AN INVESTIGATION ON THE NUTRITION OF THE PERCHES OF THE MADRAS COAST.

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(Conducted at the University Zoological Research Laboratory, Madras.)

(Plates V, VI.)

Contents.

Introduction.

Despite the great importance of the question of the food of fishes, with its varied bearings on feeding adaptations, migration and allied topics of considerable scientific interest, and economic issues connected with the development of fisheries and the biological control of human diseases, very little attention has so far been devoted to the subject. As Sim (1883) observes, pond owners seem to have been content to throw a few handfuls of oats occasionally into their ponds, while others " considered themselves more ' knowing ' when, before putting the oats they had it steeped for a time in ale " The study of the food of fishes began to attract the attention of scientific men only towards the close of the last century, and since then several ichthyologists have tackled the subject both in the New and the Old World. As the nature of the food depends to a great extent upon the nature of the environment, the problem is interesting from specific as also ecological viewpoints. In India very little is known about the nutrition of the fishes of our waters. But for stray remarks on the stomach-contents of certain fishes and more or less detailed papers on the food of *Sardinella longiceps* (Hornell and Nayudu, 1923), of *Sardinella gibbosa* (Devanesen, 1932), of certain marine fishes from Ceylon (Southwell, 1913), of certain larvicidal fishes (Sen, 1937 ; Hora and Nair, 1938 ; Roy, 1938 ; Job, 1940*a*) and of the Mountain Barbel (Malik, 1940), no detailed information is available regarding the food and feeding habits of the great variety of fishes which are found in the Indian waters.

Professor R. Gopala Aiyar, Director, University Zoological Research Laboratory, Madras, suggested to me that an investigation on the food and feeding habits of the perches would be of great value, since many of them are highly prized as food-fishes in different parts of the country. In the present paper an attempt is made to record the food of the perches of the tropical waters in an analytical manner.

The work was conducted in the course of two years, 1936-1938, under the supervision of Professor R. Gopala Aiyer, at the University Zoological Research Laboratory, Madras, and I am thankful to him for his kind encouragement and constant help, especially in the identification of the Polychaete food items. I am grateful to Dr. Baini Prashad, Director, and Rai Bahadur Dr. S. L. Hora, Assistant Superintendent, Zoological Survey of India, Calcutta, for kindly going through the manuscript and for their helpful suggestions. My thanks are also due to Dr. F. H. Gravely for enabling me to check some of the identifications of Crustaceans with the help of the collections in the Madras Government Museum, to Diwan Bahadur Dr. B. Sundara Raj, Director of Fisheries, Madras, for facilities for observations on the feeding activities of fishes in the Madras Marine Aquarium, to Mr. N. D. Sundararama Sastri, Head of the Department of Statistics, Madras University, for examining the statistical part of the paper and to Mr. R. Velappan Nair for his kind help in the preparation of the diagrams. I am grateful to the University of Madras for the award of a Research Studentship which enabled me to carry out this detailed study.

GENERAL OBSERVATIONS.

The perches form a large and world-wide group of Acanthopterygian Teleosts embracing forms ranging from the smallest spiny-rayed fishes like *Microperca punctulata* and species of *Ambassis* up to the gigantic sea-perches such as *Epinephelus tauvina* recorded to grow to as much as seven feet in length and in weight to about three hundred pounds. They are cosmopolitan in their habits, thriving in the sea, brackish and fresh waters of the temperate and tropical regions. Many of the Indian species are marine, and are regarded (Nayudu, 1939) as " deep-sea prime fishes " Several of them enter estuaries and bodies of brackish water up to the tidal limit, while some like the 'cock up', *Lates calcarifer*, even migrate to fresh waters to prey upon their weaker neighbours. Many of them are hardy and wholesome food-fishes, esteemed in coastal regions as well as in the inland districts, and some of them yield valuable bye-products such as isinglass. Along the Madras Coast several genera occur almost all the year round.

Perches are of immense economic importance. Moses (1922) in his statistics of the fish supply of Madras, has shown that for the year from July 1921 to July 1922, 75,118 pounds of sea-perches worth more than eleven thousand rupees were caught from the Madras Coast besides 21,511 pounds of 'cock up' worth about six thousand rupees. The fishery of these fishes depends not a little upon the nature and regular supply of their food, both as regards its quality and quantity, and a study of their food and feeding habits, therefore, constitutes one of the first steps in the ways and means to be adopted for conserving and increasing their numbers.

Very little systematic information is available regarding the food of the perches and all that is known is confined mainly to the freshwater forms. Speaking about *Lucioperca*, Günther (1880) says that " like all its congeners it is stated to be voracious and destructive to smaller fish ", and about the British bass, *Labrax lupus*, he adds that with its large stomach and voracious appetite it had won for itself the appellation ' lumpus ' from ancient Romans. In the XXIst volume of Encyclopedia Britannica mention is made of *Perca fluviatilis* occurring in lakes as deep as fifty fathoms, but ascending to four thousand feet, being strictly carnivorous and most voracious, and of its wandering about in small shoals within a certain district playing sad havoc among small fishes and hence not to be tolerated in waters where fry of valuable fish are to be cultivated. O'Donoghue and Boyd (1934) studying the stomach-contents of nine specimens of the same species caught from the West Loch near St. Abbs, say that they fed on practically the same food as the trout, and observe that they are serious competitors in this way, though the extent of the menace depends upon the number of perches present and the amount of food available. Jordan (1907) speaks of the darters or ' dwark perches ', Etheostominae of America, as carnivorous, voraciously feeding on larvae of Diptera. Referring to the Sacramento perch, *Archoplitus interruptus*, the same writer cites Green describing how upon the introduction of catfish into the Sacramento, the perch fed on young catfish and died as the catfish erected their spines and tore the stomach walls. Pearse and Achtenberg (1918), dealing with the habits of the yellow perch in Wisconsin lakes, observe that it is a versatile feeder, usually feeding on or near the bottom. They analysed the diet and determined the percentages of the constituents by volume, noting the seasonal variation in the same. They found that it feeds mainly on larvae of Crustaceans and insects, on Entomostraca, small Teleosts and a few Oligochaetes. Lebour (1919) in her study of the food of young fish states that of the two young specimens of *Morone labrax* measuring 6 mm. obtained from the region of the Panther Buoy in May and June, the stomach of one contained Copepod remains, while that of the other was empty. In India no systematic work on the food of perches has so far been carried out.

MATERIAL AND METHODS OF STUDY.

Six hundred and forty-one specimens of fish belonging to eighteen species referrable to eight genera, as detailed in the following statement, were examined—

Order PERCOMORPHI[1]

Sub-order *PERCOIDEA*

Division **Perciformes**

Family APOGONIDAE

Genus *Apogon* Lacépède.

Apogon nigripinnis Cuv. & Val.

Genus *Ambassis* Cuvier and Valenciennes.

Ambassis gymnocephalus (Lacép.).

[1] The classification adopted by Weber and Beaufort (1929; 1931; 1936) has been followed.

Family SERRANIDAE

Sub-family *EPINEPHELINAE*

Genus *Epinephelus* Bloch.

Epinephelus boenack (Bl.).
Epinephelus undulosus (Q. & G.).
Epinephelus maculatus (Bl.).
Epinephelus tauvina (Forsk.).
Epinephelus lanceolatus (Bl.).

Family THERAPONIDAE

Genus *Therapon* Cuvier.

Therapon puta Cuv. & Val.
Therapon jarbua (Forsk.).

Genus *Pelates* Cuvier and Valenciennes.

Pelates quadrilineatus (Bl.).

Family LEIOGNATHIDAE

Genus *Gerres* Cuvier.

Gerres punctatus Cuv. & Val.

Family LUTIANIDAE

Sub-family *LUTIANINAE*

Genus *Lutianus* Bloch.

Lutianus johnii (Bl.).
Lutianus lutianus Bl.
Lutianus lineolatus (Rüpp.).
Lutianus sanguineus (Cuv. & Val.).
Lutianus vaigiensis (Q. & G.).

Sub-family *POMADASYANE*

Genus *Pomadasys* Lacépède.

Pomadasys maculatus (Bl.).
Pomadasys olivaceous (Day).

The investigation was directed towards determining the details of the natural diet of these fishes since what is eaten in captivity is never a reliable criterion of their natural tastes. Again different species show specific preferences, and only by examining the contents of stomachs of the various species caught from their natural environment can the details of their diet be determined, and as Knauthe (1907) says, " the value of food must be determined biologically even more than phenologically or chemically "

The limits of the present study are indicated in the title of the paper, the observations being mainly confined to specimens obtained from catamarans returning from the sea, from the Chintadripet Market and from catches of fishermen from the rivers Cooum and Adyar, while in a few cases they extended to collections from the Buckingham canal and the Fort St. George moat. Except in the cases of the catches from the Adyar, the Cooum, the Buckingham Canal and the Fort St. George moat it was not possible to study the environmental conditions directly; for, in the absence of a sea-going boat, the statements of the fishermen returning from the sea had to be relied upon (of course these have to be taken with some reserve), while in the case of specimens purchased from the market, even this was not available. In all cases whenever possible

the approximate time of catch was noted with a view to determining the amount of feeding activity during different hours, as early in the morning, late in the forenoon, early in the afternoon and towards evening and nightfall. The specimens usually reached the laboratory dead. They were identified and labelled. The length of each specimen from the extreme anterior end of the snout to the end of the caudal fin was taken, the animal being held straight on a measuring tape. The fish was then cut open and the extent of feeding was recorded by noting the state of distention of the stomach and the amount of food contained in it. The following symbols are used in the account given :— 1 represents a full stomach, while 1+ represents a stomach gorged with food ; 0·8 represents pretty full, 0·6 about half full, 0·4 containing appreciable amount of food, 0·2 a little, 0·1 very little and 0·0 an empty stomach. Since the amount of food present in the stomach may depend, among other factors, upon the interval between the actual time of feeding and the capture of the fish and upon the stage of digestion and the passage of digested stuff into the intestine, this method of estimating the stomach contents is only a rough one, but this was the only practical method that could be adopted for getting an approximate idea of the extent of feeding under natural conditions.

The stomach-contents were carefully removed and examined immediately whenever time permitted it, or stored in 5 per cent. formalin in tubes to be examined later. The maturity of the specimens was determined from the condition of the gonads, that of the females from the nature of the ovaries and of the males from the presence or absence of fully formed sperms in the genital ducts. Often the size and colour of the gonads were useful indications for determining the state of their development.

In the analysis of the food-contents, the larger elements were identified with the help of a hand-lens. To distinguish the smaller organisms the gut-contents were transferred part by part to slides. After the addition of a little water they were spread out under a binocular microscope, and when this was not sufficient, the elements were teased out and examined under cover-slips with a compound microscope. After separating the different constituents of the food, their volumes in percentages were roughly estimated and recorded. From individual tabulations thus made, monthly lists were prepared. The food was often more or less mixed with mucus and it was not always possible actually to measure the volumes of the different components, and so Pearse's method (Pearse, 1915—cited by Breder and Crawford, 1922) was adopted for the estimation of the quantities of the various items of food. " Briefly in this method the contents of each sample is considered as unity, the various items being expressed in terms of percentage by volume as estimated by inspection " Obviously a rough estimate alone can be obtained by such a method ; but none other was feasible. It has to be noted that frequently only small quantities of food such as the ceratophores of a Polychaete or the scales of a fish would be found ; yet in the absence of evidence of other food having been eaten, such contents had to be listed as 100 per cent. Polychaete or Teleostean remains as the case might be. However, as Breder and Crawford (*op. cit.*) explain,

" these errors would be naturally compensating rather than cumulative ", and in the tables presented here, giving the averages for the different months and for the total number of fish examined, these do not appear to be very significant.

The exact determination of the food of the species under consideration presented several difficulties. The fishes did not always have food in the stomachs. It is significant, as Aflalo and Marston (1904) explain, that many fishes have the habit of throwing their last meal when captured, and " whether they do so in pain, in terror or in some hope of throwing over ballast when struggling for life and liberty, we can only surmise, but the habit is very familiar to fishermen and anglers." Hardy (1924) more or less agrees with these observations as far as the young herring is concerned. Many of the perches in the present study were caught in the immediate presence of the writer. But none of them showed any direct evidence in support of such a view and as Ogilvie (1927) observes in the case of post-larval herrings " even the shock of capture " never seemed " to have induced any attempt to get rid of " the food-contents. Regurgitation or sudden ejection of food-contents was never seen, except when live specimens were suddenly thrown into the preserving fluid. However, several of the fishes examined were found with empty stomachs. While in the case of gravid females, ripe males and spent up individuals this may partly be explained as being due to a retardation of the food capturing activity in the breeding season, in other cases this explanation does not hold good. More or less long intervals of complete or partial starvation are not infrequent among fishes. Thus Pearse and Achtenberg (*op. cit.*) observe that perches in the Wingra and Mendota lakes have periods when little or no food is eaten. Again Devanesen (*op. cit.*) remarks that *Sardinella gibbosa* refrains from feeding at intervals. It is only reasonable to suppose that in cold blooded forms nutriment is mainly employed for growth, hardly any being required for the maintenance of body temperature. While the abstinence from feeding may in some cases be for the purpose of giving rest to the stomach (Devanesen, *op. cit.*), in others it may be due to the lack of hunting for food.

The perches studied, excepting the species of *Epinephelus*, seem to digest their food fairly rapidly; for the stomach-contents were very often seen to be in a more or less advanced stage of digestion. Regarding the items of diet themselves, it was not always easy to identify them. The larval forms of many species are by no means well known. Sometimes the food consists partly or wholly of these or other delicate organisms, and when these have been submitted to be strong solvent action of the gastric juice, it is often difficult, if not impossible, to determine precisely the species or even the genus to which the organisms belong. But since a fish usually takes whatever edible material the water within its range contains and which its peculiar alimentary apparatus enables it to appropriate, it is apparent that the exact identification of the food elements is usually of little importance when carried beyond a certain point.

In the case of the Crustaceans[1], identification was comparatively easy, the chitinous test, especially of the smaller forms, being fairly tough and flexible and often found more or less complete among the stomach-contents. Even when only fragments were obtained the genus if not the species to which they belonged could be determined. Characteristic appendages were often helpful in the identification of the species. Annelids were easily acted upon by digestive juices, and often the only evidence obtained of their presence was some mucus mixed up with setae and sometimes parts of segments. Teleosteans met with were usually post-larval forms, but the fins, when present, gave a fairly good clue to their identification. The Molluscs obtained were all minute forms and when their shells were perfect, as occasionally they were, they could easily be distinguished; but often they were fragmentary, being corroded by the gastric juice if not crushed by the raptorial pharyngeal teeth of the fish. The Echinoderms observed usually consisted of discs and arms of tiny Ophiuroids, but sometimes small specimens were seen to appear intact, while at times broken plates and spines were the only evidence for Echinoderms having been taken in. One interesting point observed during the analysis of the food-contents was that Campanulariid colonies occasionally formed a portion of the menu of *Therapon puta,* while Ciliates such as *Zoothamnium* were eaten in the form of large tufts by *Therapon jarbua.* In rare instances small quantities of Foraminiferan shells and sand particles were met with. Devanesen (*op. cit.*) found Foraminiferans and sand particles in some of the specimens of *Sardinella gibbosa* caught from the Kundugal point, while the vast majority of the specimens examined by him never contained them, and he left this as a problem yet to be solved. In the perches, however, the traces of Foraminifera and sand can be explained as accidentally swallowed along with the food, or taken indirectly, being conveyed as the food of the prey. Houston (cited by Day, 1883) showed " at the Zoological Society a 2½′ long angler containing inside its stomach the skeleton of a 2′ long cod, within whose stomach again were contained the skeleton of two whiting of ordinary size, while inside the stomach of each of these lay numerous half digested bones of little fishes too small and too comminuted to be identified " This shows that in the consideration of the stomach-contents the food of the prey which is consumed is a factor that cannot be ignored.

Statements about the details of observations with regard to the perches dealt with follow in the order in which their names are listed in the contents. In each case concise introductory observations are followed by a general analysis of the diet. Detailed records of the stomach-contents of the individuals examined are tabulated, omitting those with empty stomachs. Diet tables are appended showing percentages, by months, of the different food items. In the case of species like *Therapon puta, Therapon jarbua* and *Lutianus vaigiensis* large numbers of which were examined, the average percentages of the various food items for the species are represented in text-fig. 1. The average percentages for the total number of specimens under individual genera

[1] My thanks are due to my colleague, Dr. N. Kesava Panikkar, for his kind assistance in the identification of several Crustaceans.

are represented by charts on plate VI. In suitable instances graphs are also given to show the minima and maxima of the important kinds of food at different times of the year. Photographs of pickings from typical stomach-contents of various species are included in plate V.

