusta-ceans	Molluscs	Fish	Sand mud	Miscell-aneous
2009	June	60	9.41	9.41	4.71	1.1	10.59	4.71
	July	19	19.51	17.07	2.44	-	17.07	43.90
	August	39	21.43	3.57	-	1.79	8.93	64.29
	September	69	19.38	5.43	4.65	0.78	9.30	60.47
	October	78	14.82	9.63	5.19	0.74	9.63	60.00
	November	69	16.00	15.20	5.60	-	4.00	59.20
	December	67	31.29	10.20	6.80	-	5.44	46.26

2010 June	65	17.24	10.35	6.04	-	9.48	56.60
February	37	18.42	10.53	7.90	-	13.16	50.00
March	39	26.39	9.72	5.56	1.39	5.56	51.39
April	39	18.06	12.50	4.17	1.39	11.11	52.78
May	63	5.04	11.77	15.13	-	16.81	51.26
% Occurrence		17.96	10.47	6.21	0.51	9.53	55.32

Table III. Percent of total points of food contents of *C. bilineatus* from Karachi coast in different months (N-644).

Year	Month	Stomach Examined	Poly-chaetes	Crusta-ceans	Molluscs	Fish	Sand mud	Miscell-aneous
2009	June	60	20.39	4.95	1.46	1.82	4.13	57.23
	July	19	26.29	23.20	3.09	-	5.67	41.75
	August	39	29.90	1.21	-	8.08	3.43	57.37
	September	69	16.84	4.26	2.56	0.43	3.63	72.28
	October	78	18.95	11.58	4.74	3.95	8.82	51.20
	November	69	9.07	13.04	5.86	-	1.89	70.13
	December	67	22.5	11.56	5.43	-	1.48	58.99
2010	January	65	11.06	10.74	1.76	-	2.56	73.88
	February	37	19.57	4.59	3.36	-	4.59	67.89
	March	39	20.24	5.75	1.66	1.11	0.89	70.69
	April	39	15.96	5.86	1.01	0.40	5.46	71.31
	May	63	2.17	5.03	18.42	-	8.97	65.42
% of TotalPoints			16.89	7.71	4.92	1.24	4.30	64.94

Table IV. Percentage of intensity of feeding of *C. bilineatus* in different size groups from Karachi coast (N-644).

Size-groups (mm, TL)	Stomach examined	Gorged-full	¾ Full	½ Full	¼ Full	Little	Empty
191-200	1	-	-	100.00	-	-	-
201-210	5	-	20.00	20.00	20.00	40.00	-
211-220	7	-	-	28.57	-	71.43	-
221-230	10	-	-	-	10.00	90.00	-
231-240	27	-	-	7.41	18.52	66.67	7.41
241-250	52	1.92	-	5.77	21.15	67.31	3.85
251-260	56	1.79	3.57	8.93	12.50	62.50	10.71
261-270	67	1.49	1.49	7.46	22.39	62.69	4.48
271-280	80	-	2.50	11.25	23.75	61.25	1.25
281-290	80	1.25	-	5.00	31.25	58.75	3.75
291-300	66	3.03	3.03	3.03	25.76	65.15	-
301-310	50	-	2.00	16.00	44.00	38.00	-
311-320	43	4.65	-	16.28	39.53	37.21	-
321-330	12	-	-	25.00	41.67	33.33	-
331-340	21	-	-	4.76	42.86	47.62	4.76
341-350	17	-	5.88	17.65	47.06	29.41	-
351-360	6	-	16.67	16.67	50.00	16.67	-
361-370	11	-	9.09	27.27	45.45	18.18	-
371-380	6	16.67	33.33	33.33	16.67	-	-
381-390	11	18.18	18.18	27.27	36.36	-	-
391-340	3	-	-	33.33	33.33	33.33	-
401-410	13	15.38	23.08	38.46	15.38	7.69	-
% of Intensity		2.02	2.95	11.03	27.64	53.42	2.95

Table V. Percentage of occurrence of various groups of food items of *C. bilineatus* in different size groups from Karachi coast (N-644).

