OBSERVATIONS ON THE FISHERY AND BIOLOGY OF THE SILVER POMFRET *PAMPUS ARGENTEUS* (EUPHRASEN) FROM THE BAY OF BANGAL†

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CONTENTS

INTRODUCTION

Pomfrets which are of considerable commercial importance formed the main bulk constituting about 82% of the "A"* *class category of the trawler catches of the Government of West Bengal. These trawlers were engaged in exploratory fishing of the different fishing grounds of the Bay of Bengal and the log reports of these vessels provide information only regarding total catch, depth range and nature of bottom, as such, the present investigation has its own limitations. Since no information is available regarding the fishery and biology of pomfrets the data analysed and presented here throw light on the resources of this fishery in the different fishing regions, its trend and also the biology of *Pampus argenteus*.

MATERIAL AND METHOD

The material for the study was collected during January 1958—June 1962 from the trawling operations of *Kalvani* I-V in the Bay of Bengal between depths of 5-40 fathoms during the fishing periods, August-April. Abount 80% of the collections were made from off Mahanadi

†From Sand heads to Gopalpur.

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**According to the market value the trawler catches are classified into three categories *viz*, A, B, and C classes by the Directorate of Fisheries, West Bengal Government.

"A" class:— pomfrets, prawns, big sized perches, sciaenids, polynemids and scombroids.

"B" class:— leiognathids, clupeids, mullids, mugilids, kurtids, muraenids and medium sized sciaenids polynemids and perches.

"C" class:— trichiurids, synodontids, scopelids, tachysurids, sole fishes, sharks' rays and skates.

and Sand-head regions and the rest from the other fishing grounds. Specimens ranging from 4 to 28 cm. (standard length) were collected from the trawlers at the landing centre, shore base station, whereas 18 juveniles were collected from the surface plankton hauls in the sand head regions about 30 miles north-east of Balasore in March 1960.

Data relating to the biological studies were collected during 1959-'62. Points(Numerical) method was adopted to obtain the percentage composition of the diet. The extent of feeding was determined by the degree of distension of the stomach and also the amount of food it contained. The degree of feeding was classified as empty, little, ¼ full, ½ full, ¾ full, full and gorged. Since this varies during different stages of maturity, five broad divisions of maturity were recognised *viz.*, immature, maturing, mature, spawners and spent.

Haddock type of otter trawl was the gear employed by *Kalyanis*.

ANALYSIS OF THE DATA

(*a*) *Total yield of pomfrets by the trawlers* :

The total catch of pomfrets by all the five vessels amounted to 38386·31 kg. Table I represents the vessel-wise catch per day of pomfrets in relation to "A" class category of fishes together with the available fishing details. Though the total number of fishing days spent by these trawlers was found to be more during 1958-'59, it is of interest to note that the highest catch per day of 711·91 kg. of pomfrets was recorded during 1961-62—the highest ever since the inception of the deep sea fishing in West Bengal. *Kalyani* III alone brought 58·3% of the total catch of pomfrets during 1958-62.

Kalvani I had not performed any fishing trip after 1958-59 since the vessel met with heavy damage and dry docked, *Kalvani* II had also not undertaken any voyages due to major engine trouble, whereas regular fishing trips were made by *Kalyani* III, IV and V during the fishing season.

(*b*) *Seasonal fluctuations* :

The fluctuations of the c.p.u.e. at the different fishing grounds during 1958-'61 can be seen in Table II. A regular pattern of fluctuation could not be observed since the data for the entire year is not avaliable as the trawlers did not undertake continuous fishing throughout the year due to rough and unforeseen climatic changes in the Bay. However, from the data gathered and presented it is seen that a progressive increase in the c.p.u.e. of pomfrets was noted with the approach of winter season—December and January being the most productive period.

