OBSERVATIONS ON THE FEEDING HABITS OF SOME SARDINES TOGETHER WITH THE KEY TO THE IDENTIFICATION OF THE YOUNG ONES OF THE GENUS *SARDINELLA*.

By

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(With 3 Tables and 3 Text-figures)

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I—INTRODUCTION

The nutrition of fishes provide valuable data not only for determining the food charts, but also the seasonal scarcity, shoaling and migration of fishes, and such information will be useful to commercial fisheries in forecasting the movements of the fish into or out of their feeding grounds. It is hoped that the present account on the food of larvae, juveniles and adults of *Sardinella sirm*, *S. gibbosa*, *S. melanura*, *S. clupeoides*, *S. albella* *S. fimbriata*, *S. sindensis* and *S. longiceps*, together with a key to the identification of some young stages of sardines, will add to our knowledge of Indian Sardines. In preparing the key, Misra (1953) was of considerable help. Other references such as Day (1889), Weber and Beaufort (1913), Fowler (1931), and Nair (1953) were also consulted.

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II—MATERIAL AND METHODS

The material for the study consisted of 621 young fishes and 881 adults collected from Madras, Nagapatam, Mandapam and Ernakulam areas at a depth ranging from 4-20 fathoms. Shore-seines, boat-seines, hand nets and gill nets are the main types of gear employed in the fishery.

The fishes were examined, fixed and preserved in 5 per cent formalin and brought to the laboratory where detailed examination was made. A detailed description of the method of analysis and the method of determining the volume of stomach contents of young fishes has been already dealt with by the author (Kuthalingam 1955). As the diet of the fishes varies even in the same species during different stages of growth and maturity, four broad divisions were made regarding the sexual maturity, *i.e.*, immature, mature, ripe and spent.

The vague and indefinite terms used by many authors were avoided in describing the larval stages and the recommendation by Hubbs (1943) was followed. For the purpose of convenience three terms are recounted below.

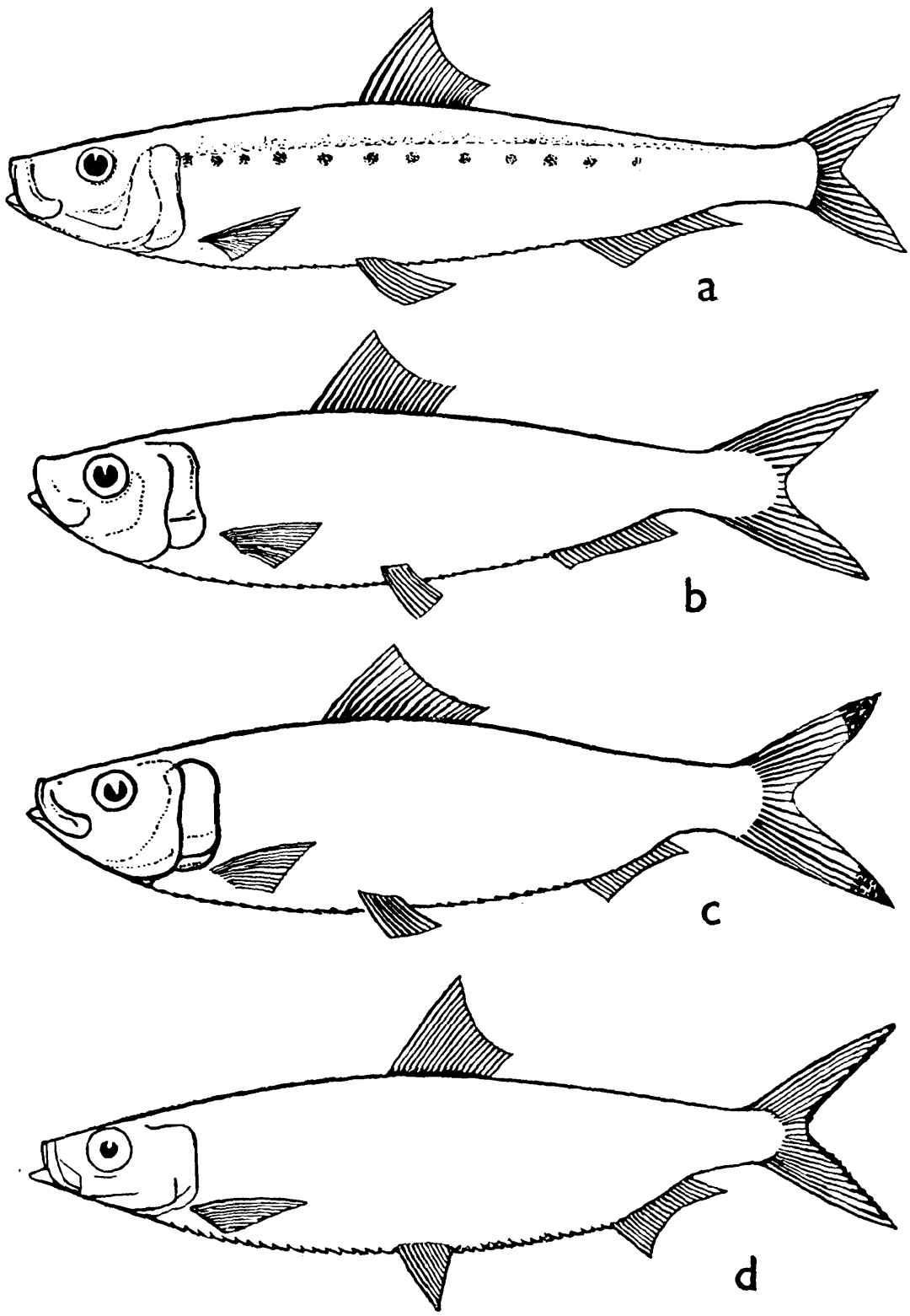
Post larvae.—The structure and form continue to be strikingly unlike that of the juveniles and the digestive system is differentiated enough to take in food.

