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ON THE SHEDDING OF GILL RAKER PROCESSES IN GREY MULLETS*

By G. LUTHER

Central Marine Fisheries Research Institute, Mandapam Camp

INTRODUCTION

WHILE studying the food habits of the grey mullets, *Liza macrolepis* (Smith) and *Mugil cephalus* Linnaeus from the lagoon adjoining the Palk Bay near Mandapam, the author came across certain unidentifiable item in the stomach contents. Since this appeared not to belong to any group of known organism the possibility of its being part of some internal structure of the mullets themselves was investigated, the details of which are presented below.

OBSERVATIONS

The unidentifiable item (Plate I) formed a significant proportion of the stomach contents of nearly 35% of a total number of 1147 fish of both the species in different size groups. Occurrence of this item in the stomachs of mullets from the sea (Palk Bay), however, was negligible. It was found that the gill raker processes (the tiny processes present in double row on the inner face of the gill rakers) of mullets are similar in structure to this item. Examination of the branchial apparatus of the two other common fishes viz., *Chanos chanos* and *Nematalosa nasus* and many other fishes in the lagoon (Tampi, 1959) revealed that the gill raker processes of these fishes do not bear resemblance to those of the mullets.

Fishes with gill raker processes in their stomachs showed the processes on their gill rakers intact indicating that the fish does not swallow its own gill raker processes.

In a detailed study of the food habits of the above two species of mullets, the fish have been arbitrarily separated into two groups viz., those with stomach contents predominated by decayed organic matter and foraminifera (Type A stomachs), and those with stomach contents formed virtually of gill raker processes (Type B stomachs). While copepods were seen neither to occur regularly nor to form any appreciable proportion in type A stomachs during the period of observation they were of common occurrence in the type B stomachs (Table I) indicating an association of copepods with the gill raker processes. The copepods, *Harpacticus* spp., *MkroseteUa rosea* and *Metes jousseumi* met with in type B stomachs are known to be omnivorous and benthic found on sea weeds and other organisms. Besides copepods foraminifera, diatoms, sand grains and spicules which are common at the bottom were also found in type B stomachs. The foregoing observations, therefore, suggest that the gill raker processes were ingested by the fish

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while feeding at the bottom. The corollary of the above inference is that the gill raker processes were first shed by the fish into the lagoon environment.

The gill raker processes in the corresponding arches of the different species of mullets available in the lagoon look so much alike that it has not been possible to make any specific distinction as to whether only a few or all the species of mullets shed the gill raker processes.

The salient features of the structure of the gill raker processes from the first four arches and the ceratobranchial of *M. cephalus* are given below. In the first arch, the gill rakers of the outer row are the longest; those of the inner row are very much shorter being about 1/3 or slightly less than the middle rakers of the outer row. The rakers of the inner row in the second arch are nearly half those of the outer row. In the third arch the rakers of the inner row are more than half the length of the outer row. In the fourth arch the rakers of both the rows are almost equal in length. The rakers on the ceratobranchial are modified to form a concave floor over which are present the parallel rows of gill raker processes. While the distal ends of the gill rakers in both the rows of the first and second arches remain free, those of the rakers of the third and fourth arches bear fleshy hood-like structures which more or less adhere to one another thus providing rigidity to the gill rakers. The rakers on the ceratobranchial also bear fleshy hood-like structures, but only on the margin facing the operculum. The gill raker processes are simple on the first arch, but beset with bristle-like processes in the remaining arches. The bristles of each row oppose similar structures of the adjacent rakers forming a very efficient seiving apparatus.

Based on the above structural differences it has been possible to identify that the gill raker processes found in the stomach contents belong to the third and fourth arches, and the ceratobranchial (Plate I, Figs. 4, 5, 6 and 7). Rarely those of the second arch were seen. The strips of processes from the corresponding arches deliberately removed from the fish are shown in Plate I, Figs. 1, 2 and 3 for comparison.