Size-groups (mm, TL)	Stomach examined	Poly-chaetes	Crus-taceans	Moll-uscs	Fish	Sand mud	Misce-llaneous
191-200	1	33.33	-	-	-	33.33	33.33
201-210	5	22.22	11.11	-	-	22.22	44.44
211-220	7	33.33	-	-	-	-	66.67
221-230	10	11.11	11.11	55.56	-	11.11	61.11
231-240	27	15.69	9.80	7.84	-	17.65	49.02
241-250	52	17.39	9.78	5.43	2.17	8.70	56.52
251-260	56	17.44	5.81	2.33	2.33	11.63	60.47
261-270	67	19.51	8.13	5.70	-	8.13	58.54

271-280	80	16.89	10.81	5.41	-	10.14	56.76
281-290	80	16.20	11.27	7.04	-	7.75	57.75
291-300	66	13.71	12.10	8.87	0.81	8.87	55.81
301-310	50	18.75	10.42	10.42	-	12.50	47.92
311-320	43	20.25	12.66	5.06	-	6.33	55.70
321-330	12	23.81	14.29	9.52	-	-	52.38
331-340	21	22.50	10.00	2.50	-	12.50	52.50
341-350	17	22.22	8.33	2.78	-	11.33	55.55
351-360	6	9.09	9.09	9.09	-	18.18	54.55
361-370	11	28.57	14.29	4.76	-	-	52.38
371-380	6	18.18	27.27	9.09	-	-	45.45
381-390	11	19.05	9.52	9.52	-	9.52	52.38
391-340	3	-	14.29	14.29	-	28.57	42.86
401-410	13	34.72	21.48	11.11	33.33	11.11	56.85
% Occurrence		17.96	10.47	6.22	0.51	9.53	55.32

Table VI. Percentage total points of food contents of *C. bilineatus* in different size groups from Karachi coast (N-644).

Size-groups (mm, TL)	Stomach examined	Poly-chaetes	Crus-taceans	Moll-uscs	Fish	Sand mud	Misce-llaneous
191-200	1	40.00	-	-	-	8.00	52.00
201-210	5	35.35	10.10	-	-	4.04	50.51
211-220	7	53.75	-	-	-	-	46.25
221-230	10	15.15	7.58	1.52	-	6.06	69.70
231-240	27	12.84	4.13	7.34	-	7.34	68.35
241-250	52	14.02	4.07	1.63	3.46	4.07	72.76
251-260	56	26.43	4.21	0.51	7.07	4.38	57.41
261-270	67	23.75	6.75	4.25	-	3.96	61.29
271-280	80	15.23	5.67	7.91	-	6.14	65.05
281-290	80	9.25	10.70	3.96	-	4.10	71.10
291-300	66	22.70	5.12	12.86	1.31	2.76	55.41
301-310	50	17.99	9.55	7.96	-	12.26	52.22
311-320	43	11.20	5.44	5.92	-	1.60	75.84
321-330	12	13.21	20.76	12.57	-	-	53.46
331-340	21	11.40	16.06	0.52	-	4.15	67.88
341-350	17	12.75	12.35	0.80	-	2.39	71.71
351-360	6	0.86	3.42	1.71	-	17.09	76.92
361-370	11	18.78	9.14	0.51	-	-	71.57
371-380	6	3.38	29.96	2.11	-	-	64.58
381-390	11	24.82	9.93	0.71	-	1.42	63.12
391-340	3	-	2.33	2.33	-	25.58	69.77
401-410	13	19.37	4.63	9.00	60.00	-	58.77
% total points		16.89	7.71	4.92	1.24	4.30	64.94

DISCUSSION

Present study indicates that *C. bilineatus* is a carnivorous in nature, fish which mainly feed upon polychaetes, crustaceans, molluscs and fishes. Polychaetes and crustaceans are the most favored diet of *C. bilineatus*. Seasonal variations in feeding habits are marked considerably. More than 50% stomachs were empty in almost all size groups with the maximum of 75-80% in 401-410 mm size groups, in 191-210 mm TL, and rarely less than 50% empty were marked after 210 mm size groups. Similar observations have also been made by Rao (1964), Khan and Hoda (1993), Shaukat (1994), De-Groot (1971), Lande (1973), Bayhan et al., (2009) and

Dewan and Saha (1979).

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