Juvenile.—Young essentially similar to adults with all the taxonomic characters.

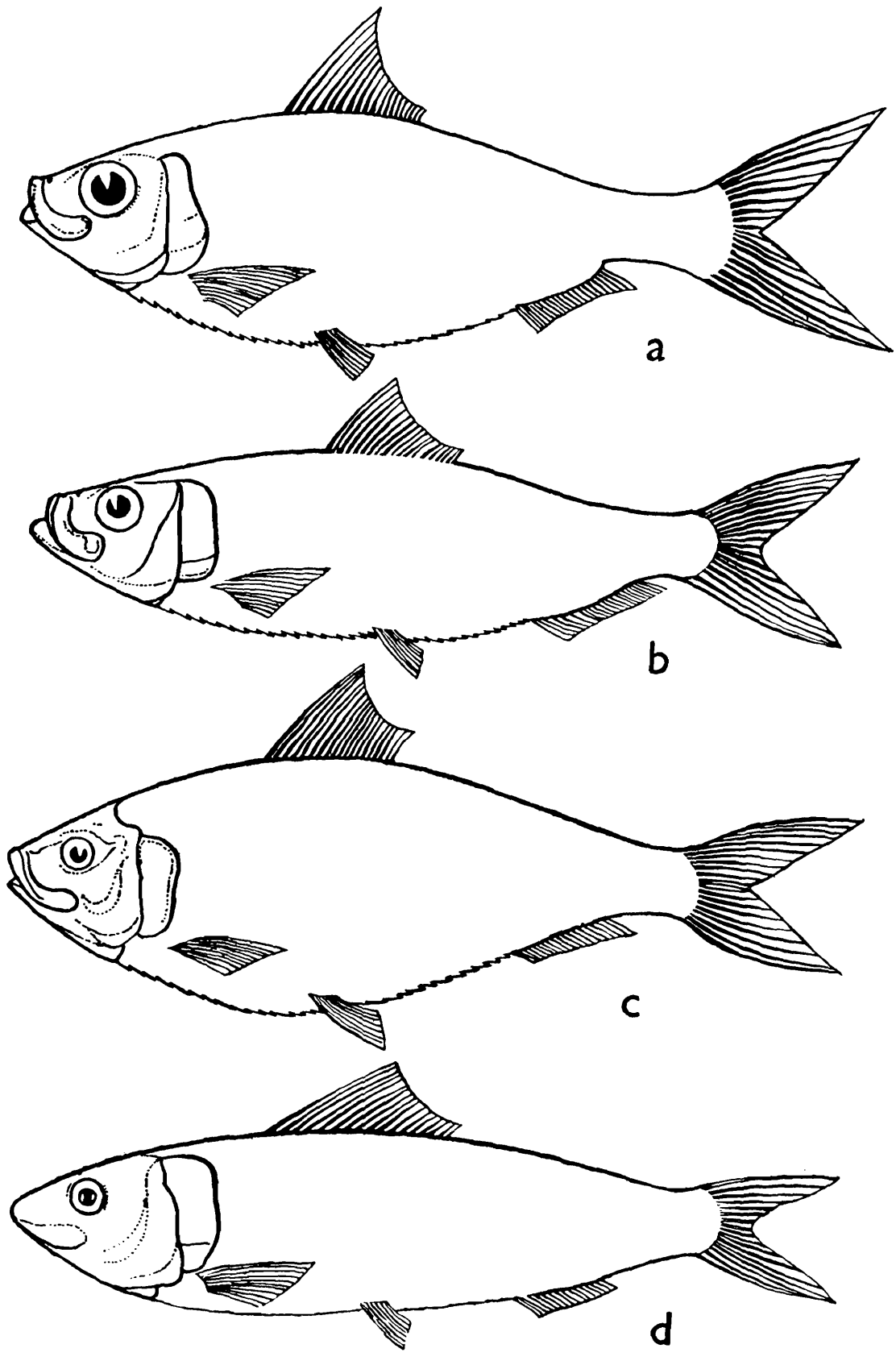
Adults.—Full grown with all mature features.