(*c*) *Area of fishing* :

Some important fishing grounds, Sands heads, off Balasore,off Mahanadi, Devi and Prachi rivers and off Black Pagoda, Puri, Chilka and Gopalpur have been located and the fishing operations were conducted at depths ranging from 5-40 fathoms. Actual fishing operations were conducted only from sand heads to Chilka during the period of observation. The fishing

TABLE I

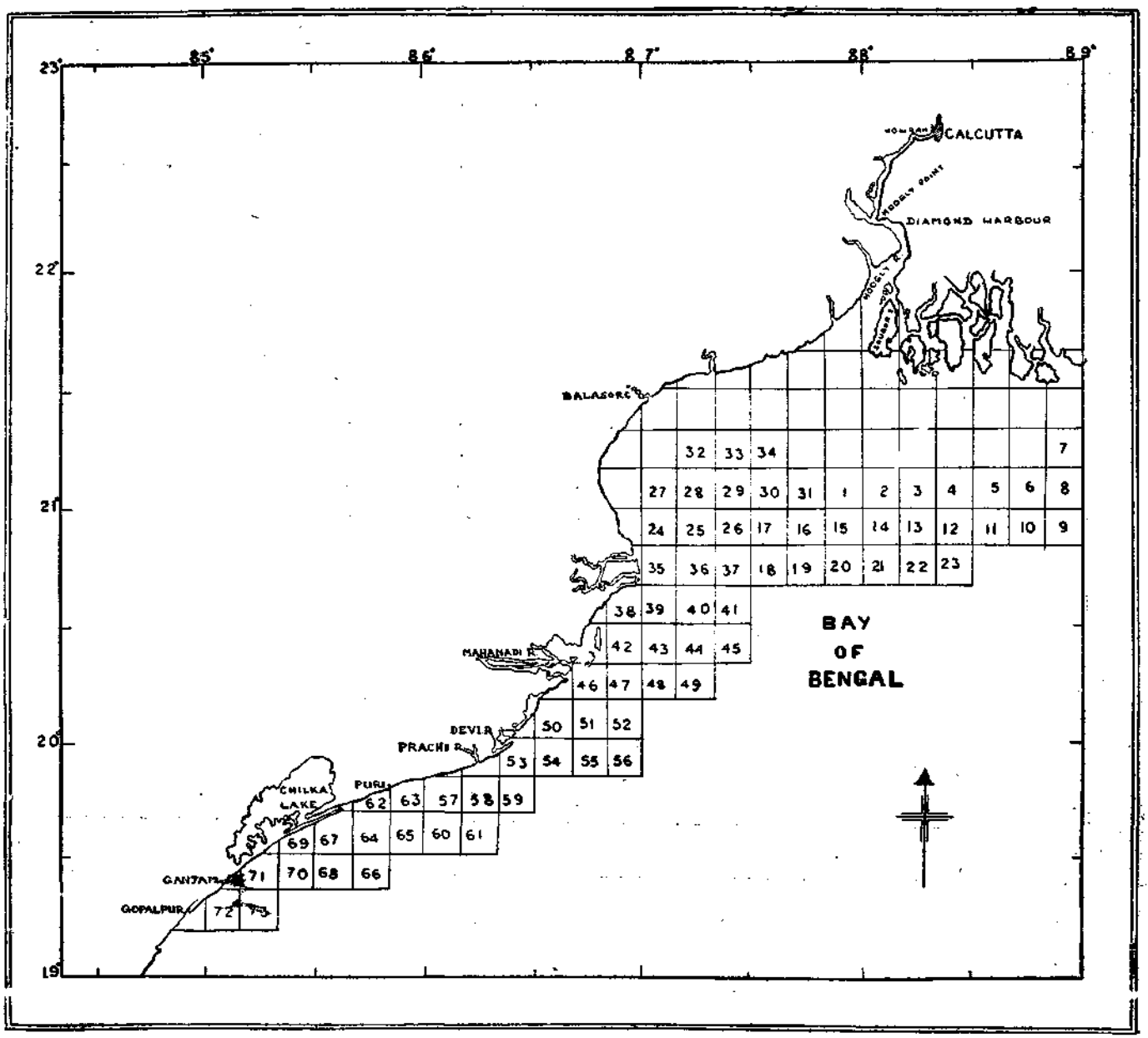
Names of Vessel	Kalyani I					Kalyani II					Kalyani III				
Details of* fishing	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
1958—'59 .	7	72	46·02	95·8	13·6	..	No	fishing	..	..	8	82	1400·26	622·90	77·8
1959—'60 .		No	fishing			6	44	531·0	373·0	62·2	7	83	4,358·31	3,308·76	472·6
1960—'61 .			,,			1	13	142·12	..	..	7	76	6,945·13	5,659·00	808·4
1961—'62 ...			,,			3	26	410·30	200·00	66·6	12	116	15,240·71	11,809·33	984·2

Name of Vessel	Kalyani IV					Kalyani V				
Details of* fishing	a	b	c	d	e	a	b	c	d	e
1958—'59 .	6	65	1,150·31	705·8	117·6	11	101	2,419·43	1,680·9	143·7
1959—'60 .	7	65	893·39	564·62	801·4	5	52	1,436·0	727·28	145·4
1960—'61 .	6	61	1,156·43	1,093·63	182·2	9	90	3,759·61	864·20	96·6
1961—'62 .	7	71	4,363·02	1,634·25	233·5	10	100	14,051·50	9,137·75	913·8

*a= No of voyages; b= No of days absence; c=catch/day of "A" class fish in kg; d= Pomfrets in kg; e= catch/voyage of pomfrets in kg.