Observations on the Stomach-contents of Perches.

Genus **Therapon** Cuvier.

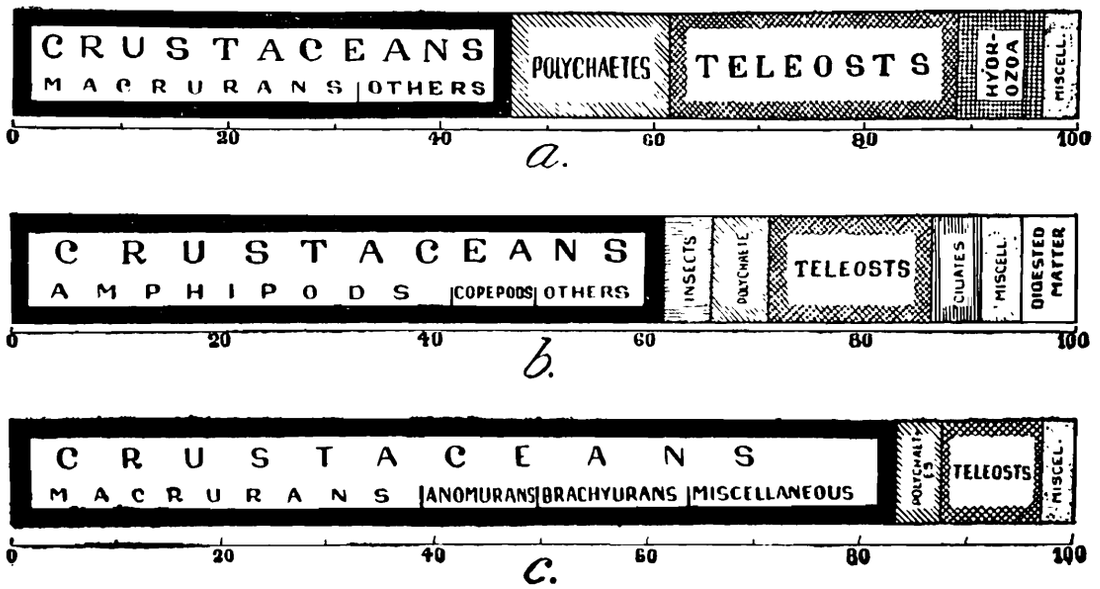
Fishes of this genus have been observed to inhabit the tropical Indo-Pacific seas, some entering fresh waters. While the species of the Australian rivers are entirely limited to fresh waters and valued as food, the Indian species are not very much esteemed, being small in size and reputed to feed on carrion, but they are eaten by the poorer classes. The only record available about the food of the genus is the brief statement by Günther, that these fishes feed " usually on small sized prey of comparatively soft consistency " Of about twenty species comprising the genus the common ones occurring at Madras are *Therapon puta* and *Therapon jarbua.* Two hundred and forty-one specimens, representing these two species were examined. Plate VI, fig. 1 represents the proportions of the food-components for the genus as represented by the two species studied.

Therapon puta Cuvier and Valenciennes.

The " Kove Keetchan " of Madras is a widely distributed marine fish which has been observed to enter brackish waters. Hora (1923), however, mentions it as living " in salinities varying from fresh water to water as saline as that of the Bay of Bengal " At Madras it is caught by fishermen in large numbers both from the sea as well as from the mouths of the rivers Adyar and Cooum, being most abundant from October to March. Here it grows to a size of six and a half inches in length. Its flesh is not much esteemed, but in season it is cheap and easily available in large quantities.

Eighty-two specimens were obtained from October 1936 to April 1937, and their stomach-contents were duly examined. The catches were made in the forenoon, usually between 9 A.M. and 11 A.M. and in the afternoon, between 3 P.M. and 6 P.M. Eleven of them were caught at 9 A.M., 43 at 10 A.M., 6 at 11 A.M., 18 at 3 P.M. and 4 at 6 P.M. Their size ranged from 100 mm. to 159 mm. As regards their sex, the males outnumbered the females, their numbers being 45 and 37 respectively. Of the males 5 were immature, 29 were fully mature and 11 were nearly spent. Of the females, 1 was immature, 6 were fairly mature and the gonads of the remaining 30 were fully developed. Food was present in the stomachs of 38 specimens. Analysis of the food-contents shows that *Therapon puta* is almost exclusively carnivorous. Traces of algae and other vegetable matter, which were only rarely met with, might have been taken quite accidentally. About half of the total food was made up of Crustaceans, about one-quarter of Teleosteans and the remainder consisted of the following :—Polychaetes, Hydrozoa, Molluscs, plants,

Salpa, Foraminifera and sand. Thus the chief food is of a type similar to that which is hunted by sight—a type which may be said



TEXT-FIG. 1.—Charts representing the proportions of the food-components of (*a*) *Therapon puta* Cuvier and Valenciennes; (*b*) *Therapon jarbua* (Forskål); (*c*) *Lutianus vaigiensis* (Quoy and Gaimard).

(The proportions are the results of dividing the totals of the percentages of the different food items of individual fishes of each species by the number of fish with food in stomach.)

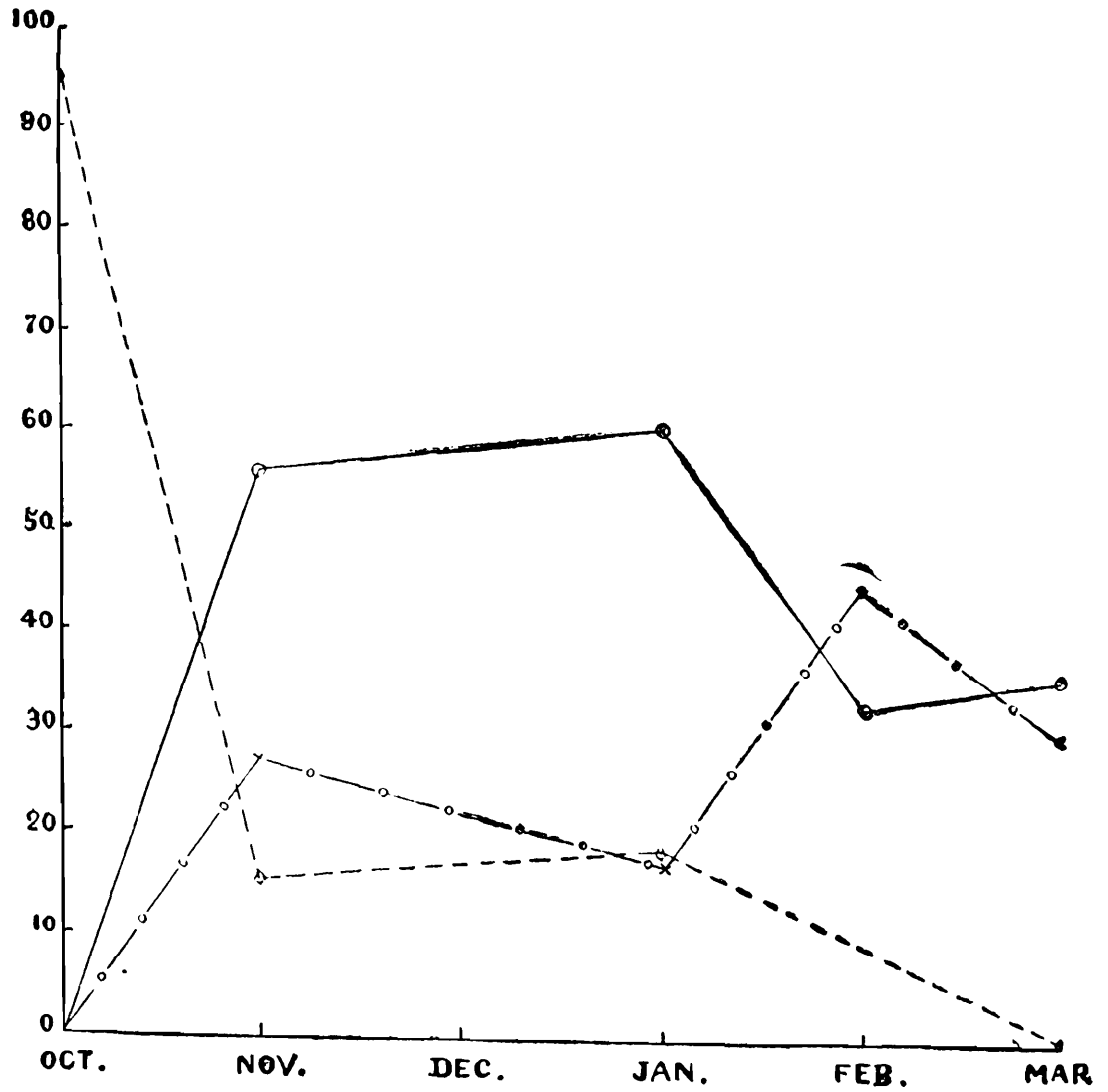
to be 'more solid' than the fragile microplankton which forms the usual food of the herring described by Huxley (1881). It has to be observed that the proportions of the components vary in different months. This is not surprising since as Yarrell (cited by Sim, *op. cit.*) has noted the food of fishes is very different at different times of the year. Details of the diet of *Therapon puta* are as follows :—

Crustaceans.—Decapods, mainly Macrurans like *Acetes erythraeus*, *Penaeus indicus*, *Palaemon lamarrei* and *Leander* sp. composed the main portion. The Decapods, though absent in the October specimens, rose to more than one-half of the total food in November, and thereafter continued to form a considerable part of the diet. Besides Macruran Decapods, small numbers of Brachyuran crabs, traces of Anomurans, Isopods. Amphipods, Mysids and Entomostracans represented by Copepods and Pedunculate Cirripedes were occasionally eaten. Cirripedes that were usually found in association with the branchiae of crabs were probably swallowed along with the latter.

Polychaetes.—The maximum was in October, nearly 95 per cent. of the total food in that month being composed of them. But thereafter the amount decreased gradually until in March only traces of them were found.

Teleosteans.—Appearing in fairly large quantities in November, Teleosteans continued thereafter to form a considerable proportion of the food. Usually they were in the form of post-larval fishes such as *Megalops cyprinoides*, *Pellona* sp., *Elops* sp., etc., while packets of fairly large fish scales were often found with neither the soft parts nor any trace of the endoskeleton of the prey. This fact, especially the fairly

large size of the scales, indicates that this species might have been feeding on some dead fish of a large size or on the offal from the " table " of some larger fishes of prey.



TEXT-FIG. 2.—Monthly variations in the proportions of the three chief food-components of *Therapon puta* Cuvier and Valenciennes during the period of investigation.

(The abscissa represents the months and the ordinate, the percentages; the continuous line represents Crustaceans eaten, the broken line Polychaetes and the chain Teleosteans.)

Molluscs.—Minute Bivalves and small Cephalopods were also found in small numbers.

Coelenterates.—Colonial Hydrozoans such as *Laomedea spinulosa* and *Thyroscyphus juncea* were met with in rare cases.

Salps.—These were extremely rare, being found only in a solitary instance in the month of March.

Foraminiferans.—These again were but rarely seen, being observed only in a single case in the month of February. They belonged to the genus *Polystomella.*

Vegetable matter.—Algae and sea weed were obtained only in minute traces from the stomach of one fish in October and of another in March.

Sand.—In spite of the frequent turbidity of the waters in which the fish feeds, sand was not usually found in the stomachs, and with the exception of Polychaete tubes the only instance of its presence was in

one fish in November, and even in this case if formed a very small percentage of the stomach contents.

Parasites.—No entozoic parasites were discovered in the stomach of any of the fish examined.

Plate V, fig. 1 shows pickings from typical stomach-contents of *Therapon puta*. Table 1 gives the details of the size, sex, stomach-contents, etc., of the 38 specimens found with food. Diet table 1 shows the percentages of the different items of food for the different months. Text-fig. 1*a* shows the percentages for the total number analysed. Text-fig. 2 represents the monthly variation of the three chief constituents of the diet of this species.

Therapon jarbua (Forskål).

The " Palin Keetchan " is another member of this genus very common along the Madras Coast. It is a hardy fish, characterised by three, or sometimes, four large downwardly convex lateral bands on either side. At Madras the fish occurs both in the open sea and in the brackish-water near the mouths of the rivers Cooum and Adyar, and also in the Fort St. George moat. It is found to breed in the Adyar river. Specimens measuring up to 9″ have been obtained, while, according to Day, it attains a size of 12 to 13 inches. The flesh is fairly good eating, especially when the fish is mature and full of fat.

As for previous observations on the food of this fish, Tickell (cited by Day, 1888) remarks that *Therapon jarbua* is termed in Arracan as ' nga-sabasa-msa ' (paddy eating fish), in consequence of the young being so frequent in the inundated rice fields. Wilson (1917) and Moses (*op. cit.*) have recorded it to be a mosquito larvicide.

During the present investigation 159 specimens were examined in the months of January, April, May, September and October, in the year 1937. The fish were caught, some in the forenoon between 8 and 10 A.M. and others in the evening between 3 and 6 P.M. The largest specimen measured 171 mm. in length, while the smallest was 28 mm. long. Of these, 47 were found to be males, 71 females, and in the remaining 41 the sex could not be determined. Of the males 39 were immature and 8 had fairly well-developed gonads. Sixty-four females were immature, while 7 specimens had their ovaries very well developed. Seventy-one specimens were found with food in their stomachs.

An examination of the stomach-contents shows that while the fish is a versatile feeder, Crustaceans and Teleosts form the major portion of the diet. Small quantities of Polychaetes and insect parts were found among the stomach-contents of many. Filamentous algae were seen in a few cases. Eggs of both fishes and Crustaceans were occasionally met with. A small percentage of the food was in a digested state and could not be identified. A general analysis of the diet is as follows :—

Crustaceans.—Amphipods, such as *Grandidierella gilesi*, *G. magnae* and *Paracalliope fluviatilis*, were the chief items. Natantian Macrurans like the young ones of *Penaeus indica* and *Palaemon lamarrei* appeared

in small proportions. Copepods, such as *Pseudodiaptomus annandalei* and *Acartia southwelli*, were occasionally met with, especially in September and October. Mysids like *Mesopodopsis orientalis* and *Rhopalophthalmus egregius* were present in a few samples. *Squilla*, *Caprella* and Crustacean eggs also appeared in small quantities.

Teleosteans.—These were very frequent both as young of Clupeids like *Pellona* sp. as well as packets of large scales.

Polychaetes.—The amount of Polychaetes consumed was conspicuously small, and these were mainly *Owenia* sp. and *Marphysa gravelyi*.

Insects[1].—A number of mosquito larvae and larvae of mayflies and dragonflies were found among the stomach-contents of several fish, especially young ones. Even adult mosquitoes, with well-developed wings, were found to have been swallowed. Obviously the fish devours the adult insects as they emerge out of the pupal cases or settle on the surface of the water for oviposition and may even spring out of the water and snap at them as they hover near the water surface. Maggots of insects and adult mites also occurred in a few cases. Some of these fish were caught from the Fort St. George moat. Though the fish does not feed exclusively on mosquito larvae, the large numbers of the latter observed in the stomachs of many individuals show that they are active larvicides and will be of use in the biological control of mosquito-borne diseases. These findings agree with the statements of Wilson (*op. cit.*) and Moses (*op. cit.*). The present observations, however, indicate further that while in the sea and river mouths *Therapon jarbua* appropriates Crustaceans and Teleosteans swimming about it, in enclosed waters it feeds ravenously on insect larvae[2] and also that the fish is a better larvivore in the young and immature stages[3] when its comparatively feeble mouth-parts induce it to prefer larvae and other elements of a fragile nature.[4] Wilson states that the species can be found in all backwaters and will live and thrive in brackish- and fresh-water ponds. The fish being easily acclimatising, the possibility of transporting it into inland

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[1] I am thankful to Mr. S. Jones, Assistant Entomologist to the Government of Travancore, for his kind assistance in the identification of some of the insect remains.