III—KEY TO THE IDENTIFICATION OF SOME YOUNG SARDINES

The young sardines were collected from the plankton as well as from the fishermen's nets. They measured from 25 mm. up to 60 mm. Since these sardines are alike in general shape, structure and appearance, the need for identifying these commercially important groups of fishes was felt, in order to identify them without much difficulty. The easily recognisable characters, such as, fin formula, number of scutes, colour and other important taxonomic features are given in Table I against the names of the respective species. Text-figures 1 & 2 were drawn directly from the specimens.



TEXT-FIG. 1.—Young sardines. (*a*). *Sardinella sirm.* (*b*). *S. gibbosa.* (*c*). *S. melanura.* (*d*). *S. clupeoides.*

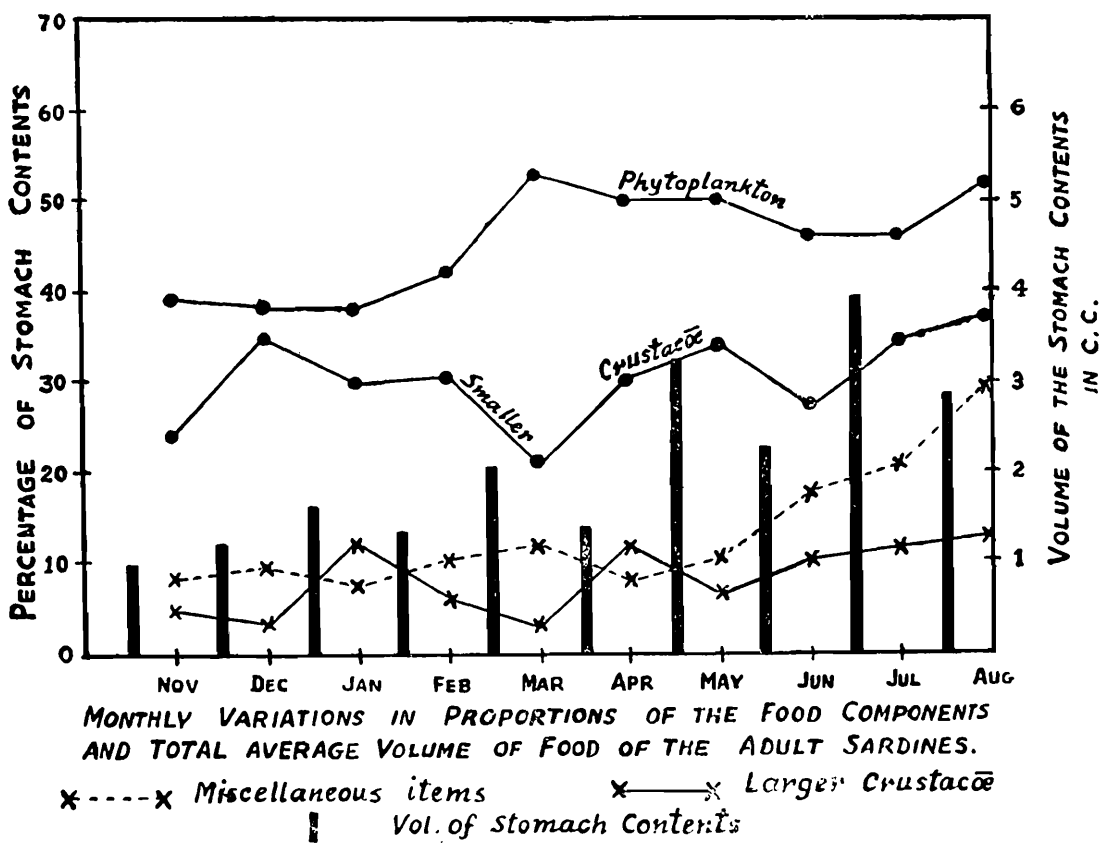


TEXT-FIG. 2.—Young sardines. (*a*). *Sardinella albella*. (*b*). *S. fimbriata*. (*c*). *S. sindensis*. (*d*). *S. longiceps*.

IV—THE FEEDING HABITS OF ADULT SARDINES

The previous work on the feeding habits of the different species of sardines of the tropical and the subtropical countries was already reviewed by the author (Kuthalingam, 1960*b*). In India *Sardinella longiceps* and *S. fimbriata* rank as the most valuable species along the west coast, while in south-east coast *S. gibbosa* occurs in shoals. *S. kanagurta*, *S. melanura* and *S. brachysoma*, which are commonly landed in Madras coast, are known as the Indian Sardines.