TABLE II

Area	Catch/Unit of effort in kilograms.											
	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Off Mahanadi	120·2	..	..	..	96·04	165·8	122·2	128·0	180·8	220·0	87·0	58·5
Off Devi & Prachi . . .	..	..	..	..	..	..	..	57·6	152·2	146·0	28·0	29·2
Off Black Pagoda	..	..	..	..	..	..	..	33·4	124·4	99·4	38·4	39·2
Sand Heads	..	..	..	..	..	..	..	176·0	848·2	747·0	240·0	541·2


85°
86°
87°
88°
89°
23°
22°
21°
20°
19°
CALCUTTA
DIAMOND HARBOUR
HOOGLY R.
HOOGLY POINT
BALASORE
MAHANADI R.
DEVI R.
PRACHI R.
PURI
CHILKA LAKE
GANJAM
GOPALPUR
BAY OF BENGAL

grounds were charted out and divided into series of areas (Text Fig. 1) and numbered fixing the latitude and longitude. Each region has a total extent of about 100 square miles and the areas fished by these vessels fall into the following region :

Sand heads	1–23
Off Balasore	24–34
,, Mahanadi	35–49
,, Devi & Prachi	50–56
,, Black Pagoda	57–61
,, Puri	62–66
,, Chilka	67–71
,, Gopalpur	72–73

The details of fishing together with the c.p.u.e. in each of the fishing areas are tabulated and presented in Table III. It is seen from the table that during 1958-'59 to 1960-'61 the c.p.u.e. was more off Mahanadi region. During 1958-'59 to 1960-'61 more concentration for fishing was paid to off Mahanadi region, whereas during 1961-'62 only sand heads area was trawled. Out of 32 voyages, 31 trips were undertaken at the sand heads area where square numbers 4-12 between depths of 7-40 fathoms were intensively fished. A comparative account of the fishing effieciency off Mahanadi and Sand heads could not be made since the former region was not fished during the year 1961-'62. A scrutiny of the data revealed that square numbers 4-12 off Sand heads and 35-49 off Mahanadi were found to be the best grounds for pomfret fishing. Negligible quantities of pomfrets were also recorded in square numbers 50-61. The nature of the sea bottom where pomfrets were found in abundance was recorded to be sandy and muddy.

(*d*) *Variations in the size and catch composition* :

Table IV shows the seasonal variations in the average weight per standard basket, (approximately 37·3 kg.) and size of the pomfrets landed in relation to the different fishing areas. Specimen recorded off Mahanadi were larger in size and ranged between 14·0 and 28·5 cm. The weight per basket of pomfret off Mahanadi was always found to be higher by 2·8-4·7 kg. when compared with that of the other regions. A maximum of 42·0 kg. was recorded in February off Mahanadi.

Table V shows the percentage composition of the different species of pomfrets in each of the fishing grounds. Of the various species of pomfrets, *Pampus argenteus* dominated the catch and constituted 91·7%. *Pampus chinensis* and *Parastromateus niger* formed 3 and 5·3 per cent respectively *P. argenteus* was particularly abundant off Mahanadi and Sand head regions.

TABLE III

YEAR	Area of fishing	Depth range in fathoms	Nature of bottom	Catch/unit of effort
1958-'59	Off Black Pagoda	8—10	S.M.	68.2
	Off Devi & Prachi	7—10	S.	168·3
	Off Mahanadi	10—15	S.M.	450·1
	Off Sand heads	23—35	S.M.	77·6

TABLE III—*Contd.*

YEAR	Area of fishing	Depth range in fathoms	Nature of bottom	Catch/unit of effort
1959-60	Off Black Pagoda	8—12	S.M.	132·4
	Off Devi & Prachi	8—10	S.	121·2
	Off Mahanadi	8—10	S.M.	366·3
	Sand Heads	15—20	S.M.	220·0
	Off Puri Coast	10—30	S.C.	..
	Off Chilka	20—25	S.C.M.	..
1960-61	Off Black Pagoda	10—20	S.M.	134—2
	Off Devi & Prachi	8—17	S.	123·5
	Off Mahanadi	7—25	S.M.	362·5
	Sand heads	12—20	S.M.	180·4
	Off Puri coast	9—12	S.C.	..
	Off Chilka	12—25	S.C.M.	..
1961-'62	Sand Heads	8—40	S.M.	274·00
	Off Puri	8—10	S.C.	..