It should be stated that the actual shedding of these processes was not observed. However, when the gill rakers of *M. cephalus* and *L. macrolepis* were examined *in situ* the gill raker processes were seen partially dislodged in the form of strips lying loosely in the branchial cavity during December to February months. The monthly percentage occurrence of fish with the gill raker processes in their stomachs, the monthly percentage of fish in active feeding stage (gorged, full and g full stomachs) for the two species of mullets studied and the rainfall in the area for a period of two years is given in Table II. It may be seen that a fairly high percentage occurrence of fish with gill raker processes in the stomachs is preceded by a period of intense feeding activity which also coincided with a period of good rainfall in the area. In this connection it may be stated that the author had observed mullets with gorged stomachs whenever fine and soft decayed organic matter, fresh algae and diatoms were available in plenty in the habitat. During the rainy period from October to December, which is also a period of intense feeding, the specimens examined had their branchial apparatus literally clogged with large quantities of detritus.

L. fade collected on 24-10-1960 from Matlah estuary, Port Canning, Calcutta (obtained through the courtesy of Dr. M. D. K. Kuthalingam) were also examined for this purpose. Out of five specimens examined one had the gill raker processes

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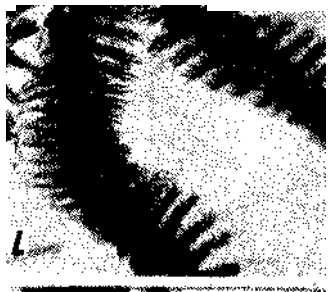

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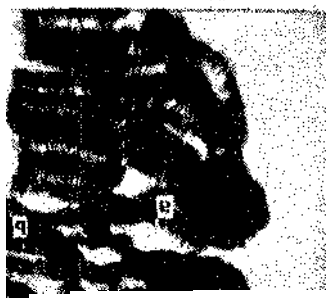

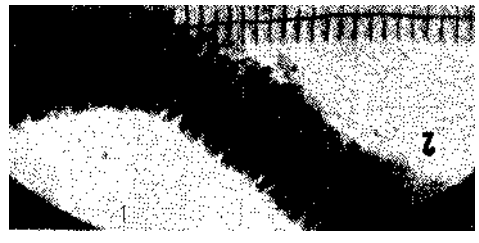

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in its stomach. Examination of twenty stomachs of grey mullets from Port Blair (Andamans) revealed the occurrence of these processes in two stomachs of

TABLE I

Monthly percentage composition of copepods in the food of *Liza macrolepis* and *Mugil cephalus* from lagoon environment

Month	*L. macrolepis*		*M.ce phalus*	
	Type A stomachs	TypeB stomachs	Type A stomachs	TypeB stomachs
1958				
April	*	..	—	
May		1	—	3.87
June	»*	3.21	—	5.11
July	0.09	4.37	—	1.13
August	—	1 4.22	—	—
September	0.45	—	—	—
October	—		—	
November	—	2.65	—	0.71
December			..	••
1959				
January				
February	—	—	—	1.18
March	—	1.20	0.34	2.28
April	—	2.40	—	2.86
May	—	2.62	—	2.50
June	—	4.99	—	5.00
July	—	3.95	—	4.38
August				. ,
September			..	
October	1.18	..	0.88	. ,
November	0.42	—	0.56	, m
December	0.57		0.40	..
1960				
January	0.38	3.93	0.95	5.77
February	—	—	—	6.70
March		3.95		4.21
Over the whole perio i	0.30	2.43	0.21	2.12

* (..) Fish sample not available for study.
** (—) Absent.

M. cephalus collected during March 1963. Dr. R. V. Nair and Shri D. Sudarsan (personal communication) of the Central Marine Fisheries Research Institute informed the author that similar structures have been observed by them in the gut contents of grey mullets from Calicut and from Vishakhapatnam respectively.

DISCUSSION AND CONCLUSIONS

On account of their common occurrence in the stomach contents, the gill raker processes of the third and fourth arches, and the ceratobranchial seem to be worst affected and are shed by the fish to overcome the deleterious effect brought

about due to clogging. As pointed out earlier, the rakers from these arches are not flexible due to the presence of the adhesive fleshy hoods and therefore incapable of getting rid of the clogging effect unlike those of the first and second arches. The gill raker processes of an entire arch are shed as a single unit as evident from the stomach contents.