From Table No. 2 it is obvious that the males predominated the catch and the spawners were found only in the case of *S. longiceps*. It is also evident from the table that the immature fishes appear to take more food



TEXT-FIG. 3.—Graph, showing monthly variations in proportions of the food components and total average volume of food of the adult sardines.

than the mature ones and the spawners were found with empty stomachs. However, the spent fishes continued to feed once again. The present author admits that such a conclusion can only be accepted with due caution especially in view of the fact that these data were based on a study of 881 individuals belonging to eight species of sardines irrespective of the possible differences in the time of capture, ecological conditions of the catch and other bionomic factors. The total volume of food consumed by immature, mature, ripe and spent fishes was measured separately and averaged.

It is observed from the food chart as well as from the Text-fig. 3 that there was almost a similarity in feeding of these adult sardines. Phytoplankton formed the main bulk of the food. They are represented by diatoms, algae and green matter. The diatoms were identified as *Asterionella* sp., *Coscinodiscus* sp. *Thalassiothrix* sp., *Thallasionema* sp., *Rhinozosolenia* sp., *Tabellaria* sp. Filamentous algae were found in the stomach mixed with copious quantities of mucus and were in a partly digested condition. *Trichodesmium* and *Oscillatoria* were the only algae that could be made out. Very frequently green matter was found. This is probably the digested algae or the sea weeds. Previous workers like Huxley (1881), and Lebour (1918) have mentioned the presence of green matter in the stomach of certain fishes and consider it as digested plant matter. Smaller crustaceae were represented by copepods (*Oithona* sp., *Temora* sp., *Acartia* sp., *Paracalanus* sp., and *Pseudodiaptomus* sp.), ostracoda, amphipoda, megalopa, zoea, cypris-larvae and crustacean remains. Larval bivalves and pteropods, polychaetes, eggs and sand particles constituted the miscellaneous item. The larger crustaceae were represented by *Acetes* sp., *Penaeus* sp., *Squilla* sp., *Lucifer*, and Palmonidae. However, the digested matter is not taken into consideration.

V—THE FOOD OF YOUNG SARDINES

From Table No. 3 it will be seen that smaller crustaceae formed the main bulk of the food. They were represented by copepods, copepod nauplii (*Oithona spinulosa*, *O. rigida*, *Temora* sp., *Paracalanus* sp., *Pontella* sp., *Eucalanus* sp., *Pseudodiaptomus* sp., *Labidocera* sp., and *Acartia* sp.) ostracoda, zoea, amphipoda and larval forms of Acetes Lucifer, *Penaeus* sp., and cirripede. Larval bivalves, gastropods and broken bits of shells indicated that mollusc formed a minor item of diet ; parapodia and isolated segments of polychaetes were also present in the stomach. They were found in such and advanced stage of digestion.

VI—REMARKS

From the data gathered and presented it is obvious that young as well as the adult sardines are surface feeders, feeding mainly on planktonic organisms. Though there are indications of particulate as well as filter feeding, it is observed from the data that even though they are capable of feeding on organisms of larger consistency indicating particulate feeding, the major part of its food is constituted by smaller planktonic organisms thus showing that these sardines are essentially filter-feeders. The absence of these species in certain months of the year cannot be explianed unless and until we study more about their biology and the seasonal distribution of the various food organisms in the environment.

Though there has been considerable diversity of opinion as to whether the sardines are selective or non-selective in its food, the observations of many authors on the predominance of different organisms in the stomach of sardines collected at different places are worth noting. Lewis (1929) examined and found in the californian sardine a very high percentage of diatom. Parr (1930) raised the question whether these diatoms were included in their diet in a selective manner or only accidentally along with larger copepods. Nair (1953b) reported that the food of *Sardinella longiceps*, consisted of plankton with phytoplankton predominating. Vijayarahavan (1953) showed that the three species of Sardines, *Sardinella brachysoma*, *S. kanagurta and S. melanura* feed mainly on zooplankton. It is Scofield (1934) who reported that the California sardine (*Sardinops caerulea*) became more efficient filter feeder capable of straining diatoms only when they grew larger and the gill rakers developed fine straining structure like those demonstrated by Kishinouye (1907) in Japanese sardine (*Sardinops melanostica*).

The foregoing analysis reveals that the adult sardines feed more on phytoplankton, whereas in the case of young ones the stomachs were filled with zooplankton. It is probable that the diversity in feeding of the young as well as the adults may be due to the development of gill rakers and filtering mechanism which are the aspects of the study which deserve further attention.

VII—SUMMARY

The analyses of the stomach contents of 1,502 specimens of sardine belonging to eight species were studied with special reference to the sex differentiation, maturity and feeding intensity. An aid to the identification of the young stages of sardines is also given. The results of the study revealed that :—

(*a*) young sardines feed more on zooplankton,

(*b*) phytoplankton formed the main bulk of the adult sardines,

(*c*) the immature fishes appear to take more food than the mature,

(*d*) the spawners were found practically starving, and

(*e*) seasonal fluctuations were observed in the volume and composition of food.