S.M.—Sand & Muddy; S—Sandy; S.C.—Sandy Coral; S.C.M—Sandy coral and muddy.

MARKETING, DISPOSAL & INCOME FROM THE FISHERY

The catches secured by the trawlers were subsequently sold by the West Bengal Fisherir es Directorate in wholesale markets through auction and the minimum rates were fixed fo- "A" class @ Rs. 141·20, "B" class @ Rs. 66·50 and "C" class @ Rs. 18·20 per quintal (100 kg.) During 1958, majority of the catch was auctioned at the shore base station—fish landing centre and a portion was also sent to the wholesale markets in Calcutta and Howrah and this practice continued till the end of 1959. In 1960 a co-operative fish marketing and consumers' society was set up to which the entire catch was sold. When the Deep Sea Fishing Board took charge in 1961, arrangements were made to auction major portion of the catch at the shore base station and the remaining sold through the co-operaive society.

Table VI represents month-wise income from the pomfret fishery during 1959-62 together with the rate per quintal. The pompfrets fetched the highest value (Rs. 107·20—164·40 per quintal) among the trawler catches. The total income from the fishery during this period was estimated at Rs. 35,279·37.

BIOLOGY OF PAMPUS ARGENTEUS (EUPHRASEN)

The present study relates to the food and feeding habits maturity and size groups of the fishery.

(i) *Food and feeding habits* :—

(*a*) *Composition of the diet of young ones*

The specimens that were collected at sand heads ranged between 1·8 and 2·6 cm. Fig- 2 a, represents the percentage composition of the different items of diet of the young- ones. Copepods and smaller crustaceans formed the main bulk of the diet. The commonest forms that could be indentified were *Paracalanus parvus*, *Oithona* spp., *Euterpina* spp., *Macrose- tella* sp., *Temora* sp., *Acartia* spp. and *Harpaticus* sp. Apart from this, Ostracods, amphipods,

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TABLE IV

Area	November		December		January		February		March	
	Length in cm.	Weight in kg.	Length in cm.	Weight in kg.	Length in cm.	Weight in kg.	Length in cm.	Weight in kg.	Length in cm.	Weight in kg.
Sand heads	12·0—19·5	37·3	11·0—18·5	36·4	7·8—16·0	36·4	20·0—23·8	38·2	8·2—22·8	35·4
Mahanadi	14·0—19·0	40·1	14·0—17·5	40·1	14·5—17·5	39·2	16·0—28·5	42·0	14·0—22·5	40·1
Devi & Prachi . . .	12·5—16·5	35·4	10·5—16·5	35·4	14·0—16·0	37·3	12·0—16·8	37·3	12·5—17·5	34·5
Black Pagoda	12·0—18·0	35·4	12·0—16·0	35·4	13·5—17·0	34·5	9·5—14·5	35·4	14·5—17·5	34·5

TABLE V

Area	PERCENTAGE COMPOSITION											
	1958—'59			1959—'60			1960—'61			1961—'62		
	I	II	III	I	II	III	I	II	III	I	II	III
Sand heads	13·6	..	4·0	20·0	..	2·0	15·0	..	3·2	90·4	..	9·0
Off Mahanadi	64·3	2·0	..	59·0	3·0	..	60·8	2·0	..	..	..	..
Off Devi & Prachi . . .	7·2	2·0	..	6·2	..	..	5·2	3·0	..	..	..	..
Off Black Pagoda	6·9	..	..	9·8	..	..	7·8	..	3·0	..	..	..
Off Puri coast	..	..	..	..	..	..	..	..	..	·6	..	..