[2] Scepticism has been expressed in certain quarters (Sen, 1937; Roy, 1938) about the efficiency of indigenous fishes as larvicides in the destruction of mosquitoes. Several authors are, however, convinced about the utility of indigenous species with larvivorous tendencies. Hora (1937) affirms, and the practical results obtained by workers such as Chatterjee (1933; 1934), Gravely (1937), Hora and Nair (1938); and Job (1940*a*) corroborate this, that the "biological control of mosquito larvae by the use of fish will prove very effective in India", though "considerable work on proper lines remains to be done to determine the utility of the different species under field conditions."

[3] A decrease in the proportion of insect elements consumed as the young fish grows into adult has been observed also in the case of Pickerel (Hunter and Rankin, 1939).

[4] It is sad to note that large numbers of *Therapon jarbua* are too often caught along with larger fishes and prawns, and, being too small for consumption, are thrown away to perish on the shore. The writer has often observed that many of the "Katcha valai" used by the shore fishermen have their meshes too small to allow the escape of the young fish (Plate V, fig. 3). Such wasteful methods of fishing resulting in the destruction of large numbers of these young fish not only inhibit the number of large ones which would otherwise thrive and fill our waters, but also take away a valuable agency of mosquito-control. Such criminal waste continues in the absence of proper legislation regarding methods of fishing in this country.

waters and utilising it both as a food-fish[1] and a larvicide are quite obvious.

Vegetable matter.—The occasional appearance of filamentous algae like species of *Oscillatoria* and other vegetable remains are only to be explained as being taken in accidentally along with the normal diet.

Protozoa.—Tufts of *Zoothamnium* sp. were met with both alone and in association with egg masses in several specimens. In this connection it may be mentioned that Jones and Job (1938) have observed in the case of 'Synoecy ?' between *Acentrogobius neilli* and *Zoothamnium* sp. that though colonies of *Zoothamnium* sp. flourished in the oral region of the fish, the stomach-contents of no specimen of *A. neilli* revealed any indication of *Zoothamnium* sp. having been swallowed. Unlike *A. neilli*, *Therapon jarbua* was seen to have deliberately consumed appreciable quantities of *Zoothamnium* sp.

Parasites.—No entozoic organism was observed among the stomach-contents.

Plate V, fig. 2, shows pickings from typical stomach-contents of *Therapon jarbua*. Table 2 gives the details of the stomach-contents of the specimens found with food. Diet table 2 gives the volumetric percentages of the food-constituents for the different months. Text-fig. 1*b* represents the percentages for the total number of specimens studied.

Genus **Pelates** Cuvier and Valenciennes.

Pelates quadrilineatus (Bloch).

This is one of the commonest perches caught from the Madras coast. The largest number of specimens were obtained from October to January. The fish is often found to enter the brackish waters of the Adyar and the Cooum. Specimens measuring up to 6 inches have been secured, while Weber and Beaufort (1931) have recorded a length of 8½ inches. The flesh is not much of a delicacy, but being a cheap and abundant food fish, it is of considerable value to the poor. The author could find no previous record regarding the food of this fish.

One hundred and forty adult specimens were examined from August 1936 to the end of February 1937. The catches were made usually in the forenoon, while a few were obtained in the evening. The length of the specimens ranged from 108 mm. to 152 mm. Sixty-nine of them were males and seventy-one females. Of the males, 3 were immature, 29 were seen to be advancing towards maturity and 30 possessed fully developed gonads, while 7 were in a spent condition. Of the females,

[1] There is a prejudice attached to *Therapon jarbua* as it is reputed to be a carrion-feeder, and this stands in the way of its popularity as a food-fish. However, during the present investigation no evidence of its feeding on corpses has been seen, and the only evidence of its ever having tackled discarded parts of offal from the "tables" of larger fishes of prey was the occurrence of packets of large fish scales in the stomach; for it is incredible that it could have swallowed Teleosts of such a size as to own such large scales. In waters where abundance of life and a variety of low forms exist, fishes cannot be expected to develop epicurian tastes. Perches are not the only creatures which may prey upon an appetising morsel of animal remains, and even if the "zoned perch" could occasionally be detected in the vicinity of some drifting carcase, it would be unjust to taboo it as an exclusive carrion-feeder, considering the amount of wholesome food discovered in the stomachs of the numerous individuals examined in the course of the present study.

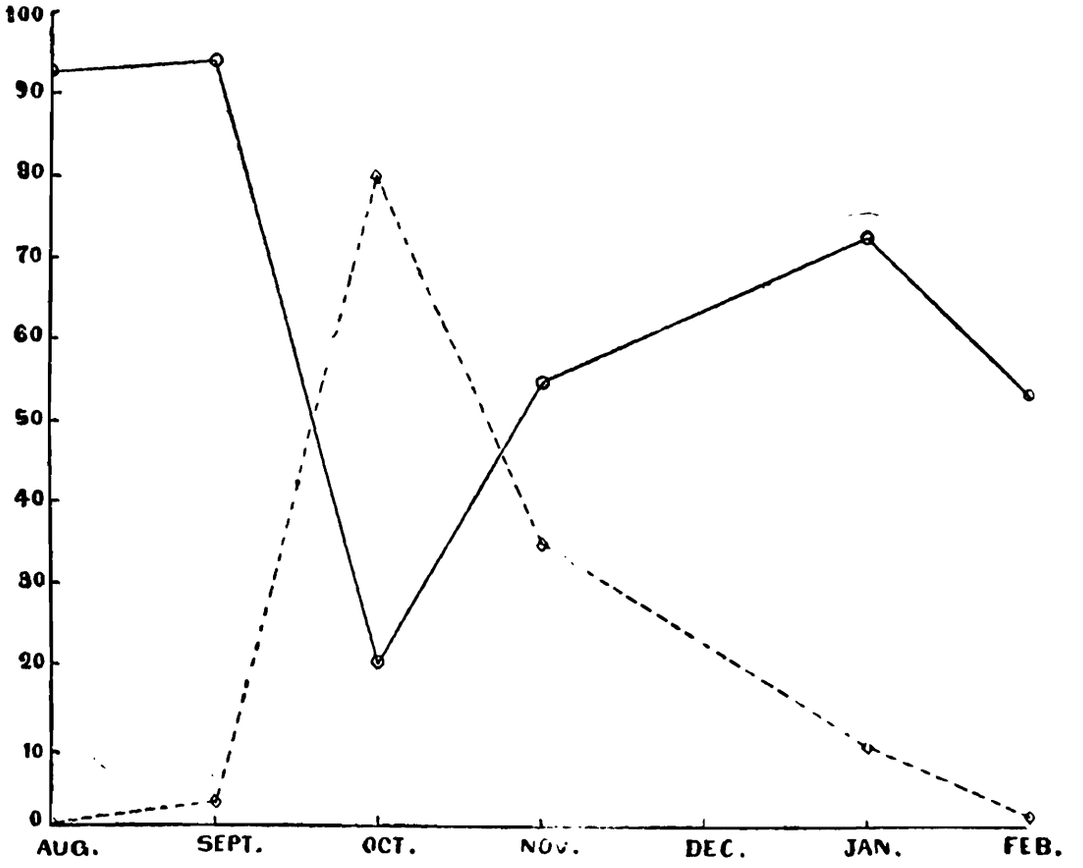
6 were immature, 15 were fairly mature and 43 had fully developed gonads, whereas the ovaries of 7 were in a spent state. As to the extent of feeding, 79 specimens had considerable amounts of food in the stomach. Even in the others the intestines often contained undigested parts of food, chitinous tests of Crustaceans, Polychaete setae etc., while not rarely shrimps and other Crustaceans were met with, gorging the mouth and the oesophagus. However, among all the catches made, both in the morning as well as in the afternoon, specimens were found with moderate quantities of animal food. Hence it may be concluded that though intermittent feeders, they are carnivorous in taste, appropriating available food at all hours of the day. Only in one instance was the stomach seen to be gorged with food (1+); two were just full (1), four were pretty full (0·8), eleven were about half full (0·6), twenty-three 0·4, twenty-nine were 0·2, nine 0·1 and the remaining sixty-one were empty (0·0). The data given in table 4 point to the conclusion that in general, as far as this fish is concerned, the feeding activities grow sluggish as the gonads ripen, though the fish may not completely cease to feed. In this respect the fish agrees more or less with the salmon, trout and anadromous shad (Day, 1883). This is probably owing to the reproductive activity engaging the major part of the fishes' energy, rendering them comparatively weak and incompetent to chase and capture their usual prey. Also, immediately after spawning the fish seem to be exhausted by the effort, so that feeding activity is again at a low ebb during this period. These observations are confirmed by the fact that gravid specimens captured and handled are most often seen to be comparatively lethargic and inactive.[1]

A study of the food-contents reveals that the fish feeds ravenously on Crustaceans, about three-fifths of the total food being composed of them; Polychaetes form about one-fourth and the remainder is made up of Molluscs, Teleosteans, vegetable matter, Echinoderms, Foraminiferans, Polyzoans and occasional traces of sand particles, of which the last might have been accidentally swallowed.

Crustaceans.—About two-thirds of the Crustaceans consumed are Decapods, about one-sixth Amphipods and the remainder miscellaneous Crustaceans. The Decapods are mainly Macrurans, and of these the Sergestid, *Acetes erythraeus* is the most dominant. *Penaeus indicus*, *Alpheus malabaricus*, *Palaemon lamarrei* and species of *Leander* and *Leucifer* also were often met with. In August the Macrurans appeared in large quantities, but little was seen in the fish examined in September and October. However, they again began to appear in considerable proportions from November onwards. The chief Amphipods were *Grandedierella magnae* and *Paracalliope fluviatilis*. They were eaten in large quantities in August and September; then followed a decline in their amount, but they again began to rise in appreciable quantities towards January and February. The miscellaneous Crustaceans were Mysids like *Mesopodopsis orientalis* and *Rhopalophthalmus egregius*, Stomatopod larvae, Entomostraca represented by Copepods

[1] Regarding the Mountain Barbel, *Oreinus*, Malik (*op. cit.*) writes, "During the breeding season the ripe males and females probably give up feeding and depend for nourishment on the fat stored in the viscera".

like *Pseudodiaptomus annandalei*, *Pontella danae*, *Acartia southwelli*, etc. and Ostracod fragments. Occasionally Bopirid and Sphaeromid Isopods



TEXT-FIG. 3.—Monthly variations in the proportions of the two chief food-components of *Pelates quadrilineatus* (Bloch) during the period of investigation.

(The abscissa represents the months and the ordinate, the percentages: the continuous line represents Crustaceans eaten and the broken line Polychaetes.)

were met with. These, however, might have gained entrance into the stomach of the fish as parasites of the prey which was swallowed.

Polychaetes.—Tube-dwelling spioniform Polychaetes like *Owenia* sp. formed the main item. Small quantities of Eunicids such as *Marphysa gravelyi* and *Diopatra variabilis* and a few larval worms were also common. Most of the Polychaetes, especially the larvae, were seen to be very much acted upon by the digestive juices, and the setae were sometimes the only remains left undissolved. Polychaetes were rare in August, but soon rose up to a maximum of about 80 per cent. in October while they again began to decrease towards February.

Mollusca.—These were mainly small Gastropods like *Gyraulus* sp. with fragments of bivalves.

Teleosteans.—Teleosteans were but sparingly eaten, being found only in a solitary instance in the month of January. On another occasion a post-larval Clupeid, *Pellona elongata*, was discovered entangled in the gills of a specimen; but this was probably a case of accident.

Vegetable matter.—In rare cases minute quantities of species of *Oscillatoria* and *Trichodesmium* were met with. But as these were invariably seen to be in an unplasmolised state it is very likely that these had been devoured accidentally along with the Invertebrates which are usually

associated with filamentous algae. Hence the fish cannot be said to be intentionally vegetarian to any cognisable extent.

Echinoderms.—These were minute Ophiuroids like *Ophiothela danae* and *Ophiothrix* sp., traces of Echinoids and spines and fragments of shells.

Parasites.—But for a solitary case of a Trematode discovered in the month of August and traces of Nematodes met with in very rare cases, no entozoic organism was seen in the stomachs of the fish.

Table 3 gives the details of the 79 specimens of *Pelates quadrilineatus* which had food-contents in their stomachs. Diet table 3 shows the volumetric percentages of the various articles of diet appropriated by the species in the different months, while Pl. VI, fig. 2 represents diagrammatically the proportions of the food-components for the genus *Pelates* as represented by the total number of specimens. Text-fig. 3 shows the monthly variation in the percentages of the two main constituents of the food.

Genus **Lutianus** Bloch.

Extensively salted and dried in many localities, fishes of this genus are all as a rule good for food, though a few are said to be rather insipid in the fresh state. Day (1873) mentions that these (included by him under the genus *Mesoprion*) are of " great value in the production of food, because they appear to come inland to breed and are consequently much more frequently captured, some growing very large " Bridge (1922) speaks of some species as normally hermaphrodite. One hundred and fourteen individuals belonging to five species of the genus were examined. These are :—*Lutianus vaigiensis*, *L. sanguineus*, *L. lutianus*, *L. lineolatus*, and *L. johnii*. Plate VI, fig. 3 represents the proportions of the food components for the genus as represented by the five species.

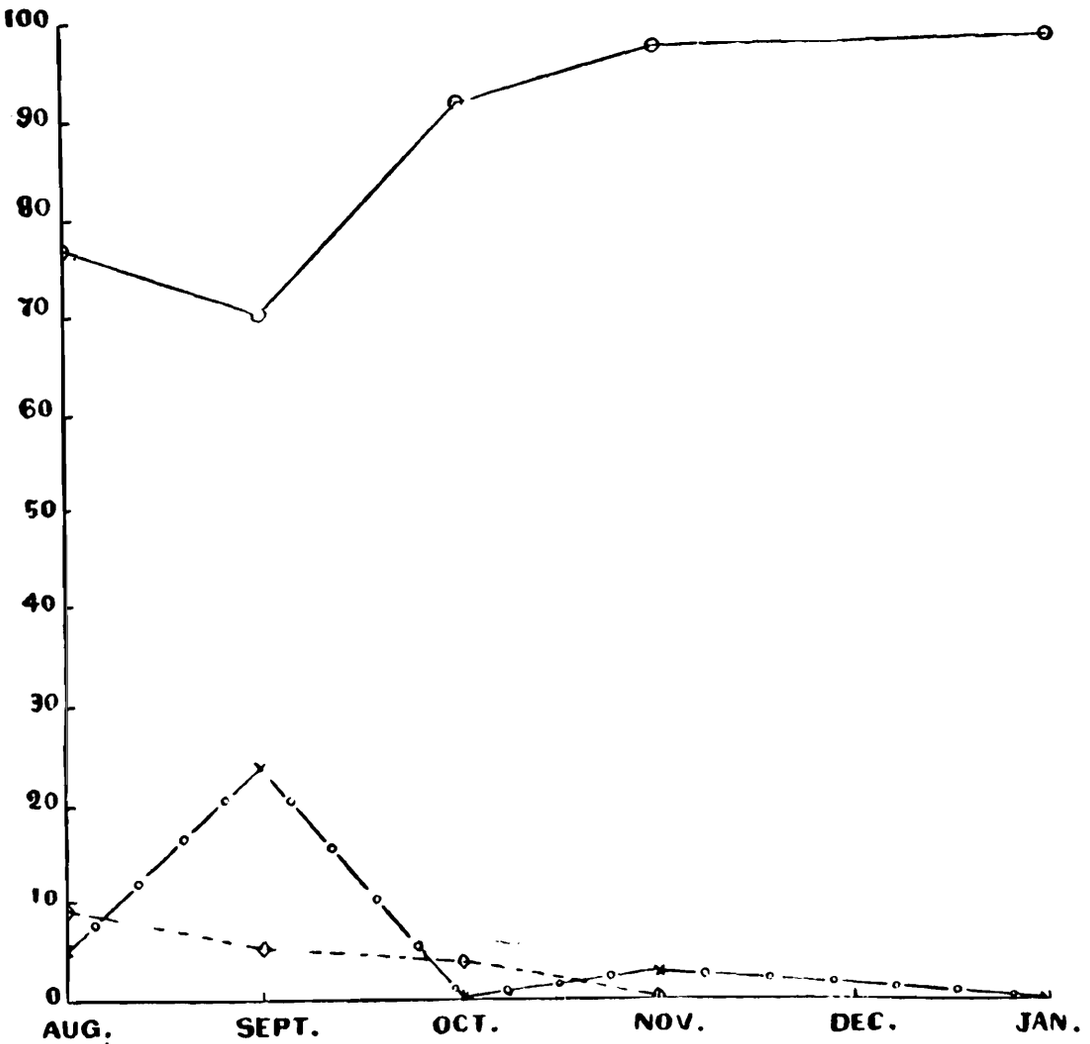
Lutianus vaigiensis (Quoy and Gaimard).