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TABLE 1.—*An aid to the identification of some young fishes of the genus* Sardinella.

Serial No.	Species	Taxonomic Characters	Colouration	Fin formula
I	*Sardinella sirm* (Ruff)	Maxillary reaches almost the front margin of the eye. Scales deciduous and thin with very fine concentric stripes. Teeth were found on the Palatines, Pterygoids and tongue. Gill filaments were longer than ½ diameter of the eye. There were sixteen pre-ventral and thirteen post-ventral scutes.	A bluish-green colour was observed on the dorsal region whereas the ventral region was silvery. The sides were also silvery. Just below the lateral line twelve dark spots were recorded, arranged in a row from the anterior region to the caudal. Both the caudal region and the pectorals were light brown. The other fins were hyaline.	B. 5 ; D. 18 ; A. 19 ; P. 17 ; V. 18; L. 1·40 ; L. tr. 12. (Text-fig. 1*a*).
II	*Sardinella gibbosa* (Cuv. Val.)	Maxillary reaches almost the pupil. Lower jaw was slightly prominent. Last two anal rays were thickened and a little prolonged. Scales with partly vertical lines and the hinder part with irregular holes were noted. Gill filaments were 1¼ times in eye diameter. Seventeen pre-ventral and twelve post-ventral scutes were found.	The upper-part of the body was dark bluish-green and the lower silvery. The base of the dorsal fin was characterised by a dark black spot. The caudal fin was light blue.	B. 6 ; D. 19 ; P. 15 ; V. 8 ; A. 20 ; C. 20 ; L. 1·45 ; L. tr. 12. (Text-fig. 1*b*).
III	*Sardinella melanura* (Cuv.)	Maxillary reaches under pupil as far as middle of the eye ; lower jaw was rather longer than the upper. Scales were seen in irregular longitudinal rows. 25 serrated scales were noticed along the abdominal edge. Teeth were present on the tongue. Caudal was deeply forked and the lower lobe was longer than the upper one. Fourteen pre-ventral and eleven post-ventral scutes were recorded.	The dorsal region was brownish and the sides silvery. Caudal was dipped black. The opercle had a blue spot.	B. 6 ; D. 18 ; A. 18 ; P. 14; V. 8 ; L. 1·44 ; L. tr. 11. (Text-fig. 1*c*).
IV	*Sardinella clupeoides* (Blkr.)	Maxillary reaches below the middle of the eye. Caudal fin was seen with longer inferior lobe. Abdominal profile was more convex than that of the back. Lower jaw projected beyond the upper. There were eighteen pre-ventral and sixteen post-ventral scutes.	Bluish-green above and the sides and ventral-region were purple with gold dots in it. The caudal fin was characterised with a blackish margin.	B. 6 ; D. 17 ; P. 16 ; V. 8 ; A. 20 ; C. 19 ; L. 1·47 ; L. tr. 14. (Text-fig. 1*d*).

V	*Sardinella albella* (Val)	Maxillary reaches middle of the eye. Lower jaw most prominent. Anal was much lower than the dorsal, its base a little shorter than that of dorsal. Scales with an irregular crenulated, incised and striated margin. Seventeen pre-ventral and twelve post-ventral scutes were recorded.	The upper part was greenish and silvery below. A dark black patch was noted at the tips of the dorsal, at the base of the first three dorsal rays, at the tips of the caudal and behind the operculum.	B. 6 ; D. 19 ; P. 17 ; V. 8 ; A. 22 ; C. 20 ; L. 1·45 ; L. tr. 12. (Text-fig. 2*a*).
VI	*Sardinella fimbriata* (Val)	Maxillary extends below the front margin of the eye. Lower jaw was slightly projecting beyond the upper jaw. A band of teeth was seen along the middle of the tongue and also on the palatines. The last two anal rays were thickened and a little prolonged. The caudal is highly forked. The pre-ventral and post-ventral were sixteen and fourteen in number respectively.	The dorsal region was bluish-green and the sides silvery. Numerous fine black dots were noticed on the dorsal fin. Other fins were pale yellow in colour.	B. 6 , D. 19 ; V. 8 ; A. 21 ; C. 20 ; P. 16 L. 1·43 ; L. tr. 12. (Text-fig. 2*b*).
VII	*Sardinella sindensis* (Day)	Maxillary reaches to below the 1st ¼ of the eye. Lower jaw was prominent. Preorbital with a raised and branched ridge. Scales with their edges a little rough and having some vertical lines were recorded. Gill rakers were closely set, nearly as long as the eye. Only twelve post-ventral scutes were recorded.	The back was deep blue and the sides golden. The end of the caudal lobes were dark. A dark small black mark was seen in the shoulder. Caudal was dipped black.	B. 6 ; D. 19 ; V. 8 ; A. 19 ; C. 21 ; P. 17 ; L. 1·41 ; L. tr. 13. (Text-fig. 2*c*).
VIII	*Sardinella longiceps* (Cuv. & Val.)	Maxillary extends below the front margin of the eye. Lower jaw slightly projected beyond the upper. Scales were indistinctly crenulated and regularly arranged. Caudal were deeply forked. Gill rakers were numerous about one half longer than the eye. Teeth on palatine pterygoids and tongue were noted. Out of thirty-one scutes noted, eighteen were pre-ventral and thirteen post-ventral.	The back was blue with golden reflection and the abdomen silvery. A large greenish gold spot on the upper margin of the opercle and preopercle was noticed. Caudal and dorsal were stained green.	B. 6 ; D. 17 ; P. 17 ; V. 9 ; A. 16 ; C. 17 ; L. 1·46 ; L. tr. 11. (Text-fig. 2*d*).