TABLE n

Percentage occurrence of *Liza macrolepi*$ and *Mugil cephalus* (from lagoon environment) with type B stomachs and in active feeding state, and the data on rainfall in Mandapam area

Month	*Liza macrolepis*			Rainfal	*Mugil cephalus*		
	No. of fish examined	Percentage occurrence			No. of fish examined	Percentage occurrence	
		Fish with typeB stomachs-	Fish in active feeding state (Type A & B stomachs)			Fish with typeB stomachs	Fish in active feeding state (Type A & B stomachs)
1958							
January	#			9		..	
February				4	..		
March			..	23			
April		..		68	16	**	81.25
May			..	141	28	28.57	71.43
June	26	42.31	38.46	0	31	61.29	35.48
July	43	13.95	62.79	1	31	38.71	64.52
August	14	92.86	21.43	30	26	92.31	11-54
September	39	71.79	17.95	1	35	42.86	57.14
October	24	20.83	62.50	65	9	—	100.00
November	15	40.00	93.33	150	14	71.43	85.71
December				23		••	• •
1959							
January				39			
February	40	45'.00	32.50	3	35	45.71	34.29
March	38	60.53	21.05	0	37	70.27	16.22
April	42	42.86	33.33	-27	31	29.03	58.06
May	37	37.84	37.84	61	37	27.02	48.65
June	23	26.09	43.48	11	14	28.57	57.14
July	47	63.83	17.02	0	36	19.44	50.00
August	..			18			
September		..		0			
October	37	—	89.19	130	17	—	100.00
November	18	11.11	72.22	351	30	—	100.00
December	56	—	73.21	101	15	—	93.33
1960							
January	47	38.30	29.79	9	31	25.81	51.61
February	34	29.41	23.53	72	13	23.08	46.15
March	51	39.22	33.33	0	30	33.33	40.00
Over the whole period	631	36.13	42.63		516	35.08	54.84

* (..) Fish sample not available for study.
** (—) Fish with Type B stomachs absent.

In this connection it may be stated that Chidambaram and Kurian (1952), Pillay (1953) and Sarojini (1954) had recorded the occurrence of 'Polychaete Moults' and 'Polychaete remains' in the stomach contents of mullets. There is every possibility of the gill raker processes having been considered by them to be the 'Polychaete Moults' and 'Polychaete remains'.

Parker and Boeseman (1954) reported that the basking shark *Cetorhinus maximus* loses its gill rakers in winter. They 'calculated that during the winter months the plankton is probably insufficient in amount to meet the energy requirements of the actively feeding animal and at that time the rakers are lost and the fish enters upon a resting demersal stage'. But, Hardy (1959, p. 72) commenting on the same habit of the basking shark in winter stated that 'after feeding all summer in the plankton rich waters near our coast they sink to deep water and replace their frayed and worn-out "net" by a brand new one ready for the fresh outburst of plankton in the spring'. It is interesting that the mullets lose only their gill raker processes.

The shedding of the gill raker processes in mullets may probably be due to excessive feeding by the fish on its favourite item of food available during the period of rains in this area with the consequent wearing of the seiving apparatus. But another factor which appears to be equally important is the clogging of the branchial apparatus of the fish by the suspended particulate matter that is abundantly present in the lagoon during the same period. The foregoing observations suggest that the grey mullets in general, under similar circumstances would exhibit this habit of shedding their gill raker processes. However, this habit of shedding the gill raker processes in grey mullets has not hitherto been reported by other workers. Experimental studies might throw more light on this shedding and its biological significance.

SUMMARY

A study of the stomach contents of the grey mullets, *Liza macrolepis* and *Mugil cephalus* from the Mandapam area indicates that the grey mullets shed their gill raker processes into the environment and later pick them up from the bottom while feeding.

Wear and tear due to excessive feeding and clogging of the branchial apparatus by suspended and particulate matter are considered to be the possible factors for effecting the shedding of these processes.

ACKNOWLEDGEMENT

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