Eighty-eight specimens of the " sungarah " were obtained from August 1936 to April 1937 except for the months of December, February and March. The catches were made in the forenoon between 10 and 11 A.M. and in the afternoon between 2 and 6 P.M. The size of the individuals ranged from 80 mm. to 164 mm. Food was present in the stomachs of 29 fish. As the gonads were poorly developed in the specimens the sexes could not be made out.

An analysis of the food contents shows that the fish feeds mainly on Malacostracan Crustacea, supplemented by traces of Teleosteans, Copepods and Polychaetes. Less than 2 per cent of the food was seen to be composed of vegetable matter. But as this was always found in an unplasmolised condition it does not warrant one to regard the fish as intentionally vegetarian. The details of the diet are as follows :—

Crustacea.—From three-fourths of the total food in August and September Crustaceans rose to nine-tenths in October and almost cent per cent from November onwards. *Acetes erythraeus* was the most dominant item. Shoals of this Crustacean have been followed and consumed, since no fewer than 34 of them were discovered in some of the

fish. *Metapenaeus monoceros* was eaten in October. *Alpheus malabaricus* was also frequent in that month. Hermit crabs appeared in considerable proportions in September and October, while *Hippa* were seen exclusively in the stomach of an individual in the month of April. Brachyuran crabs like *Grapsus maculatus*, *Neptunus pelagicus* and *N. sanguinolentus* were very common from August to October, rising to very high percentages in the latter months. Schizopods like *Mesopodopsis orientalis* and *Rhopalophthalmus egregius* appeared in small quantities in August and in large numbers thereafter. Amphipods were seen from August to October, mainly represented by *Grandedierella gilesi*. Stomatopod larvae were met with in rare cases in September. Entomostracans were represented by Copepods which occurred in minute quantities in August and October.



TEXT-FIG. 4.—Monthly variations in the proportions of the three chief food-components of *Lutianus vaigiensis* (Quoy and Gaimard) during the period of investigation.

(The abscissa represents the months and the ordinate the percentages; the continuous line represents Crustaceans eaten, the broken line Polychaetes and the chain Teleosteans.)

Teleosteans.—In August and September small Carangids and Clupeids appeared in plenty, while fish scales appeared in small quantities in November.

Polychaetes.—Small quantities of *Pectinaria* sp. and *Laonome indica* were eaten in August, *Diopatra variabilis* in August and September, and some *Marphysa gravelyi* in October.

Vegetable matter.—About 4 per cent of the stomach-contents in August and October were composed of algal matter, while traces of it also appeared in January. But for this and a tiny piece of sea-weed found swallowed in November the fish were decidedly carnivorous. Possibly the vegetable matter was accidentally swallowed along with the animal diet.

Of the twenty individuals caught in the forenoon, three were gorged with food, two were full and the stomach-fill in the case of two was 0·8, in two 0·6, in two 0·4, in two 0·2 and only seven were devoid of food. Of the forty-two specimens caught in the evening, one was full, and the stomach-fill in the case of four was 0·8, in five 0·6, in one 0·4, in one 0·2, in four 0·1 and twenty-six were empty. As far as the data show, in general, feeding is comparatively more active in the earlier part of the day than late in the evening. Plate V, fig. 4 shows pickings from typical stomach-contents of the species. Table 5 gives the details of the contents. Diet Table 4 shows the percentages of the items of diet for the different months. Text-fig. 4 represents the monthly variations of the three chief constituents of food. Text-fig. 1*c* represents the proportions of the food-components for the species.

Lutianus sanguineus (Cuvier and Valenciennes).

Seven specimens were obtained in the month of August. Their lengths ranged from 180 mm. to 200 mm. Only in two individuals food appeared in appreciable quantities. The stomach-contents consisted of Crustaceans like *Leucifer*, Decapod appendages and a Pedunculate Cirripede, cycloid scales, Gastropod remains and Teleostean otoliths along with a piece of intestine, probably of a Teleost. Table 6 gives the details of the stomach-contents. Diet Table 5 shows the percentages of the items.

Lutianus lutianus Bloch.

Six specimens were obtained in the month of August. They were caught in the afternoon. In no case were the gonads sufficiently developed to distinguish the sex. The largest specimen measured 164 mm. in length and its stomach was nearly full of food, which consisted of a partly digested Carangid, a little *Oscillatoria* and some digested stuff. The stomach of another which measured 155 mm. was about half full, the contents being made up entirely of partly digested Teleostean remains, mainly *Ambassis* sp. A third measuring 152 mm. contained only a small amount of fish remains, digested stuff and algal filaments. The stomachs of the other three specimens were empty. Table 7 gives the details of the stomach-contents. Diet Table 6 shows the percentages of the items.

Lutianus lineolatus (Rüppell).

Twenty specimens were examined, 10 in September and 10 in October. They measured from 108 mm. to 146 mm. The gonads were poorly developed. Only two of the specimens had full stomachs, while 8 had small quantities of food and the rest were empty. The food was chiefly composed of Teleosts (55 per cent) and the remainder consisted of digested stuff. Table 8 gives the details of the stomach-contents. Diet Table 7 shows the percentages of the items.

Lutianus johnii (Bloch).

Five specimens were obtained in November. The largest one measured 300 mm. and the smallest 22 mm. The gonads were not well developed. Only two fish contained food in the stomach. The food consisted of remnants of Teleosts (25 per cent), Brachyuran remains (50 per cent), Chitinous tests (10 per cent) and digested matter (15 per cent). Table 9 gives the details of the stomach-contents. Diet Table 8 shows the percentages of the items.

Genus **Epinephelus** Bloch.

This genus comprises the "sea perches" proper (Günther, 1880). The majority are small, about one to two feet, while many like *Epinephelus tauvina* attains a length of about 7 feet and a weight of about 300 lbs. Owing to their predaceous habits some are even said to be dangerous to man. Günther mentions bathers having been "attacked at the Seychelles and Aden by a gigantic species, the persons having died from the injuries received" Nearly all of the numerous species are edible and esteemed as food. Several species are reported by Bridge (1922) to be normally hermaphrodite. Usually living in the coastal and deep waters of the tropical and sub-tropical seas, a few species are said to enter brackish- or even fresh-water. Those ascending rivers, however, do so for predaceous purposes, as all of them spawn in the sea. At Madras the species are all marine, but, small specimens of some, such as *Epinephelus tauvina*, are found to enter the mouths of the Adyar and the Cooum. Forty-two specimens of five species were examined. Plate VI, fig. 4 represents the proportions of the food-components for the genus as represented by them.

Epinephelus tauvina (Forskål).

21 specimens were obtained from September 1936 to February 1937 excepting the month of December. The size ranged from 93 mm. to 222 mm. The gonads were in all cases undeveloped. One of the specimens was seen to be gorged with a large sized crab. 13 were devoid of food. Two were full, and the stomach-fill in two were 0·6, in one 0·4, in one 0·2 and in one 0·1. They were caught, two in the forenoon between 10 and 11 A.M. and the others in the afternoon between 2 and 4 P.M.

Crustaceans formed the main constituent, the chief components being hard-shelled Brachyuran crabs like *Neptunus pelagicus* and *Dotilla* sp.

It is significant that the crabs were found to have been swallowed whole, unlike the case of the " native dora ", a Mediterranean perch, which is said to grind up the calcareous carapace. It is surprising how *E. tauvina* breaks up the hard test of these crabs especially since the stomach walls are more or less thin and transparent when distended with food. Probably their digestion is so powerful that a considerable portion of the test is dissolved as in the case of the cods described by Day (1883). Next came Macruran Decapods like *Leander* sp., and a considerable portion of the stomach-contents was made up of small Teleosts. One specimen obtained in December 1937 was seen to have swallowed a fairly large specimen of *Therapon puta*, with which its stomach was gorged (Plate V, fig. 6). Table 10 gives the details of the stomach-contents. Diet Table 9 shows the percentages of the items. Plate V, fig. 5 shows pickings from typical stomach-contents of *Epinephelus tauvina*.

Epinephelus undulosus (Quoy and Gaimard).

Southwell (1913) records Cepholopods, oysters, small fish, crabs, etc., from the stomach of this species from Ceylon. In the present study 9 specimens were examined in October 1936. One was obtained at 10 A.M. and the others at 2 in the afternoon. The largest was 144 mm. and the smallest 77 mm. In none of them the gonads had developed. Three had food-contents in them. The stomach of one was gorged with a Macruran Decapod, *Alpheus malabaricus*, while another contained the anterior part of a young Teleostean, appendages of crabs, a small Brachyuran and the anterior part of a young Alphaeid. In another, which was nearly empty, the food consisted of traces of Polychaete setae with some Crustacean appendages. The stomachs of the remaining ones were empty but for a little mucus which was present in some of them. Table 11 gives the details of the stomach-contents. Diet Table 10 shows the percentages of the items.

Epinephelus maculatus (Bloch).

This species has been reported from the sea only. Five specimens were examined in October 1936. They were caught in the afternoon. The largest was 174 mm. while the smallest was 129 mm. in length. The gonads had not developed. Only two of them contained food, while the others were empty. The stomach-contents were seen to consist of crushed parts of Macruran Decapods of the genus *Leander* along with their dislocated appendages, besides a small amount of digested matter (Table 12 and Diet Table 11).

Epinephelus boenack (Bloch).

The " veri-cullawah " is a brilliantly coloured sea perch often caught by the fishermen of the coast. 5 specimens were examined, two in September 1936 and three in March 1937. The stomach in the first two were empty, while the other three contained food (Table 13 and Diet Table 12).

Nearly four-fifths of the food were composed of hard shelled Decapods, namely, *Grapsus maculatus* and *Alpheus malabaricus* with megalopa stages of crabs. The anterior part of an *Ambassis* sp. appeared in the stomach of one of the specimens. A small percentage of the food was too well digested for identification. Considerable traces of sand were seen along with the food, possibly indicating bottom feeding.

Epinephelus lanceolatus (Bloch).

The " wutla-cullawah " attains a large size and is very valuable, the fish having an agreeable flavour. Being a bottom feeder this is expected to contribute to the success of steam trawling when introduced in these parts. Weber and Beaufort (1931) record it as occurring " in the sea ", but mention them to be entering rivers.

Two specimens were obtained in September 1936. The larger one was 400 mm. but had an empty stomach while the smaller measured 370 mm. in length and a fairly large berried female *Leander* was seen to block the oesophagus; besides, some digested material and mucus was also present inside the stomach (Table 14 and Diet Table 13).

Genus **Pomadasys** Lacépède.

These are shore fishes very common between the Tropics, and some are said to extend into the neighbouring sub-tropical parts. *Pomadasys* is called a " grunter " from its habit of making a grunting noise when disturbed. Plate VI, fig. 5 represents the food-components of the genus as represented by two species which were studied.

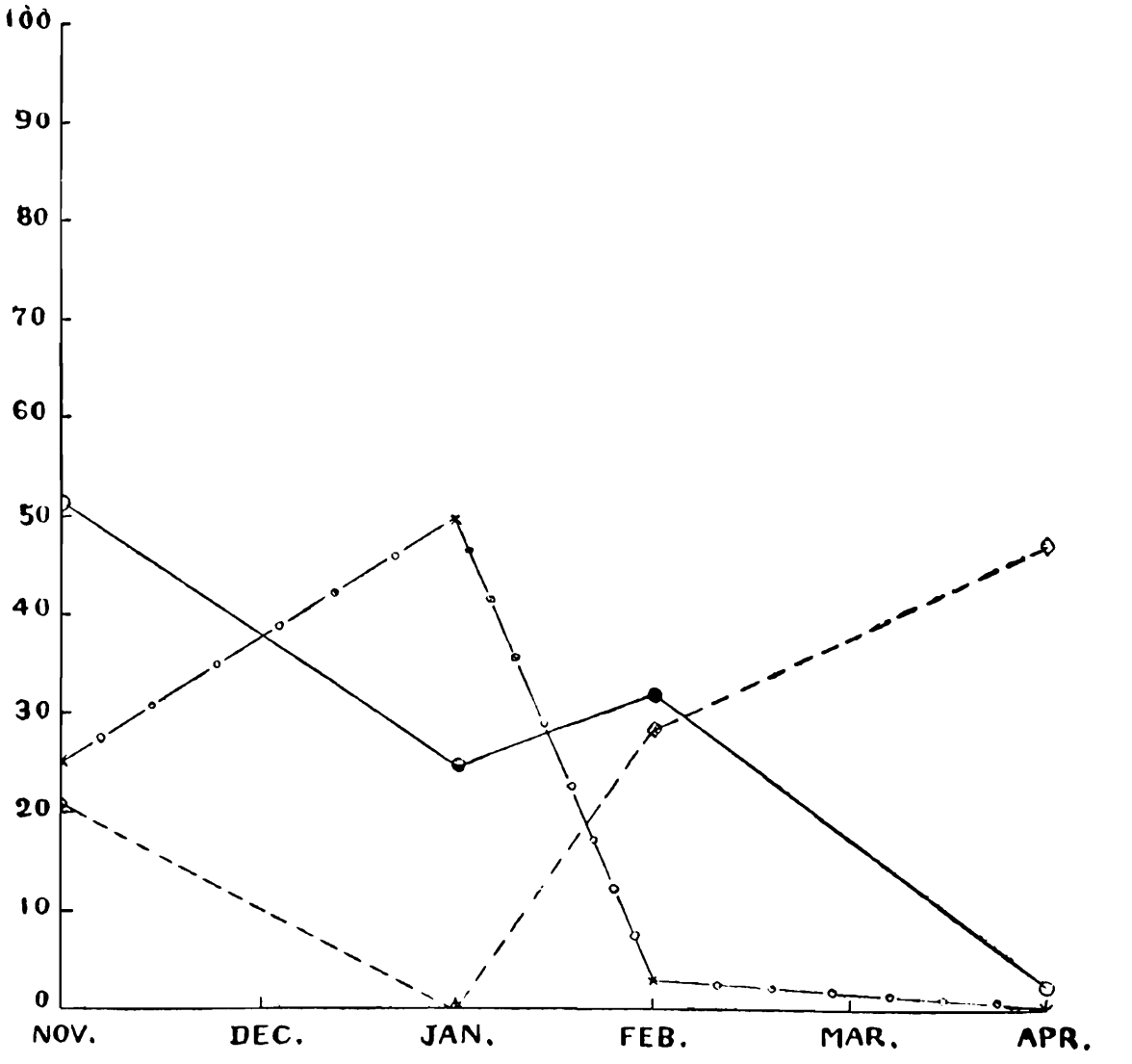
Pomadasys maculatus (Bloch).

The fish is called " kallanthalai " owing to the presence of ' stones ' in the head, which are said to be of medicinal value. Locally it is known as the " kurrutche " and is said to grow up to 16 inches in length and to breed in April and May. The fishes of this genus are fair as food but not much esteemed; the air bladder in some cases is collected for isinglass. Southwell found only prawns in the stomach-contents of some of the specimens examined by him in Ceylon.

Fifty specimens were examined from November 1936 to April 1937 excepting the month of March. 21 of them were males and 29 females. 17 specimens were found to contain food. The fish were caught in the morning from 9 to 11 A.M. and in the afternoon from 2 to 6 P.M. Only two individuals had their stomachs filled with food, while one was fairly full (0·6), the stomach-fill in four was 0·4, in eight 0·2 and two had only traces of food in them. The large number of fish with empty stomachs indicates that the feeding is probably intermittent.

Food analysis showed that Crustaceans like *Acetes erythraeus*, *Penaeus indicus*, crabs and Amphipods represented by *Grandedierella gilesi* formed more than half of the food. Polychaetes formed one-fifth. The rest was composed chiefly of Teleosts with small quantities of young

Gastropods, Pectinibranchiate larvae, Larvaceae, Asteroids, Hydrozoa and sand (Table 15 and Diet Table 14). Text-fig. 5 represents the monthly variations of the chief food-components.



TEXT-FIG. 5.—Monthly variations in the proportions of the three chief food-components of *Pomadasys maculatus* (Bloch) during the period of investigation.