TABLE 2.—*Showing the length range, sex differentiation, maturity stages, etc., of the 8 species of adult Sardines.*

Serial No.	Names of Species	Tot. No. examined	Length range in m.m.	Sex		Maturity and feeding							
				No. of ♂	No. of ♀	No. of immature	Average Volume of St. cont. in c.c.	No. of mature	Average Volume of St. cont. in c.c.	No. of ripe	Average Volume of St. cont. in c.c.	No. of spent	Average Volume of St. cont. in c.c.
1.	*Sardinella sirm*	78	100—128·0	50	28	78	3·2	—	—	—	—	—	—
2.	*S. gibbosa* .	92	90—138·5	62	30	50	3·8	22	1·2	—	—	20	1·4
3.	*S. melanur a*	121	110—128·2	81	40	21	4·2	88	8·8	—	—	12	1·3
4.	*S. clupeoias*	128	119—132·0	68	60	128	5·1	—	—	—	—	—	—
5	*S. albella* .	132	100—128·5	90	42	—	3·9	132	0·9	—	—	—	—
6.	*S. fimbriata* .	91	95·2—110·2	68	30	98	4·1	—	—	—	—	—	—
7.	*S. sindensis* .	91	90·5—112·2	51	40	40	3·3	20	1·2	—	—	31	1·7
8.	*S. longiceps*	141	100—162·4	79	62	7	4·2	60	1·1	30	Empty	10	1·8

TABLE 2.—*Showing the length range, sex differenciation, maturity stages, etc., of the 8 species of adult Sardines.*—contd.

Food Chart No. 1

Food item/Months	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Species
P	42·0	37·0	37·0	44·0	51·0	52·0	49·0	50·0	46·0	54·0	
SC	25·0	32·0	32·0	33·0	28·0	32·0	37·0	30·0	37·0	40·0	
M	10·0	14·0	6·0	12·0	12·0	10·0	8·0	18·0	28·0	29·0	*Sardinella sirm*
LC	4·0	2·0	8·0	6·0	2·0	12·0	10·0	12·0	4·0	20·0	
P	42·0	40·0	36·0	44·0	50·0	49·0	50·0	47·0	47·0	51·0	
SC	30·0	38·0	30·0	32·0	20·0	31·0	38·0	29·0	38·0	37·0	*S. gibbosa*
M	8·0	11·0	3·0	10·0	8·0	8·0	13·0	19·0	20·0	27·0	
LC	3·0	6·0	4·0	4·0	1·0	8·0	8·0	10·0	8·0	24·0	
P	42·0	36·0	36·0	44·0	50·0	52·0	48·0	50·0	46·0	52·0	
SC	20·0	33·0	32·0	34·0	18·0	33·0	39·0	30·0	37·0	38·0	*S. melanura*
M	9·0	10·0	12·0	11·0	20·0	9·0	5·0	18·0	18·0	30·0	
LC	6·0	5·0	8·0	10·0	3·0	20·0	9·0	11·0	12·0	8·0	
P	39·0	37·0	38·0	41·0	52·0	50·0	48·0	48·0	48·0	50·0	
SC	20·0	34·0	26·0	33·0	16·0	32·0	37·0	24·0	30·0	40·0	
M	12·0	12·0	9·0	14·0	14·0	12·0	7·0	19·0	16·0	26·0	*S. clupeoids*
LC	7·0	2·0	8·0	12·0	4·0	24·0	12·0	14·0	8·0	12·0	
P	40·0	40·0	37·0	42·0	51·0	52·0	49·0	46·0	47·0	50·0	
SC	22·0	39·0	31·0	27·0	21·0	26·0	30·0	27·0	34·0	36·0	
M	5·0	8·0	8·0	7·0	8·0	5·0	14·0	5·0	21·0	32·0	*S. albella*
LC	3·0	3·0	12·0	40·0	1·0	8·0	5·0	7·0	24·0	8·0	

TABLE 3.