I=*Pampus argentenus.* II=*Pampus chinensis.* III=*Parastromateus niger.*

TABLE VI

Months	Total yield in Rupees					
	1959—'60	Rate per quintal	1960—'61	Rate per quintal	1961—'62	Rate per quintal.
April	246·33	109·10	..	..	..	..
August	..	..	..	..	..	..
September	..	..	..	..	..	..
October	..	..	..	..	..	..
November	658·42	47·20	440·14	107·20	1171·76	130·60
December	2660·09	147·40	2917·43	123·20	9836·12	164·40
January	1644·16	109·80	4136·30	115·30	6793·82	154·10
February	642·00	109·80	461·30	115·30	3581·50	128·60
March	90·00	107·20	..	..	..	..
TOTAL	5941·00	..	7955·17	..	21383·20	..

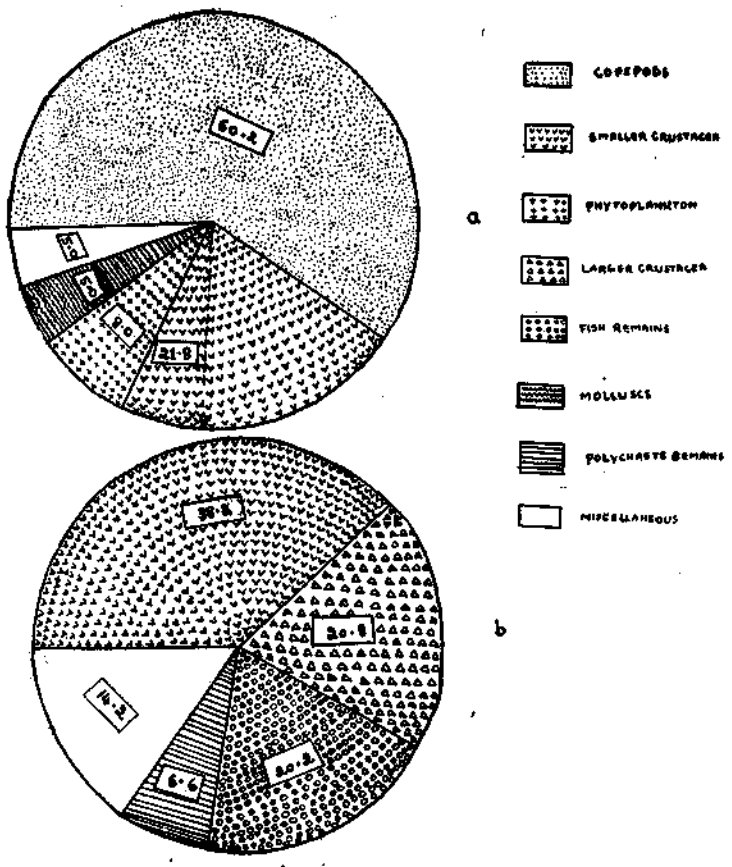

FIG. 2. Percentage composition of the different food items of *Pampus argenteus*.

larval stages of *Squilla*, and *Lucifer* were also present. Filamentous algae and diatoms were found mixed with copious quantities of mucus and were in a partly digested condition. *Trichodesmium* was the only algae that could be identified. Larval bivalves and gastropods were also recorded. Remnants of polychaetes and crustaceans and their nauplii together with sand particles formed the miscellaneous items. No specific identification could be made out since they were in advanced stages of digestion.

(b) Composition of the diet of adults.

The percentage composition of the food of adult can be seen from Fig. 2 b. Crustaceans formed the main bulk, of which the smaller forms predominated. The smaller crustaceans included the copepods (*Oithona* spp., *Euterpina* spp. and *Eucalanus* spp.), copepod nauplii, ostracods, amphipods, *Lucifer* and zoea larvae of which copepods alone constituted 10·8%. The larger crustaceans were represented by *Penaeus* spp., *Acetes* spp. *Squilla* spp., and anomurans. Fish scales, vartebra and *Cynoglossus* spp. were also recorded. Polychaetes belonging to the families Maldanidae and Glyceridae were reprenented. Larval decapods, Foraminifera, *Sagitta*, sand particles and digested matter comprised the miscellaneous items.