(The abscissa represents the months and the ordinate the percentages; the continuous line represents Crustaceans eaten, the broken line Polychaetes and the chain Teleosteans.)

Pomadasys olivaceus (Day).

Six specimens were obtained in October 1936. The largest measured 130 mm. while the smallest was 122 mm. long. Four of them were males and two females. Two had empty stomachs. The other four contained a fair amount of partly digested food, which was mainly composed of Polychaetes, Penaeids, Brachyurans and Amphipods (Table 16 and Diet Table 15).

Genus **Apogon**, Lacépède.

These small fishes abound in sheltered spots, some having been caught, as Day (1889) states, at the mouths of, or even a short distance up, tidal rivers and backwaters. They are called "coral fish", being found in

great abundance in or near coral reefs. Bridge (1922) observes how the males in some species take care of the eggs in their mouth. Though small, these fishes are eaten both in the fresh state and when salted and dried. Plate VI, fig. 6 represents the proportions of the food-components for the genus as represented by the single species *Apogon nigripinnis.*

Apogon nigripinnis Cuvier and Valenciennes.

Nine specimens were examined, 5 in August and 4 in November 1936. Five of them had food contents, while four were empty.

The food was mainly composed of Macruran Decapods, chiefly prawns of the genus *Leander* and other young Penaeids and young Teleosteans like *Sciaena.* A small portion of the contents was digested beyond identification (Table 17 and Diet Table 16).

Genus **Ambassis** Cuvier and Valenciennes.

The little bony fishes composing this genus are eaten by the poorer classes. Owing to their thin shape they are easily dried without salt. Some species are exclusively found in fresh water. As several fishes of this genus constitute the food of larger fish, the latter are often enticed by them to come nearer inshore to be easily caught by man. Plate VI, fig. 7 represents the proportions of the food-components for the genus as represented by the single species studied.

Ambassis gymnocephalus (Lacépède).

This small species is common in the coastal waters, often ascending the rivers. Twelve specimens were procured, 8 in the month of November 1937 and 4 in February 1938. The largest was 68 mm. and the smallest 50 mm. Seven of them were females and the other five males. Eight of them were empty. In the others the stomach-contents were made up of Crustaceans like Copepods, Mysids, digested stuff, algal matter and some sand. In specimens caught from the Fort St. George moat large numbers of Copepods, mainly *Pseudodiaptomus annandalei,* were seen. An examination of the gill-rakers of this fish shows that its comparatively long and filamentous rakers, especially those of the first true gills serve as sieves somewhat as in the case of the herring and mackerel, to strain the micro-organisms from the water passing through the gills. Even here, however, the power of selecting and rejecting is remarkable as evinced by the stomachs found packed full of *Cyclops,* while the surrounding water contained various other organisms as well. The fish resembles the mackerel described by Bullen (1912) in having two distinct methods of procuring food, *viz.,* (i) a system of filtration (through the gill sieve) and (ii) hunting by sight prey of a larger size. The cyclops-cidal tendencies of the fish point to its probable utility in the biological control of Guinea Worm disease. But sufficient data are not yet available for discussing the point. Table 18 gives the details of the stomach-contents. Diet Table 17 shows the percentages of the items.

Genus **Gerres** Cuvier.

About 30 species which compose this genus live in the tropical seas, most species entering fresh water. These plain silvery perches are small, being often less than 10 inches in size. Plate VI, fig. 8 represents the proportions of the food-components for the genus as represented by the single species studied.

Gerres punctatus Cuvier and Valenciennes.

The " oodan " is the " silver belly " common at Madras both in the sea and in the brackish waters of the Adyar and the Cooum. Day records about 8 inches as its maximum length. The specimens studied ranged from 129 mm. to 147 mm. The fish, while not very popular in the fresh condition owing to too many bones and lack of flavour, is more esteemed when salted and dried and is even exported.

Fourteen specimens were examined, 10 in November 1936 and 4 in February 1937. The specimens obtained in February were devoid of any food. Four were caught in the morning at about 9 o'clock and 1 at 10. The others were obtained late in the forenoon, at about 11 o'clock. Eight of them were males and six females. The gonads were well developed, so that the sexes could be easily identified. The four specimens caught at 9 o'clock and the one caught at 10 contained food, but even in these the stomachs were not completely full. In the case of one of the males however the stomach was nearly filled with Crustacean limbs.

Polychaetes like Chaetopterids and Eunicids formed more than half of the total food. Crustaceans formed the major part of the remainder, while Molluscs and larval Cephalochordates appeared in rare instances (Table 19 and Diet Table 18).

DISCUSSION.

Feeding Habits.—These investigations show that none of the perches of the Madras Coast habitually feeds on vegetable matter ; minute traces of it met with in very rare cases are too insignificant to be considered of any importance in connection with their food, and their presence is undoubtedly accidental. These perches are decidedly carnivorous, and probably this is one of the reasons why they are so highly prized ; for, as food-fishes, carnivorous fishes are said to be preferred to herbivorous ones. Animal food is abundant in the coastal waters of Madras, and the rich zooplankton of the region also helps in the nutrition, partly directly, but much more indirectly, of the perches, both young and adult. While carnivorous perches like *Epinephelus* and *Lutianus* are actively predaceous, the comparatively innocuous forms like *Ambassis* are, in this respect, more " sinned against than sinning ", as judged from the numbers of them discovered in the stomachs of larger perches, to say nothing of the quantities which may be consumed by other large fishes of prey.

The perches, however, cannot be reckoned as indiscriminate carnivores [1]. Nor have these been found to act as " filth-feeders " like the sucker and the blunt-nosed minnows, which according to Pearse (1916) obtain organic remains from the mud and debris at the bottom.[2] The packets of large scales seen in *Therapon* may indicate offal-feeding, but regular mud-feeding has never been observed in these perches. On the other hand, the general results brought out by the examination of these fishes serve to show that excepting forms such as *Ambassis* possessing comparatively slender gill-rakers, the large perches are incapable of nourishment by means of filtration, and even the larger planktonic organisms appear to be hunted by sight, the fish being capable of selective feeding. It is but natural that being devoid of feelers or other similar appendages these keen-eyed active swimmers should be mainly sight-feeders like the yellow perch of the Wisconsin lakes described by Pearse and Achtenberg (*op. cit.*). However, the sense of smell seems to supplement sight in food capture ; for, the present writer has observed several perches with impaired eye-sight in the Madras Marine Aquarium approach and devour bits of fish thrown into the water. These carnivores are to some extent cosmopolitan in their tastes, exhibiting carcinivorous, piscivorous and vermivorous tendencies, while at least one form, *Therapon jarbua*, is, in addition, insectivorous.

On reviewing the diet charts of the various genera studied, it is seen that in the majority of cases Malacostracan Crustaceans form the main part of their food. Entomostracans are conspicuously rare except in the case of *Ambassis*. Evidently these perches, excepting the last mentioned, cannot, like *Sardinella gibbosa* or *S. longiceps*, be said to be microplankton-feeders. The absence of Entomostracans or diatoms cannot be attributed to the absence of these forms in the waters ; for, stomach-contents entirely composed of these forms have been obtained by the writer in the case of Scombrid fishes from the same region. On the other hand, the absence in the perches of the sieve-like straining mechanism seen in the Clupeidae and Scombridae, makes it impossible for the perches to appropriate minute planktonic organisms which easily escape out of their loose-meshed ' gill-basket ' The size and condition of food is a decisive factor directly concerned with the act of taking food. While the " too large to be swallowed " or " too hard and unsuitable for nibbling into small pieces " form the upper limitations, the " too small to be retained within the gill-sieve " or the " too flocculent as to be melting in the mouth " form the lower. Under these circumstances many of the perches naturally prefer the deeper layers of water to prey upon larger animals which abound at this level and some like *Epinephelus tauvina* almost confine themselves to the bottom. The presence of bottom-dwelling Spioniform Polychaetes and Gastropods along with

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[1] Discussing on the stomach-contents of certain cod fishes, Day (1883) records such things as " an entire partridge from one, a hare from another, a black guillemot from a third, a piece of tallow candle from two others, a white turnip, a bunch of keys, etc., from other cod fishes ".

[2] Discussing on the food of *Oreinus*, Malik (1940) writes that it feeds on slimy vegetable matter encrusting rocks and stones in rapid waters, and adds that " the fish is a bottom-feeding vegetarian, and any animal matter found in the intestine is probably accidental ".

pelagic Crustaceans like *Acetes erythraeus* in the stomachs of species of *Therapon, Lutianus*, etc., on the other hand indicates considerable vertical feeding in the case of these fishes. Being rovers into all layers of the sea they can obtain the most and the best of food and this ability to change from one layer to another is of immense help in the struggle for existence.

Diet Table 19 shows a summary of the proportions of the food-components for all the perches investigated. Of the Malacostracans, the Decapods rank foremost. Macrurans are profusely consumed, while bottom-dwelling crabs and Alpheids form the staple article of diet of the species of *Epinephelus*. Hence it is obvious that these fish feed at or near the bottom like the yellow perch described by Pearse and Achtenberg (*op. cit.*). It is surprising to find hard shelled and well armed crabs in the stomachs of these fish. No parallel to Green's record (cited by Jordan, 1907) of young cat fish erecting their spines inside the stomach of the Sacramento perch and tearing open its stomach wall was observed in the case of any of the Madras perches ; and in no case did the writer observe any injury to the stomach walls caused by spinose Crustaceans. Also no pearl-like concretions such as those described by Rao (1936) from the stomach-contents of the Hammer-headed shark, *Zygaena blochii*, and of *Caranx* (*Caranx*) *melampygus*, from the Andamans and from the remains of *Rita rita* (Rao, 1937) have been noticed in the stomach-contents of the perches. Possibly such pearls are, as Rao (1937) has suggested, peculiar to the Siluroids, and no Siluroid remains were ever met with in the case of the perches studied.

Preferring a rocky bottom, species of *Epinephelus* are not serious rivals in the matter of food to other perches which move about and pursue Macruran shoals at the higher levels. Sluggish and slow moving though these sea perches are, they are cautious and cunning enough to lay in wait or even rise up and snatch at their weaker brethren, who, though agile and swift in their own way, happen to come in the vicinity of their formidable jaws, unwary of danger. Being highly voracious they greedily gulp in prey that is often too large for their stomachs, and in one case observed (Pl. V, fig. 6) by the writer a specimen of *Therapon puta* that was swallowed had caused a great distention of the stomach of an *Epinephelus tauvina*, even though the tail of the prey was still sticking out of its oesophagus. In some cases the fishes devoured remained quite fresh. One is reminded of the words of Aflalo and Marston (1904) about the torpedo and the angler fish feeding and digesting more after the fashion of pythons, devouring a large victim at a meal and then lying quiet to digest at leisure, and of the bass and other fishes being recovered from their inside, often having sustained such trifling injury as to be quite good for sale ; as also the large fresh specimens of *Sillago sihama*, reported from the stomach of *Ichthyscopus inermis* (Job, 1937).

Damage to Fisheries.—As is clear from the tables, the predaceous propensities on the part of the perches are responsible for considerable damage to many food-fishes, especially to their spawn and young stages. The danger, however, does not seem to be so great as in the case of some of the fresh-water perches described by Günther (1880). As long as smaller perches like *Ambassis* serve to satisfy the piscivorous appetites

of the larger perches the danger to the valuable food-fishes can be minimised by the proper direction of the supply of these easily available small fish.

Several Decapods suffer a great deal at the hands of the perches of the Madras Coast. Moses (*op. cit.*) states, that " both in quantity and value the crustaceans are of greater importance than any kind of fish in Madras ". Prawns top the list, while crabs come next. He records 678,654 pounds of prawns worth Rs. 91,118-7-0; 338,584 pounds of crabs worth Rs. 40,243-15-0 and 33,004 pounds of shrimps worth Rs. 3,694-8-0 as being caught from Madras alone during the year from July 1921 to July 1922. The perches are inimical to these forms as many of the Decapods, as adults, larvae and eggs, enter into the diet of the perches. However, large quantities of Amphipods like *Grandedierella magnae* and *Paracalliope fluviatilis* are also eaten by forms like *Pelates quadrilineatus*, and the fish, while swallowing them when available in the open sea, also prey upon the large numbers of them found in the algal beds, when they enter brackish-water; and this must be the reason why fishermen make better catches of these perches from the neighbourhood of " paschee ", as they term the beds of algae and vegetable growth. Hence in percicultural projects and perch acclimatisation schemes a proper supply of these small Crustaceans may profitably be attempted so as to solve the main problem of the diet of these fish.

Worm diet.—The amount of Polychaetes consumed is fairly large. Worms are eaten in large quantities by *Pelates quadrilineatus*, *Therapon puta*, *Pomadasys maculatus* and *Pomadasys olivaceus*. The monthly variations in the amounts of Polychaetes consumed are graphically represented in text-figures 2-5. In the month of October a decided maximum is observed in the cases of both *Pelates quadrilineatus* as well as *Therapon puta*. Such seasonal variations in food-items have been observed in the case of the yellow perch by Pearse and Achtenberg (*op. cit.*).

Comparison with Fresh-Water Perches.—On comparing the food of these coastal perches with that of the inland fresh-water forms like the yellow perch of the Wisconsin lakes (Pearse and Achtenberg, *op. cit.*) it is seen that while insects, both larval and adult, Oligochaetes, Entomostracans and Molluscs form a high percentage of the food of the fresh-water perch, the coastal forms treated in the present paper show a decided preference for Malacostracans, Polychaetes and Teleosteans. Scott (1902) referring to the fresh-water perch *Perca fluviatilis* from Marlee Loch, Forfarshire, observes that they " were found to have been living almost exclusively on insect larvae " The difference in the diet is mainly due to the difference in the environment; for, often the food of fishes varies in accordance with the locality inhabited as has been shown in the case of the haddock (Day, 1883) and of *Therapon jarbua* in the present study.

The proportion of vegetable matter is greater in the case of the yellow perch, but this is because deposits of loose and broken-up plants are the favourite resorts of insect larvae along with which they are swallowed. A fair parallel is seen in the case of *Therapon jarbua*, specimens of which captured from the Fort St. George moat, Madras, contained

in their stomachs considerable quantities of plants mixed with insect larvae.

In spite of the apparent difference in the diet between the coastal forms and the inland forms, it becomes clear, when due consideration is paid to the wide range of variety in the food of these fishes and the presence of forms like *Therapon* of an intermediate habit between the true sea-perches and the fresh-water forms, that the perches would be one of the easiest for acclimatisation in lakes and for the development of inland fisheries. The loss caused by the predaceous habits of a few forms will be insignificant as compared to their yields.

Mucus Factor.—A large amount of mucus discovered in the stomachs whenever the latter contained gritty food and spiny articles of diet as tubiculous Polychaetes, Echinoderm spines and Crustaceans like crabs with sharp armature, deserves consideration. As Macginite (1937) states, little is definitely known about the chemical composition of mucin and much less of its physical properties. His observation on the formation in the case of *Chaetopterus variopedatus*, by the aliform notopodia, of mucus filter bags entangling food and being rolled into balls which are passed into the stomach is of course not applicable in the case of the perches. In the latter case one thing is certain, that one of the main purposes served by the viscid mucus is to form a slippery protective investment for the delicate gastric mucosa and to bind the food-contents into a smooth yielding mass; for, as Cowdry (1934) holds, possibly " the physical properties of mucin as outlined by Inouye (1930) are more important than the chemical ", and owing to its viscid consistency it can easily form a protective sheet. The prime causative factor in the abundant secretion of mucus in the presence of gritty food is most probably the irritation caused by those articles as they enter the stomach.[1] Cowdry states that any form of local irritation excites the flow of mucus, and this appears to be a natural means of protection against any possible injury to which the more or less thin walls of the stomachs of the perches may be subjected to.

Migration.—Food is one of the main factors with which migration of fish is associated; for, besides the changes in Oceanic currents, as Pearse (1916) observes, " the annual succession of season brings breeding, changes in gases and minerals in the water, variations in temperature, fluctuations in the food supply and shelter and other things which require variations in behaviour. Through all these changing influences, food is in general more important than any other single factor in causing fish to select particular habitats "

In the food of some of the perches studied, planktonic organisms like post-larval Decapods, *Acetes erythraeus* for instance, are quite dominant. These perches are reported to enjoy a wide distribution, many of them

[1] Rao (1936) writes that " Fourcroy and Vauquelin (1807) recorded the remarkable occurrence of a fish-hook in the stomach of a fish coated by concentric layers of a dull yellowish material, smooth and brilliant, and composed of calcium carbonate, calcium phosphate, and some gelatinous organic matter. The material and manner of deposition on the fish-hook seemed to show that the former was of the nature of a concretion secreted by the tissues of the fish around the nucleus provided by the irritant fish-hook." No such case of permanent source of irritation and consequent deposit was met with in the perches studied.

being recorded from the Red Sea to the Australian waters. However, until the times of appearance of these fishes in different places and the ecological details connected therewith are definitely known, it would be premature to discuss the question of their migration.