Length of fish (mm.)	*Sardinella sirm*			*Sardinella gibbosa*				*Sardinella melanura*					
	25—30	30—35	35—40	20—25	25—30	30—35	35—40	30—35	35—40	40—45	45—50	50—55	55—60
Number of fish with food.	7	11	16	10	12	8	8	6	6	5	15	9	7
Number of fish without food.	1	—	3	2	—		2	1	—	4	—	—	—
Area of fishing	Madras Off-shore			Mandapam In-shore				Nagapatam Off-shore					
Time of catch	Morning			Morning				Evening					
Copepoda	23·2	18·2	20·6	12·2	18·2	30·2	10·8	20·8	15·8	28·8	12·3	10·8	8·2
Copepod nauplii	16·8	16·8	10·4	10·2	10·8	8·8	12·2	12·8	10·8	32·2	10·8	12·2	10·8
Ostracoda	13·0	10·8	8·2	8·8	16·8	—	11·2	4·3	18·2	2·2	20·2	10·2	12·2
Zoea	2·0	2·2	—	4·8	4·8	—	3·4	3·8	2·5	4·8	—	10·8	10·4
Amphipoda	—	4·3	2·2	—	4·3	—	4·4	—	5·3	6·2	—	12·2	11·2
Acetes	—	—	4·8	2·2	—	10·8	3·3	—	—	—	10·2	11·2	12·2
Squilla larva	—	—	8·8	8·2	2·2	12·2	10·8	—	—	—	8·8	3·4	4·4
Penaeus larva	—	—	12·2	2·6	—	12·8	12·2	—	2·2	—	—	4·4	3·4
Lucifer	—	—	10·2	2·2	—	4·2	10·8	2·2	8·0	—	10·2	3·4	2·2
Anomuran larva	5·8	—	—	—	6·4	11·0	2·2	10·8	8·0	—	—	2·2	3·4
Bivalve larva	4·2	4·8	2·2	—	2·5	1·1	3·4	8·2	2·0	—	2·2	—	3·0
Pteropoda	1·4	6·4	6·8	—	6·0	2·3	2·8	3·3	6·0	—	3·5	3·4	—
Algae	4·4	2·5	8·8	20·2	2·0	1·4	8·2	1·3	2·5	—	4·7	2·8	—
Diatoms	8·2	6·0	2·2	10·8	8·0	—	—	0·3	6·4		—	—	3·4
Polychaetes	—	2·0	—	8·8	8·0	—	—	4·2	2·2	—	6·2	—	2·8
Cirripede larvae	10·8	16·0	—	6·8	2·2	—	—	20·2	—	—	—	8·2	—
Pycnogonida	4·8	5·3	·6	—	5·3	2·1	4·2	2·2	—	10·8	—	—	8·2
Eggs of crustacea	2·2	2·5	—	—	—	2·1	—	2·4	4·3	5·0	3·2	—	—
Green matter	32	3·2	—	—	2·5	—	—	2·2	5·8	3·2	2·4	4·2	—
Teleostean remains	—	—	—	2·2	—	1·0	—	1·8	—	6·8	4·4	—	4·2

Showing the percentage average of the various food items of the different species of young sardines