FIG. 3. Seasonal variation of the food components and average volume of stomach contents of *Pampus argenteus*

(*c*) *Seasonal fluctuations in the composition of the diet.*

The fluctuations in the percentage composition of the various food items during the different months of the year are shown in Fig. 3. It is noted that the crustaceans formed the main bulk of the food reaching the peak in February. The fall in the crustaceans items of food during March was compensated by the increase of teleosteans, polychaetes, molluscs and miscellaneous items. It is clear from the present study that while the crustacean item of food increased, the fish, polychaetes, molluscs and miscellaneous items showed a decrease. It is probable that these fluctuations may be due to the availability of the various organisms in a particular environment. On a comparison of the volume of the stomach contents in different months, a steady rate of feeding was noticed from August to October. A slight decrease in feeding was observed in November. Feeding activity is low in December and high in March. However, the increase in the volume of food in March is not through the crustancean items but due to other items of diet, mainly fish.

(*d*) *Feeding intensity* :

It is of interest to note from the data presented in Table VII that maturity has a direct bearing on the feeding intensity of *Pampus argenteus*. Feeding intensity was found to be more during the early stages of maturity (immature and maturing stages) and less in fishes with mature gonad. Spent fishes were observed to have a feeding intensity higher than in the mature stage. In mature specimens the space inside the body cavity was reduced because of the growth of the reproductive structure. The digestive organs were also pushed towards the dorsal side and these factors may be the reason for the low intensity of feeding in the advanced stages of maturity. However the author admits that such a view can only be accepted with due caution since these data are based on a study of 286 individuals only, irrespective of the possible differences in the time of capture, ecological conditions and other bionomic factors.

TABLE VII

	No. of fishes examined . . .		82	62	48	58
Condition of feed	Average volume of stomach contents in cc.		3·2	2·4	0·8	1·8
	Stages of maturity . . .		immature	maturing	mature	spent
Empty	Depth range in fathoms 7-25	Length range in cm 12.5-24.5	..	..	8	4
Little			..	..	2	3
¼ full			2	12	16	14
½ full			12	28	2	13
¾ full			20	12	..	18
Full			28	10	..	..
Gorged			20	..	..	..

TABLE VIII

Area of operation	Total No. of fish examined	Length range in cm.	Depth in fathoms	Percentage of stomach contents
	42	9·5—20·5	7—15	Copepods—25·5; *Metapenaeus* sp. 25·5; Crustaceans—9·5; Acetes sp. 18·2; squilla—12·3; fishes—9·0
Sand Heads	32	8·5—16·5	15·40	Fish remains 32·8; crustaceans 13·0; polychaete 18·2; copepods 17·2; Miscellaneous 18·8;
Off Mahanadi	28	14—21·5	5—15	Amphipods—18·2; Prawns—10·80 Squilla—6·2; Lucifer—12·2; Acetes—10·2; fish remains—10·2; copepods—15·2; Anamura—8·2; Miscellaneous—7·8.
	32	11·5—18·5	15—25	Fish remains—30·8; copepod 12·0; foraminifera remains 20·2; polychaetes—16·0; Prawns—10·0; Acetes—8·; Miscellaneous—3·0

(*e*) *Feeding in relation to depth* :

Since the log sheets prepared by the masters of the vessels were not of a detailed nature, samples for this study had to be collected on board the vessel in order to correlate the feeding behaviour with depth. The results obtained from the sand head and off Mahanadi regions where pomfrets abound are presented in Table VIII. It can be inferred from the results that in the marine offshore environment depth has a specific relation to feeding. It may be pointed out that *Pampus argenteus* showed different feeding habits at different depths. Between 5 and 15 fathoms the percentage of crustacean items was found to be more whereas between 15 and 40 fathoms fish polychaetes and Foraminifera were the dominant items of diet.

(ii) *Maturity, spawning and occurrence of young ones* :

In determining the maturity stages of fishes the standard defined by the International Council for the Exploration of the Sea was adopted. A scale of only five* stages of maturity was found practicable in the case of *Pampus argenteus* as against the seven stages followed by the International Council.

*I. Immature.
II. Maturing.
III. Mature (equivalent to III, IV, V stage of the stages followed by the I.C.E.S.)
IV. Spawning.
V. Spent.

Table IX represents the percentage of the various stages of maturity in the different size groups of *Pampus argenteus*. 532 specimens ranging from 4 to 27 mm. were examined to determine the condition of the gonads during the course of investigation. On a comparision of the gonads classified according to the size groups it was found that no specific sex differentiation could be made out in the sizes ranging from 4 to 6 cm. It was also observed that fishes upto 12 cm. were found to be immature. In the next size group of 13-15 cm. majority was found to be in stage I. In the length range 16-18 cm. the percentage of maturing specimens was found to be more constituting 88%. In the length group 19-21 cm. specimens with gonads in stages II, III and V occurred. It may be pointed out here that specimens with spent gonads (Stage V) occurred for the first time in this size group, which indicates the possiblility of its spawning.