SUMMARY.

Six hundred and forty-one specimens of eighteen species belonging to eight genera of perches were procured from the Madras Coast, and their stomach-contents studied with a view to determine the mode of nutrition of these valuable food-fishes.

They were found to be decidedly carnivorous, the minute traces of vegetable matter occasionally met with being but accidentally taken in along with other food.

With the exception of *Ambassis gymnocephalus* the perches examined do not feed on microplankton as their gill-apparatus is not adapted for feeding on such forms. Selective feeding in the case of these fishes is apparent; for, while appropriating available elements within a considerably wide range, the main items of diet seem to be hunted by sight, and in some cases specific preferences are discernible as in the different species of the genus *Therapon*.

In the case of *Ambassis gymnocephalus*, in addition to sight-feeding, filtration also seems to play some part in the feeding of the species.

More than half of the total food eaten by the perches studied is composed of Malacostracan Crustaceans ranging from small Macrurans and Mysids with comparatively soft test, consumed by species of *Therapon*, *Pelates*, *Pomadasys* and *Gerres* to Alpheids and hard shelled Brachyuran crabs swallowed by species of *Epinephelus* and *Lutianus*. About one-seventh of the food is composed of small Teleosteans, often in the post-larval stages. Fishes of the genera *Lutianus* and *Epinephelus* as also *Therapon jarbua* show a definite liking for piscine diet. Another one-seventh of the food consists of Polychaetes such as Eunicids, Nereids, Sabellids and Spioniform tube-dwellers, which are eaten in large quantities by species of *Therapon*, *Pelates*, *Pomadasys* and *Gerres*. Species of *Lutianus* and *Epinephelus* do not seem to feed on worms to any appreciable extent.

The other constituents met with in the stomach-contents in small quantities are, Gastropods, Bivalves, Ophiuroids, Echinoids, Polyzoans, Hydromedusae, larval Cephalochordates, Ciliates, Foraminiferans, algae, diatoms and sand.

While often rising to the surface, the perches feed usually at moderate depths. Some like *Epinephelus tauvina* are definitely bottom feeders. Species of *Therapon*, *Pelates* and *Lutianus* mainly feed on Crustaceans, both pelagic and bottom forms; but also derive a certain amount of their food from the fauna among the algal beds of the estuarine waters. *Therapon jarbua* often resorts to surface feeding as is proved by the presence of insect larvae and even adult mosquitoes in its stomach-contents.

As enemies to the fisheries the perches cause considerable damage to the prawn, shrimp and crab fisheries. The piscivorous forms like *Lutianus* and *Epinephelus* destroy many Clupeids and Carangids in

their young stages, and even devour smaller perches themselves. Eggs of fishes and crabs are also eaten by species of *Therapon* and *Pelates.*

Therapon jarbua which exhibits definite insectivorous tendencies is an important edible and larvicidal fish, and its utility as a scavenger cannot be overlooked. It is also noted that cyclopscidal propensities of forms like *Ambassis* point to their probable utility in the biological control of Guinea Worm disease.

The nature of the food elements shows that the inland migration of forms like *Therapon* is to some extent at least governed by the attraction offered by the rich brackish-water fauna and by the presence of items like *Penaeus* which attract these fishes of prey into inland waters.

REFERENCES TO LITERATURE.[1]

Aflalo, F.G. and Marston, R. B., 1904.—*British Salt Water Fishes* London.

Breder, C. M. and Crawford, D. R., 1922.—The Food of certain Minnows. *Zoologica* II, 14.

Bridge, T. W., 1922.—Fishes. *Camb. Nat. Hist.* VII.

Bullen, G. E., 1912.—Some Notes on the Feeding Habits of Mackerel and certain Clupeoids in the English Channel. *Journ. Mar. Biol. Assoc.* (N. S.) IX.

Chatterjee, G. C., 1933.—Relation of Fisheries to the Malaria Problem of Bengal. *Sonar Bangla* IX, pp. 1-14.

Chatterjee, G. C., 1934.—*Biological Control of Malaria in Rural Areas of Lower Bengal,* Calcutta, pp. 1-28.

Cowdry, E. V., 1934.—*A Text Book of Histology,* Philadelphia.

Day, F., 1873.—*Report on the Sea Fish and Fisheries of India and Burma,* Calcutta.

Day, F., 1883.—The Food of Fishes. *Fish. Exhib. Liter.*, London VI, *Confer.*, Pt. 3, pp. 265-300.

Day, F., 1888.—*Fishes of India, Text Supplement,* London.

Day, F., 1889.—*Faun. Br. India,* Fishes I, London.

Devanesen, D. W., 1932.—A Note on the Food and Feeding Habits of *Sardinella gibbosa. Journ. Madras Univ.* IV

Fourcroy, A. F. and Vauquelin, L. N., 1807.—Description et analyse d'une concretion calculeuse tirée d'un poisson *Ann. Mus. Hist. Nat. Paris* X, pp. 179-181. (Cited by Rao, 1936.)

Gravely, F. H., 1937.—Mosquito-Destroying Fishes. *Curr. Sci.* V, pp. 482, 483.

Günther, A. C. L. G., 1880.—*An Introduction to the Study of Fishes,* Edinburgh.

Hardy, A. C., 1924.—The Food and Feeding Habits of the Herring, with Special Reference to the East Coast of England. *Fish. Invest.* (2) VII, 3.

Hora, S. L., 1923.—Fauna of the Chilka Lake. Fish, Part 5. *Mem. Ind. Mus.* V, pp. 737-769.

Hora, S. L., 1937.—Fish and Mosquito Control. *Curr. Sci.* V, pp. 554, 555.

[1] Only the literature directly referred to in the paper has been listed. For purposes of identifying the food elements the standard texts and papers of the fauna concerned were consulted.

Hora, S. L. and Nair, K. K., 1938.—Observations on the Nutrition of *Panchax panchax* (Hamilton). *Proc. Nat. Inst. Sci. India* IV, pp. 245-251.

Hornell, J. and Nayudu, Ramaswami M., 1923.—A Contribution to the Life-history of the Indian Sardine with Notes on the Plankton of the Malabar Coast. *Madras Fish. Bull.* XVII, pp. 129-197.

Hunter, G. W. III, and Rankin, J.S., Jr., 1939.—The Food of Pickerel. *Copeia*, pp. 194-199.

Huxley, T. H., 1881.—The Herring. *Nature* XXIII.

Inouye, J. M., 1930.—*Journ. Dent. Res.* X (Cited by Cowdry, 1934).

Job, T. J., 1937.—On the 'Fish-Gazer', *Ichthyscopus inermis* (Cuv. and Val.) Swainson from the Madras Coast. *Curr. Sci.* VI, pp. 100, 101.

Job, T. J., 1940.—On the Breeding and Development of Indian "Mosquito-fish" of the genera *Aplocheilus* McClelland and *Oryzias* Jordan and Snyder. *Rec. Ind. Mus.* XLII, pp. 51-79.

Job, T. J., 1940 *a*.—Practical Utility of *Aplocheilus panchax* (Hamilton) in the Biological Control of Mosquitoes. 1. Efficiency. (In the course of publication.)

Jones, S. and Job, T. J., 1938.—An Interesting Case of Animal Association (Synoecy ?) between a Brackish-Water Fish, *Acentrogobius neilli* (Day) and *Zoothamnium* sp. *Curr. Sci.* VI, pp. 558, 559.

Jordan, D. S., 1907.—*Fishes*, California.

Knauthe, K., 1907.—*Das Süsswasser*, Neudamm. (Cited by Pearse and Achtenberg, 1918.)

Lebour, M. V., 1919.—The Food of Young Fish. *Journ. Mar. Biol. Assoc.* (N. S.) XII, pp. 261-324.

Macginite, G. E., 1937.—The Use of Mucus by Marine Plankton Feeders. *Science* XXVIII.

Malik, G. M., 1940.—The Food of the Mountain Barbel *Oreinus* McClelland, and its probable bearing on the introduction of Brown Trout in Himalayan Streams. *Journ. Roy. Asiat. Soc. Bengal* (*Science*) V, pp. 1-6.

Moses, S. T., 1922.—A Statistical Account of the Fish Supply of Madras. *Madras Fish. Bull.*, pp. 131-166.

Nayudu, Ramaswami M., 1939.—Development of Fisheries in India. *Indian Finance, All-India Planning and Industries Supplement*, March.

O'Donoghue, C. H. and Boyd, E. M., 1934.—A Third Investigation of the Food of the Sea Trout (*Salmo trutta*). *Salmon Fisheries, Fish. Board Scotland* II.

Ogilvie, H. S., 1927.—Observations on the Food of Post-Larval Herring from the Scottish Coast. *Fisheries Scotland, Sci. Invest.* I.

Pearse, A. S., 1915.—On the Food of the Small Shore Fishes in the Waters near Madison, Wisconsin. *Bull. Wis. Nat. Hist. Soc.* XIII.

Pearse, A. S., 1916.—The Food of the Shore Fishes of Certain Wisconsin Lakes. *Bull. U. S. Bur. Fish.* XXXV, pp. 245-292.

Pearse, A. S. and Achtenberg, H., 1918.—Habits of the Yellow Perch in Wisconsin Lakes. *Bull. U. S. Bur. Fish.* XXXVI, pp. 293-366.

Rao, H. S., 1936.—Pearl-like Concretions (Calculi) Found in the Stomach of Cartilaginous and Bony Fishes from the Andaman Sea. *Proc. Nat. Inst. Sci. India* II, pp. 93-100.

Rao, H. S., 1937.—Pearl-like Concretion from a Siluroid Fish. *Curr. Sci.* V, pp. 649, 650.

Roy, D. N., 1938.—On the Control of Malaria-Mosquitoes in Bengal by the Use of Predacious Fish and on the Habits of two of them. *Journ. Malar. Inst. India* I, pp. 405-416.

Scott, T., 1902.—Observations on the Food of Fishes. *Twentieth Ann. Rept. Fish. Board Scotland* Part III, pp. 486-538.

Sen, P., 1937.—On the Food Factors of the So-called Mosquito-Destroying Fishes of Bengal.—*Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*. *Curr. Sci.* V, pp. 357-361.

Sim, G., 1883.—The Food of Fishes. *Fish. Exhib. Liter.*, London XI, Prize Essays Part IV, pp. 499-548.

Southwell, T., 1913.—Notes on the Food of certain Marine Fishes from Ceylon. *Ceylon Administr. Rept.* IV, *Education, Science and Art, Marine Biology*, pp. 49-52.

Weber, M. and Beaufort, L. F. de, 1929.—*The Fishes of the Indo-Australian Archipelago* V, Leiden.

Weber, M. and Beaufort, L. F. de, 1931.—*The Fishes of the Indo-Australian Archipelago* VI, Leiden.

Weber, M. and Beaufort, L. F. de, 1936.—*The Fishes of the Indo-Australian Archipelago* VII, Leiden.

Wilson, H. C., 1917.—A Note on Treatment of Swamps, Stream Beds, Ponds, Wells, Pools and other Mosquito-Infested Areas for the Destruction of their Larvae. *Madras Fish. Bull.* XI, pp. 161-172.

TABLES OF DETAILS OF SIZE, SEX, STOMACH-CONTENTS, ETC.

TABLE 1.—*Details of Size, Sex, Stomach-contents, etc., of Thirty-eight Specimens of* Therapon puta *Cuv. & Val. with Food.*

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	17th October 1936	10 A.M.	106	Male	Ripening	0·4	90	Eunicid Polychaete parts (*Marphysa* sp.).
							4	Algal filament (*Oscillatoria* sp.).
							6	Fragment of water weed.
2	Do.	10 A.M.	109	Female	Do.	0·2	100	Polychaete remains.
3	9th November 1936	9 A.M.	110	Do.	Fully mature	0·6	92	A Palaemonid (*Leander* sp.), a Sergestid (*Acetes erythraeus*) and a few post-larval Penaeids.
							5	A post-larval Clupeid (*Megalops cyprinoides*).
							3	Sand grains.
4	Do.	9 A.M.	105	Do.	Ripening	0·6	60	Sergestid Macrurans (*Acetes erythraeus*).
							38	Broken up parts of a Eunicid Polychaete.
							2	Cycloid scales.
5	Do.	9 A.M.	104	Do.	Fully mature	1+	85	Several Sergestid Macrurans (*Acetes erythraeus*).
							10	A post-larval Clupeid (*Megalops cyprinoides*).
							5	Part of a small Cephalopod.
6	27th November 1936	10 A.M.	131	Do.	Do.	0·1	50	Penaeid fragments.
							35	Brachyuran appendages.
							15	Cycloid scales.

TABLE 1.—*Details of Size, Sex, Stomach-contents, etc., of Thirty-eight Specimens of* Therapon puta *Cuv. & Val. with Food*—contd.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
7	27th November 1936	10 A.M.	135	Female	Fully mature	0·6	80	Sergestid Macrurans (*Acetes* sp.) and post-larval *Penaeus* sp.
							16	Young Teleost (*Elops* sp.).
							4	Cycloid scales.
8	Do.	10 A.M.	105	Do.	Do.	0·6	35	Pectoral girdle and part of fin skeleton of a Teleost.
							60	Cycloid scales.
							3	Anomuran remains.
							2	Amphipod remnants.
9	28th November 1936	10 A.M.	133	Male	Do.	0·2	98	Polychaete fragments.
							2	Part of a fish scale.
10	30th November 1936	9 A.M.	144	Female (infested by Nematodes).	Do.	0·2	75	Part of female crab with eggs at various stages of growth.
							8	Branchial chamber of a crab.
							2	A pedunculate Cirripede allied to *Lepas*, commensal attached to the branchiae of item 2.
							15	Brachyuran appendages.
11	Do.	9 A.M.	100	Female	Immature	1	95	The fin skeleton and liver of a Teleost.
							5	Fish scales.
12	8th January 1937	10 A.M.	124	Do.	Fully mature	0·6	95	Six Sergestid Macrurans (*Acetes erythraeus*).
							5	Cycloid scales.

13	9th January 1937	3 P.M.	128	Do.	Do.	0·2	80 20	Two Sergestids (*Acetes erythraeus*). A small Octopodid Cephalopod.
14	Do.	3 P.M.	130	Male	Nearly spent	0·1	100	Crustacean fragments.
15	Do.	3 P.M.	119	Female	Fully mature	0·2	100	Two specimens of *Acetes erythraeus*.
16	Do.	3 P.M.	111	Male	Ripening	0·4	80 10 9 1	Part of *Diopatra variabilis*. Crustacean fragments. Cycloid scales. Bivalve remains.
17	18th January 1937	10 A.M.	157	Female	Fully mature	0·8	60 30 5 5	Crustacean remains. Remains of *Eupagurus* sp. Cycloid scales. An *Acetes erythraeus*.
18	Do.	10 A.M.	129	Male	Ripening	1	90 2 2 2 2 1 1	Several Sergestids (*Acetes erythraeus*). Cycloid scales. A small Teneidacean. *Mesopodopsis orientalis*. Part of Campanulariid colony (*Thyroscyphus juncea*). Amphipod remains. Copepod (*Pseudodiaptomus annandalei*).
19	Do.	10 A.M.	139	Female	Do.	0·6	50 25 25	Part of a prawn (*Palaemon lamarrei*). Remains of *Eupagurus* sp. Decapod remains.
20	Do.	10 A.M.	133	Male	Do.	0·4	60 40	Polychaete remains. Crustacean remains (*Acetes* and other Macruran appendages).
21	Do.	10 A.M.	129	Do.	Fully mature	0·4	100	Partly digested Polychaete.