Sardinella clupeoides						*Sardinella albella*				*Sardinella fimbriata*			*Sardinella sindensis*		
35—40	40—45	45—50	50—55	55—60	60—65	30·5—35·5	35·5—40·5	40·5—45·5	45·5—50·5	35·5—40·5	40·5—45·5	45·5—50·5	40·5—45·5	45·5—50·5	50·5—55·5
8	14	8	8	9	7	11	15	18	2	1	18	14	26	18	22
3	—	2	—	—	1	3	2	1	—	2	1	3	1	2	—
Madras Off-shore						Ernakulam Off-shore				Madras Off-shore			Madras Off-shore		
Evening						Morning				Morning			Morning		
14·6	18·2	22·8	10·7	12·4	5·2	10·8	12·5	33·4	10·2	32·8	21·8	10·8	20·5	12·5	8·5
14·4	15·8	20·2	11·2	3·8	3·8	11·2	11·5	12·4	12·0	12·0	14·8	12·4	15·5	13·5	6·4
16·8	10·8	14·1	12·2	6·2	12·4	12·2	5·0	2·2	—	-	20·8	—	10·5	18·5	2·4
—	2·5	—	3·4	2·2	2·2	4·4	10·0	—	6·2	—	8·0	—	8·5	10·5	3·2
4·8	5·3	—	3·4	—	—	—	8·0	—	3·2	—	10·2	18·8	—	6·5	—
4·3	—	—	4·4	8·8	—	3·4	2·0	—	2·4	10·8	—	20·8	—	7·2	10·5
2·2	—	—	10·8	12·2	18·8	10·8	—	3·0	—	14·2	—	18·2	—	8·1	8·0
—	2·2	—	12·8	18·8	20·2	12·2	—	10·2	20·8	6·4	—	10·2	—	4·0	10·4
—	8·0	—	11·2	20·2	18·8	12·8	—	10·7	18·2	4·6	—	—	—	2·0	12·4
—	8·0	—	—	—	—	—	18·2	—	12·4	5·0	4·2	8·8	10·5	—	8 0
2·5	2·0	—	—	—	7·1	—	2·0	2·5	10·2	—	3·3	—	7·0	10·6	5·0
6·4	6·0	4·2	3·3	—	6·5	1·1	10·2	8·2	—	—	4·1	—	8·5	6·6	6·5
6·0	2·5	8·0	11·4	—	—	4·2	10·6	7·4	—	—	2·6	—	6·5	—	3·5
2·0	6·4	2·0	—	—	—	7·0	2·0	—	4·4	4·2	—	—	2·0	—	2·6
8·0	2·2	—	—	—	—	1·0	3·2	—	—	2·2	—	—	2·1	—	6.4
2·0	—	10·2	—	—	—	2·3	—	4·2	—	1·1	—	—	1·2	—	3·4
8·2	—	2·2	—	—	—	1·4	—	2·1	—	2·1	4·4	—	2·5	—	2·1
5·3	4·3	1·4	4·0	—	—	2·1	—	—	—	2·0	5·8	—	—	—	0·7
—	5·8	12·2	—	—	—	2·1	2·1	3·7	—	—	—	—	1·2	—	—
2·5	—	2·0	1·2	5·4	5·0	1·0	2·7	—	—	2·2	—	—	3·5	—	—

TABLE 2.—*Showing the length range, Sex differenciation, maturity stages, etc., of the 8 species of adult Sardines*— concld.

Food Chart No. 1—concld.

Food item/Months	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Species
P	38·0	40·0	40·0	40·0	54·0	48·0	52·0	46·0	50·0	54·0	
SC	30·0	37·0	33·0	31·0	26·0	30·0	34·0	28·0	32·0	36·0	
M	3·0	7·0	10·0	5·0	12·0	3·0	11·0	20·0	26·0	33·0	*S. fimbriata*
LC	4·0	3·0	24·0	6·0	2·0	12·0	3·0	5·0	20·0	4·0	
P	38·0	38·0	40·0	40·0	54·0	48·0	52·0	47·0	50·0	51·0	
SC	26·0	37·0	27·0	28·0	27·0	27·0	32·0	25·0	33·0	37·0	
M	11·0	5·0	5·0	13·0	8·0	11·0	10·0	14·0	27·0	37·0	*S. sindensis*
LC	3·0	2·0	20·0	4·0	1·0	8·0	11·0	13·0	8·0	8·0	
P	39·0	36·0	40·0	41·0	54·0	49·0	52·0	50·0	50·0	54·0	
SC	27·0	30·0	29·0	30·0	20·0	29·0	30·0	31·0	39·0	40·0	
M	6·0	13·0	11·0	8·0	4·0	6·0	12·0	21·0	20·0	32·0	*S. longiceps*
LC	2·0	1·0	12·0	2·0	2·0	4·0	6·0	8·0	12·0	12·0	

Note.—

P—Phytoplankton.
SC—Smaller crustaceae.
M—Miscellaneous.
LC—Larger crustaceae

Sardinella longiceps

25—30	30—35	35—40	40—45	45—50	50—55	55—60
10	20	12	18	20	10	16
—	—	—	—	2	—	—

Madras Off-shore

Evening

20·2	24·6	15·8	18·5	10·5	6·0	—
16·8	11·5	10·8	14·5	8·5	7·8	3·5
10·0	4·4	18·2	12·5	6·7	4·2	2·8
10·5	4·8	2·5	10·5	14·5	8·2	3·2
—	—	—	6·5	10·8	4·2	10·5
8·5	4·3	—	7·2	10·8	6·2	8·2
7·0	2·2	4·2	8·1	11·2	10·2	10·4
—	2·5	6·2	4·0	6·4	6·2	12·4
—	—	4·0	2·0	4·4	4·2	8·0
—	—	6·0	—	3·2	3·2	5·0
8·5	—	6·0	6·5	3·0	4·6	6·5
6·5	6·4	2·5	2·2	1·2	5·8	3·5
2·0	6·0	6·4	3·3	2·2	2·0	2·6
2·1	2·0	2·2	3·2	3·0	1·2	6·4
1·2	6·0	—	—	1·2	3·0	3·2
2·5	4·2	—	—	—	6·8	2·7
—	5·0	4·3	—	2·1	3·2	0·7
—	8·3	5·1	—	0·3	6·6	—
1·1	5·3	2·0	—	—	2·3	—
2·1	2·5	4·0	2·0	—	1·1	—