The occurrence of juveniles ranging from 1·8-2·6 cm. at Sand heads during March suggests that the spawning period may be during the winter season (January-February). This fish appears to spawn in the shallow regions which can be deduced from the presence of spent ones and the conspicuous absence of spawners as well as the eggs and early larval stages in the deeper fishing regions.

(iii) *Size groups.*

A total of 2,021 specimens was measured and the data obtained are presented in Table X and XI to represent the monthly fluctuations of the various size groups of *Pampus argenteus* for the seasons October-March (1960-'61) and November-February (1961-'62). Random samples were taken for each unloading at the shore base station and eight size groups were classified ranging from 7-27 cm. with a length range of 3 cm. in each group.

TABLE IX

Sl. No.	Size group in cm.	Total No. of fish examined	Stages of maturity in percentage			
			immature	maturing	mature	spent
1.	4—6	32	..	..	..	..
2.	7—9	68	100	..	..	..
3.	10—12	90	100	..	..	..
4.	13—15	98	78	22	..	..
5.	16—18	78	12	88	..	..
6.	19—21	80	..	24	69	7
7.	22—24	48	..	..	80	20
8.	25—27	38	..	..	75	25

TABLE X

Size range in cm.	PERCENTAGE COMPOSITION (1960-'61)					
	October	November	December	January	February	March
7—9	21·00	21·45	17·2	5·2	..	6·23
10—12	20·80	20·25	16·3	8·8	..	10·22
13—15	22·80	22·03	19·3	10.0	..	10·82
16—18	10·10	9·00	12·1	20·2	24·7	8·00
19—21	12·20	10·82	..	15·8	18·5	23·03
22—24	5·10	6·23	16·8	18·0	26·8	20·25
25—27	8·00	10·22	18·3	22·0	30·0	21·45

TABLE XI

Size range in cm.	PERCENTAGE COMPOSITION (1961-'62)			
	November	December	January	February
7—9	14·8	17·1	..	5·1
10—12	13·2	20·0	..	8·1
13—15	15·3	20·1	22·2	9·0
16—18	13·7	15·3	24·2	5·2
19—21	15·9	6·1	20·3	25·3
22—24	10·9	10·2	22·1	22·2
25—27	16·2	11·2	11·2	25·1

It is observed that during October and November of 1960-'61 season the size group 13-15 cm. dominated the catch constituting 22·8% and 22·03% respectively. Though there has been an appreciable fall in the percentage of the bigger size groups during these months two modes could be recognised at 19-21 and 25-27 cm. respectively. During December size group 19-21cm. was not represented. However, as in the previous months size group 13-15 cm. continued to dominate forming 19·3% . In January size group 16-18 cm. formed the main bulk constituting 20·2%. During February size groups ranging from 7-15 cm. were not recorded whereas the larger size groups 22-24 and 25-27 cm. formed 26·8 and 30·0% respectively. Though there were representations of the smaller size groups 7-15 cm. in the month of March the dominant size group was noted to be 19-21 cm. constituting 23·0%. The trend in regard to the representation of the modes at 13-15, 19-21 and 25-27 cm. remained the same during November of 1961-'62 season. In December unlike in the earlier season 19-21 cm. group was represented. The dominant mode was at 10-15 cm. In January the smaller size groups 7-12 cm. were not represented. However, the dominant size remained to be 16-18 cm. as in January of the previous year. From the data presented no definite conclusion could be drawn regarding the growth rate.

SUMMARY

1. The fishing grounds in the Bay of Bengal have been charted out from the very commencement of the exploratory fishing by the Directorate of Fisheries, Government of West Bengal, based on the trawling operations of Kalyani I-V. Eight trawling grounds have been recognised viz. Sand-heads, off Balasore, off Mahanadi, Devi and Prachi, rivers and off Black Pagoda, Puri, Chilka and Gopalpur.

2. Analysis of the trawling data revealed that off Mahanadi river and Sand head regions were the most productive fishing grounds for pomfrets.

3. Besides, the distribution of pomfrets and their abundance in the various fishing grounds in relation to depth and nature of the bottom and the income from the fishery are discussed.

4. An account of the biology of Silver pomfret (*Pampus argenteus*) with special reference to the food and feeding habits and maturity among the different size groups occuring in the fishery is given.

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