TABLE 1.—*Details of Size, Sex, Stomach-contents, etc., of Thirty-eight Specimens of* Therapon puta *Cuv. & Val. with Food*—concld.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
22	20th January 1937	3 P.M.	172	Female	Fully mature	0·6	80	A vertebra of a Teleost.
							10	Orbit region of fish.
							10	Fish scales.
23	Do.	3 P.M.	134	Male	Do.	0·2	100	Cycloid scales.
24	21st January 1937	3 P.M.	113	Do.	Ripening	0·8	60	*Acetes erythraeus.*
							10	Scales and other Teleost remains.
							10	A Macruran belonging to the genus *Leander.*
							15	Campanulariid hydroids.
							5	Crustacean remains.
25	2nd February 1937	3 P.M.	159	Female	Fully mature	0·6	70	Part of a Bivalve.
							20	A post-larval Teleost (*Elops* sp.).
							10	A small Brachyuran (*Neptunus pelagicus*).
26	Do.	3 P.M.	145	Male	Do.	0·4	60	A packet of cycloid scales.
							10	The gastric armature of a Decapod.
							10	A prawn (*Penaeus indicus*).
							1	Calegid Copepods.
							2	Another Copepod (*Pseudodiaptomus annandalei*).
							17	Digested matter.
27	5th February 1937	10 A.M.	138	Female	Do.	0·6	30	Macruran Decapods (*Palaemon lamarrei*).
							5	An Isopod of the genus *Cirolana.*
							4	Calegid Copepods.
							5	Decapod larvae.
							1	A Foraminiferan of the genus *Polystomella.*
							55	Crustacean fragments.

28	Do.	10 A.M.	132	Do.	Do.	1	100	Two post-larval Clupeids of the genus *Elops*.
29	2nd March 1937	10 A.M.	155	Male	Immature	0·4	100	Partly digested Hydrozoan colony.
30	Do.	10 A.M.	135	Do.	Fully mature	0·4	86	A young Clupeid (*Megalops cyprinoides*).
							4	Part of another Teleost with Mysid remains inside it.
							5	*Acetes erythraeus*.
							1	Polychaete setae.
							4	Algal filaments.
31	Do.	10 A.M.	134	Do.	Do.	0·2	40	Head of a small Clupeid.
							50	Hydrozoa.
							5	Amphipods (*Grandedierella magnae*).
							5	Decapod remains.
32	Do.	10 A.M.	128	Do.	Do.	0·2	90	Hydrozoan colony (*Laomedea spinulosa*).
							10	Partly digested *Salpa*.
33	4th March 1937	10 A.M.	144	Female	Maturing	1	90	Three specimens of *Megalops cyprinoides*.
							10	An Anomuran (*Clibenarius olivaceous*).
34	Do.	10 A.M.	142	Male	Fully mature	0·6	100	*Acetes erythraeus*.
35	Do.	10 A.M.	130	Female	Maturing	1	70	A Clupeid (*Megalops cyprinoides*)
							10	An Anomuran (*Clibenarius olivaceous*).
							12	Parts of a Bivalve.
							5	Hydrozoan colony of the genus *Lyomedia*.
							3	Gastropod remains.
36	6th March 1937	11 A.M.	150	Male	Do.	0·2	40	An *Acetes erythraeus*.
							60	A mass of Hydrozoan bits.
37	Do.	11 A.M.	140	Do.	Do.	1	100	Fifteen specimens of *Acetes erythraeus*.
38	Do.	11 A.M.	135	Do.	Do.	0·8	90	Ten *Acetes erythraeus*.
							10	Part of a Clupeid.

TABLE 2.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-one Specimens of* Therapon jarbua (*Forskål*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	15th January 1937	9 A.M.	79	Female	Immature	0·6	95 5	Hind part of a Teleost. Uropod and other appendages of a Decapod.
2	Do.	9 A.M.	65	Not clear	Do.	0·4	98 2	Decapod remains (*Penaeus indica*). Cycloid scales.
3	Do.	9 A.M.	64	Do.	Do.	0·2	80 18 2	Mysid (*Mesopodopsis orientalis*). Chironomid larvae. Cycloid scales.
4	Do.	9 A.M.	86	Female	Do.	0·1	90 5 5	Cycloid scales. Remains of *Mesopodopsis orientalis*. Fragments of Spioniform Polychaete.
5	20th January 1936	3 P.M.	144	Male	Do.	0·6	95 5	A lump of cycloid scales. Fish pulp.
6	2nd April 1937	6 P.M.	171	Female	Fully mature	0·2	20 80	Fish scales. Digested matter.
7	Do.	6 P.M.	161	Male	Do.	0·1	100	Crustacean fragments.
8	29th May 1937	4 P.M.	134	Do.	Immature	0·6	100	Closely packed cycloid scales.
9	Do.	4 P.M.	135	Female	Do.	0·8	100	Clupeid scales with some mucus.
10	21st September 1937	9 A.M.	118	Do.	Do.	0·2	20 10 60 5 5	Two Mysids (*Rhopalophthalmus egregius*). Larval insect. Cycloid scales. An Amphipod (*Grandedierella magnae*). Digested matter.

11	28th September 1937	9 A.M.	105	Do.	Do.	0·6	100	Piece of a fairly big Teleost (offal feeding).
12	Do.	9 A.M.	100	Do.	Do.	0·4	100	Teleostean eggs.
13 to 20	Do.	9 A.M.	80 to 115	Do.	Do.	Fair	40	*Zoothamnium* tufts.
							10	Polychaetes.
							10	Caprellines.
							10	Fish scales.
							10	Copepods (*Acartia southwelli*).
							10	Crustacean eggs.
							10	Remnants of Crustaceans.
21	5th October 1937	10 A.M.	68	Male	Do.	0·1	100	Copepods (*Pseudodiaptomus annandalei*).
22	Do.	10 A.M.	69	Do.	Do	0·1	100	Copepods (*Pseudodiaptomus annandalei*).
23	Do.	10 A.M.	70	Female	Do.	0·1	90	Copepods (*Pseudodiaptomus annandalei*).
							10	Unidentifiable dark matter.
24	Do.	10 A.M.	72	Male	Do.	0·3	90	Amphipods (*Grandedierella magnae*).
							10	Polychaete larvae.
25	Do.	10 A.M.	76	Female	Do.	0·5	95	Several Squillids with eggs.
							5	Digested matter.
26	Do.	10 A.M.	78	Do.	Do.	0·6	95	Polychaete remains.
							5	Digested matter.
27	Do.	10 A.M.	102	Do.	Do.	0·1	80	Amphipods (*Paracalliope fluviatilis*).
							15	Copepods (*Acartia southwelli*).
							5	Digested matter.
28	Do.	10 A.M.	95	Male	Do.	0·2	50	Cycloid scales.
							5	Copepods (*Acartia southwelli*).
							2	*Chaetomorpha*.
							43	Digested matter.

TABLE 2.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-one Specimens of* Therapon jarbua (*Forskål*) *with Food*—contd.

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
29	5th October 1937.	10 A.M.	110	Female	Immature	0·3	75	Eunicid Polychaetes (*Marphysa gravelyi*).
							20	Insect larvae.
							5	Copepods (*Pseudodiaptomus annandalei*).
30	Do.	8 A.M.	98	Male	Do.	0·2	100	An Amphipod holding a smaller female.
31	Do.	8 A.M.	99	Female	Do.	0·2	2	Insect remains.
							2	Algal matter (*Oscillatoria*).
							96	Digested matter.
32	Do.	8 A.M.	98	Do.	Do.	0·3	75	Cycloid scales.
							10	Vegetable matter (*Oscillatoria*).
							15	Insect larvae.
33 to 71	Do.	8 A.M.	28 to 95		..	..	68·5	Amphipods (*Paracalliope fluviatilis* and *Grandedierella magnae*).
							3	Syllids.
							3·5	Copepods (*Acartia southwelli*).
							2·5	Fish scales.
							1	Eggs.
							3	*Oscillatoria* sp.
							3·5	*Squilla* remains.
							6·5	Insects, mainly mosquito, larval and adult, as well as dragon fly larvae.
							4·5	Macruran Decapods, chiefly *Palaemon lamarrei*.
							4	Digested matter.

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus *(Bloch) with Food.*

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	15th August 1936	10 A.M.	140	Female	Immature	0·8	80	Numerous Amphipods (*Grandedierella magnae*).
							2	Tiny Bivalve fragment.
							3	A small Gastropod shell (*Fenella* sp.).
							5	A Trematode worm.
							10	Matter digested beyond identification.
2	Do.	10 A.M.	125	Do.	Do.	0·8	20	Amphipods (*Grandedierella magnae*).
							50	A Palaemonid Macruran (*Leander* sp.).
							10	A delicate Schizopod (*Mesopodopsis orientalis*).
							10	A Sergestid Macruran (*Leucifer* sp.).
							2	A tiny Gastropod shell (*Fenella virgata*).
							8	Digested matter.
3	18th August 1936	10 A.M.	132	Male	Do.	0·6	80	Amphipods (*Paracalliope fluviatilis*).
							20	Crustacean remains.
4	Do.	10 A.M.	124	Female	Do.	0·8	100	A prawn of the genus *Leander*.
5	4th September 1936	10 A.M.	135	Do.	Do.	1	40	Numerous Amphipods (*Paracalliope fluviatilis* and *Grandedierella magnae*).
							40	Caprelline fragments.
							6	Part of a Eunicid Polychaete (*Onuphis* sp.).
							6	Gastropod shell fragments.
							8	Decapod remains.

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus (*Bloch*) *with Food*—contd.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
6	4th September 1936	10 A.M.	130	Male	Immature	0·8	70	Numerous Amphipods (*Grandedierella magnae*).
							20	Fragment of a post-larval *Squilla*.
							10	Decapod remains.
7	17th October 1936	10 A.M.	125	Do.	Do.	1+	70	Tufts of Spioniform Polychaetes (*Owenia* sp.) with sand tubes.
							10	Amphipods (*Grandedierella magnae*).
							20	Mysids (*Rhopalophthalmus egregius*).
8	Do.	10 A.M.	130	Female	Do.	1	90	Spioniform Polychaete (*Owenia* sp.).
							10	Amphipods (*Paracalliope fluviatilis*).
9	9th November 1936	9 A.M.	111	Do.	Fully mature	0·2	20	Crustacean fragments.
							20	Eunicid Polychaete (*Marphysa* sp.).
							20	Crisiid Polyzoan (*Crisia* sp.).
							20	Ophiuroid (*Ophiothela danae*).
							8	Copepods (*Pseudodiaptomus annandalei*).
							5	Amphipods (*Paracalliope fluviatilis*).
							4	Gastropod remains.
							3	Bivalve shell.
10	Do.	9 A.M.	105	Do.	Do.	0·6	70	A Palaemonid (*Leander* sp.) and a Sergestid (*Acetes erythraeus*).
							30	Spioniform Polychaete (*Owenia* sp.).
11	Do.	9 A.M.	102	Do.	Do.	0·2	95	Spioniform Polychaete (*Owenia* sp.).
							5	Digested matter.
12	Do	9 A.M.	98	Do.	Do.	0·2	70	Spioniform Polychaete (*Owenia* sp.).
							30	Sergestid Macruran (*Acetes erythraeus*).

13	Do.	9 A.M.	106	Male	Do.	0·2	90 10	Spioniform Polychaete (*Owenia* sp.). Ostracod fragments.
14	Do.	9 A.M.	101	Female	Do.	0·6	70 27 3	Sergestid Macruran (*Acetes erythraeus*). Spioniform Polychaete (*Owenia* sp.). Ostracod fragments.
15	11th November 1936	9 A.M.	98	Do.	Do.	0·2	100	Sergestid Macruran (*Acetes erythraeus*).
16	Do.	9 A.M.	92	Male	Ripening	0·2	95 3 2	Spioniform Polychaete (*Owenia* sp.). Gastropod shell (*Gyraulus* sp.). Digested matter.
17	Do.	9 A.M.	106	Do.	Fully mature	0·4	90 5 5	Spioniform Polychaete (*Owenia* sp.). Chitinous bits of Brachyuran test. Sand grains.
18	Do.	9 A.M.	103	Female	Do.	0·1	25 75	Sergestid Macruran (*Acetes erythraeus*). Digested matter.
19	13th November 1936	10 A.M.	115	Male	Ripening	0·6	80 6 3·5 2 2 1 2·5 1·5 1·5	Spioniform Polychaete (*Owenia* sp.). Sergestid Macruran (*Acetes erythraeus*). Echinoderm spines. Macruran parts. Ostracod parts. Brachyuran appendages. Crustacean remains. Gastropod fragments. Digested matter.
20	Do.	10 A.M.	122	Do.	Do.	0·6	86 8 2 1 1 1 0·5 0·5	Sergestid Macruran (*Acetes erythraeus*). Crustacean appendages. Spioniform Polychaete (*Owenia* sp.). A Sphaeromid Isopod (*Sphaeroma vastator*). Echinoderm spines. Polyzoan fragment. Gastropod remains. Bivalve shell.

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus (*Bloch*) *with Food*—contd.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
21	17th November 1936	10 A.M.	112	Female	Ripening	0·4	90	Four large and three small specimens of Sergestid Macruran (*Acetes erythraeus*).
							10	Parts of a Palaemonid (*Leander* sp.).
22	Do.	10 A.M.	102	Male	Do.	0·4	80	Two specimens of *Acetes erythraeus*.
							10	Nereid fragments.
							10	Crustacean remains.
23	Do.	10 A.M.	88	Do.	Do.	0·4	100	Sergestid Macrurans (*Acetes erythraeus*).
24	Do.	10 A.M.	92	Do.	Do.	0·4	100	Three Sergestid Macrurans (*Acetes erythraeus*).
25	Do.	10 A.M.	93	Do.	Do.	0·4	95	A partly digested Sergestid Macruran (*Acetes erythraeus*).
							5	Chitinous pieces of Crustacean test.
26	Do.	10 A.M.	118	Do.	Do.	0·2	70	Sergestid Macruran (*Acetes erythraeus*).
							20	Eunicid Polychaete remains (*Marphysa* sp.).
							5·5	Crisiid Polyzoan (*Crisia* sp.).
							2·5	Amphipods (*Paracalliope fluviatilis*).
							2	Digested matter.
27	Do.	10 A.M.	95	Do.	Do.	0·4	100	Four small Sergestid Macrurans (*Acetes erythraeus*).

28	23rd November 1936	9 A.M.	144	Female	Fully mature	0·6	80	A Palaemonid Macruran (*Leander* sp.).
							10	Bopyrid Isopods (Probably parasitic on *Leander*).
							5	Amphipods (*Paracalliope fluviatilis*).
							4	Digested matter.
							1	Sand grains.
29	Do.	9 A.M.	119	Male	Do.	0·2	100	Digested matter.
30	Do.	9 A.M.	124	Female	Do.	0·4	90	Eight Sergestid Macrurans (*Acetes erythraeus*).
							5	Amphipods (*Paracalliope fluviatilis*).
							5	Digested matter.
31	Do.	9 A.M.	128	Do.	Do.	0·6	100	Sergestid Macrurans (*Acetes erythraeus*).
32	Do.	9 A.M.	119	Male	Do.	0·2	92	Sergestid Macruran (*Acetes erythraeus*).
							1	Amphipod fragment.
							7	Digested matter.
33	Do.	9 A.M.	120	Do.	Ripening	0·4	90	Spioniform Polychaete (*Owenia* sp.).
							10	Amphipods (*Paracalliope fluviatilis*).
34	Do.	9 A.M.	121	Do.	Fully mature	0·2	98	Sergestid Macruran (*Acetes erythraeus*).
							2	Gastropod fragment.
35	Do.	9 A.M.	114	Do.	Do.	0·2	100	A partly digested Sergestid Macruran (*Acetes erythraeus*).
36	Do.	9 A.M.	122	Do.	Do.	0·2	99	A mucus covered mass of Spioniform Polychaete tubes (*Owenia* sp.).
							1	A young Amphipod (*Paracalliope fluviatilis*).

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus (*Bloch*) *with Food*—contd.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
37	23rd November 1936	9 A.M.	123	Male	Ripening	0·4	92	Segestid Macruran (*Acetes erythraeus*).
							2·5	Copepods (*Pseudodiaptomus annandalei*).
							1	Eunicid larvae.
							0·2	Nematode worm.
							0·8	Digested matter.
							1	Algal filament (*Oscillatoria* sp.).
							2·5	Sand grains.
38	24th November 1936	9 A.M.	125	Do.	Do.	0·6	100	Two Sergestid Macrurans (*Acetes erythraeus*).
39	Do.	9 A.M.	115	Do.	Do.	0·6	27	Amphipods (*Paracalliope fluviatilis*).
							10	Eunicid Polychaete (*Diopatra variabilis*).
							2	Echinoderm parts (*Ophiothrix* sp.).
							51	Digested matter.
							10	Sand grains.
40	27th November 1936	10 A.M.	110	Do.	Fully mature	0·4	80	Mucus covered Spioniform mass (*Owenia* sp.).
							20	Crustacean fragments.
41	Do.	10 A.M.	120	Female	Ripening	0·6	70	Mucus covered mass of Spioniform Polychaete (*Owenia* sp.).
							30	Sergestid Macruran (*Acetes erythraeus*).
42	Do.	10 A.M.	120	Male	Do.	0·4	65	A small Sergestid (*Acestes erythraeus*).
							30	Eunicid Polychaete (*Diopatra variabilis*).
							5	Larval Eunicids.

43	Do.	10 A.M.	126	Female	Do.	0·2	50	A young Amphipod (*Paracalliope fluviatilis*).
							20	Crustacean fragments.
							25	Digested matter.
							5	Vegetable matter (*Trichodesmium* sp.).
44	Do.	10 A.M.	120	Male	Do.	0·4	35	A complete specimen and the hind parts of Sergestid Macrurans (*Acetes erythraeus*).
							65	Mucus covered mass of Spioniform Polychaete (*Owenia* sp.).
45	Do.	10 A.M.	113	Do.	Spent	0·4	40	Sergestid Macruran (*Acetes erythraeus*).
							60	Mucus-covered mass of Spioniform Polychaete (*Owenia* sp.).
46	Do.	10 A.M.	119	Do.	Fully mature	0·6	100	Mucus-covered mass of Spioniform Polychaete (*Owenia* sp.).
47	Do.	10 A.M.	124	Female	Ripening	0·2	90	Sergestid Macruran (*Acetes erythraeus*).
							10	Mucus-covered Spioniform Polychaete (*Owenia* sp.).
48	Do.	10 A.M.	130	Do.	Do.	0·4	60	Mucus-covered Spioniform Polychaete (*Owenia* sp.)
							12·5	Penaeid remains.
							7·5	Crustacean fragments.
							5	Eunicid Polychaete (*Diopatra variabilis*).
							1	Nematode worm.
							14	Digested matter.
49	Do.	10 A.M.	113	Do.	Do.	0·4	86	Polychaete fragments.
							10	Mucus-covered Spioniform Polychaete tubes (*Owenia*).
							4	Metanauplius stages of Copepods.

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus (*Bloch*) *with Food*—contd.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
50	28th November 1936	10 A.M.	130	Female	Ripening	0·4	90	Four Sergestid Macrurans (*Acetes erythraeus*).
							10	Mucus-covered Spioniform Polychaete tubes (*Owenia*).
51	Do.	10 A.M.	121	Male	Fully mature	0·1	100	Digested matter.
52	30th November 1936	9 A.M.	90	Female	Ripening	0·2	100	Mucus-covered Spioniform Polychaete (*Owenia* sp.).
53	8th January 1937	10 A.M.	130	Do.	Fully mature	0·4	70	Sabellid remains.
							12	Sergestid Macruran (*Acetes erythraeus*).
							8	Small Ophiuroids (*Ophiothrix* sp.).
							4	Amphipods (*Paracalliope fluviatilis*).
							6	Digested matter.
54	Do.	10 A.M.	138	Do.	Do.	0·2	96	Two whole and broken up parts of Sergestid Macrurans (*Acetes erythraeus*).
							4	An Amphipod (*Paracalliope fluviatilis*).
55	Do.	10 A.M.	123	Male	Spent	0·1	60	Amphipods (*Grandedierella magnae*).
							40	Digested matter.
56	Do.	10 A.M.	119	Do.	Fully mature	0·2	80	Three Sergestid Macrurans (*Acetes erythraeus*).
							15	Amphipods (*Grandedierella magnae*).
							5	Mucus-covered sand.

57	25th January 1937	10 A.M.	140	Do.	Do.	0·4	80	An Alpheid Macruran (*Alpheus malabaricus*).
							7	Macruran parts (*Leucifer* sp.).
							5	Amphipods (*Paracalliope fluviatilis*).
							3	Nematode worm.
							2	Ophiuroids (*Ophiothela danae*).
							1	Echinoid spines.
							1	Digested matter.
							1	Algal filament (*Oscillatoria* sp.).
58	Do.	10 A.M.	121	Do.	Spent	0·2	80	Amphipods (*Paracalliope fluviatilis*).
							20	Mucus-covered sand.
59	Do.	10 A.M.	135	Female	Fully mature	0·4	80	Sergestid Macrurans (*Acetes erythraeus*).
							5	Amphipods (*Paracalliope fluviatilis*).
							5	Ophiuroid fragments.
							5	Crustacean remains.
							5	A Nematode worm.
60	Do.	10 A.M.	124	Do.	Do.	0·4	70	Sergestid Macruran (*Acetes erythraeus*).
							20	Amphipods (*Grandedierella magnae*).
							6	Crustacean fragments.
							2	Algal filament (*Ulothrix* sp.).
							2	Digested matter.
61	Do.	10 A.M.	29	Do.	Ripening	0·4	40	Gills and other remains of Teleost.
							20	Amphipods (*Paracalliope fluviatilis*).
							5	Mucus-covered Ophiuroid arm.
							10	Ostracod fragments.
							1	A Nematode worm.
							24	Digested matter.
62	Do.	10 A.M.	140	Male	Do.	0·1	100	Tube of Chaetopterid Polychaete with fragments of body.

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus (*Bloch*) *with Food*—contd.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
63	25th January 1937	10 A.M.	142	Male	Fully mature	0·2	68	Penaeid fragments.
							10	Crustacean remains.
							10	Amphipods (*Paracalliope fluviatilis*).
							2	Digested matter.
							10	Sand particles.
64	Do.	10 A.M.	137	Female	Spent	0·2	30	Five small Sergestid Macrurans (*Acetes erythraeus*).
							10	Amphipods (*Grandedierella magnae*).
							30	Crustacean appendages.
							5	Algal filament (*Ulothrix* sp.).
							25	Digested matter.
65	Do	10 A.M.	130	Do.	Fully mature	0·4	10	Pieces of Sergestid Macruran (*Acetes erythraeus*).
							20	Numerous Amphipods (*Paracalliope fluviatilis*).
							4·5	Eunicid Polychaete (*Marphysa gravelyi*).
							30	Algal filament (*Ulothrix* sp.).
							35·5	Digested matter.
66	Do.	10 A.M.	134	Male	Do.	0·2	85	A Sergestid Macruran (*Acetes erythraeus*).
							5	A young Amphipod (*Paracalliope* sp.).
							10	Crustacean fragments.
67	Do.	10 A.M.	124	Do.	Do.	0·2	25	Part of a Sergestid Macruran (*Acetes erythraeus*).
							40	Small Amphipods (*Paracalliope fluviatilis*).
							20	Digested matter.
							15	Sand particles.

68	Do.	10 A.M.	129	Do.	Do.	0·2	90 10	Crustacean fragments. Polychaete setae.
69	28th January 1937	11 A.M.	151	Female	Ripening	0·2	100	Three Sergestid Macrurans (*Acetes erythraeus*). (A young post larval Teleost *Pellona elongata* remained entangled in the gills.)
70	Do.	11 A.M.	143	Do.	Fully mature	0·2	98 1 1	Sergestid Macrurans (*Acetes erythraeus*). Crustacean fragments. Gastropod shell.
71	Do.	11 A.M.	135	Do.	Ripening	0·2	50 20 5 25	Sergestid Macrurans (*Acetes erythraeus*). Amphipods (*Paracalliope fluviatilis*). Copepods (*Acartia southwelli*). Digested matter.
72	3rd February 1937	10 A.M.	152	Do.	Fully mature	0·1	15 10 10 45 20	Amphipods (*Paracalliope fluviatilis*). Polychaete fragments. Copepods (*Pontella danae*). Digested matter. Sand grains.
73	5th February 1937	10 A.M.	151	Do.	Do.	0·2	80 2·6 0·6 0·6 0·6 10·6 5	Crustacean fragments. Polychaete remains. Foraminiferans. Bivalve shell. Algal filament (*Ulothrix* sp.). Digested matter. Sand grains.
74	Do.	10 A.M.	142	Male	Do.	0·1	50 5 5 5 35	Amphipods (*Grandedierella magnae*). Copepods (*Pontella danae*). Bivalve shell fragment. Foraminiferans. Digested matter.

TABLE 3.—*Details of Size, Sex, Stomach-contents, etc., of Seventy-nine Specimens of* Pelates quadrilineatus (*Bloch*) *with Food*—concld.

No.	Date.	Time of catch.	Length in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
75	5th February 1937	10 A.M.	146	Female	Fully mature	0·1	30	Amphipods (*Grandedierella magnae*).
							10	Copepods (*Oithona* sp. and *Pontella danae*).
							10	Sergestid Macruran (*Acetes* sp.).
							49	Crustacean fragments.
							1	Ophiuroid remains.
76	Do.	10 A.M.	133	Do.	Do.	0·1	10	Amphipods (*Grandedierella magnae*).
							5	Copepods (*Pontella danae*).
							85	Digested matter.
77	Do.	10 A.M.	140	Male	Do.	0·2	20·75	Gammarid Amphipods (*Grandedierella magnae*).
							0·25	Ophiuroid fragment.
							25·5	Crustacean remains.
							1·5	Macruran parts (*Leucifer* sp.).
							5	Copepod (*Pontella* sp.) metanauplii.
							44	Digested matter.
							3	Sand grains.
78	Do.	10 A.M.	131	Do.	Do.	0·1	20	Gammarid Amphipod (*Grandedierella magnae*).
							5	Copepod (*Acartia* sp.).
							1	Polychaete setae.
							69	Digested matter.
							5	Vegetable matter (*Biddulphia* sp.).
79	Do.	10 A.M.	141	Female	Do.	0·2	20	Gammarid Amphipods (*Grandedierella magnae*).
							50	Crustacean fragments.
							30	Digested matter.

TABLE 4.—*Correlation between Gonadial development and Feeding Activity in* Pelates quadrilineatus (*Bloch*).

Amount of Feeding.	NUMBER OF FISH.													
	Immature.			Mature.										Total.
				Gonads developing.			Gonads fully developed.			Gonads spent.			Total.	
	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.		
Gorged (1+)	1	..	1	..	..	..	..	..	..	..	..	..	..	1
Full (1)	..	2	2		..	..	..	..	..	..	..	..	..	2
Pretty full (0·8)	1	3	4	..	..	..	..	..	..	..	..	..	..	4
About half (0·6)	1	..	1	4	1	5	1	4	5	..	..	..	10	11
Appreciable (0·4)	..	..	..	8	6	14	3	5	8	1	..	1	23	23
A little (0·2)	..	..	..	2	5	7	12	8	20	1	1	2	29	29
Very little (0·1)	..	..	..	1	..	1	3	4	7	1	..	1	9	9
Empty (0·0)	..	1	1	14	3	17	11	22	33	4	6	10	60	61
Total	3	6	9	29	15	44	30	43	73	7	7	14	131	140

TABLE 5.—*Details of Size, Sex, Stomach-contents, etc., of Twenty-nine Specimens of* Lutianus vaigiensis (*Q. & G.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	18th August 1936	4 P.M.	80	Indistinguishable.	Immature	0·8	100	*Acetes erythraeus.*
2	Do.	4 P.M.	82	Do.	Do.	0·8	100	Four specimens of *Acetes erythraeus.*
3	26th August 1936	11 A.M.	125	Do.	Do.	0·4	30	Anterior part of a Polychaete (*Pectinaria* sp.)
							30	Echinoderm remains.
							24	Part of a Sabellid worm.
							16	Algal matter.
4	Do.	11 A.M.	123	Do.	Do.	0·2	95	A young Brachyuran (*Grapsus maculatus*).
							3·8	Crustacean remains.
							1·2	Copepod remains.
5	Do.	11 A.M.	103	Do.	Do.	0·2	30	Fish scales.
							30	Mysid remnants.
							6	Hind part of an Amphipod.
							31	Part of a crab of the genus *Grapsus.*
							3	Algal filaments.
6	Do.	11 A.M.	119	Do.	Do.	1+	70	*Acetes erythraeus.*
							25	Crustacean remains.
							5	Algal matter.
7	10th September 1936	4 P.M.	85	Do.	Do.	0·8	100	*Clibanarius padavensis.*
8	Do.	4 P.M.	101		Do.	0·1	100	Crustacean remains.
9	Do.	4 P.M.	100	Do.	Do.	0·6	50	Chitinous test of Crustacean.
							50	Parts of *Opisthopterus tartoor.*

10	Do.	4 P.M.	108	Do.	Do.	0·6	100	*Opisthopterus tartoor.*
11	23rd September 1936.	4 P.M.	183	Do.	Do.	0·1	100	Partly digested Crustacean parts.
12	Do.	4 P.M.	153	Do.	Do.	0·1	100	Penaeid remains.
13	Do.	4 P.M.	153	Do.	Do.	0·6	15	Clupeid parts.
							60	A Macruran (*Leander* sp)
							5	Young crabs of the genus *Dotilla.*
							3	Four Mysids (*Mesopodopsis orientalis*).
							17	Partly digested Crustacean parts.
14	28th September 1936.	11 A.M.	117	Do.	Do.	1	40	An *Acetes erythraeus.*
							10	Crustacean parts with Squillid larva.
							2	*Mesopodopsis orientalis.*
							2	An Amphipod (*Grandedierella gilesi*).
							46	A zoea, a Portumnid crab, a Grapsoid and a Pinnotherid crab.
15	Do.	11 A.M.	105	Do.	Do.	1	75	Two young Teleosts (*Equula insidatrix*).
							20	An *Acetes erythraeus.*
							5	A Brachyuran crab.
16	Do.	11 A.M.	101	Do.	Do.	0·6	40	Eight Pinnotherid crabs.
							50	Anterior part of *Diopatra variabilis.*
							10	An *Acetes erythraeus.*
17	5th October 1936	3 P.M.	120	Do.	Do.	0·8	70	Three Ocypodid crabs.
							10	Part of *Clibanarius padavensis.*
							17·5	Amphipod appendages.
							2·5	Argulid, crushed.
18	7th October 1936	11 A.M.	110	Do.	Do.	0·8	100	A *Metapenaeus monoceros.*
19	17th October 1936	10 A.M.	119	Do.	Do.	1+	40	Four Ocypodid crabs.
							20	Appendages of *Alpheus malabaricus.*
							9	Anterior part of a Eunicid.
							0·5	Amphipod remains.
							30	Crustacean appendages.
							0·5	Algal matter.

TABLE 5.—*Details of Size, Sex, Stomach-contents, etc., of Twenty-nine Specimens of* Lutianus vaigiensis *(Q. & G.) with Food* —contd.

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
20	17th October 1936	10 A.M.	110	Indistinguishable.	Immature	1+	73 15 3 6 3	Crabs. Part of a Terebellid. *Mesopodopsis orientalis*, one specimen. Penaeid parts. Algal matter.
21	22nd October 1936	2 P.M.	92	Do.	Do.	0·1	100	Crustacean remains.
22	Do.	2 P.M.	81	Do.	Do.	0·2	80 20	Crustacean remnants. Algal filaments (*Oscillatoria* sp.)
23	24th November 1936	4 P.M.	163	Do.	Do.	0·6	95 3 2	*Acetes erythraeus*. Fish scales. Teleost remains.
24	Do.	4 P.M.	151	Do.	Do.	1	99 1	Several *Acetes erythraeus*. Algal filaments.
25	8th January 1937	10 A.M.	92	Do.	Do.	0·6	99 1	Four large and a few small *Acetes erythraeus*. A tiny knot of brown algae.
26	Do.	10 A.M.	95	Do.	Do.	0·8	100	Several *Acetes erythraeus*.
27	Do.	10 A.M.	90	Do.	Do.	0·4	98 2	*Acetes erythraeus*. Algal matter.
28	4th April 1937	6 P.M.	164	Do.	Do.	0·4	100	Parts of *Hippa* sp.
29	Do.	6 P.M.	160	Do.	Do.	0·6	100	Parts of *Hippa* sp.

TABLE 6.—*Details of Size, Sex, Stomach-contents, etc., of Two Specimens of* Lutianus sanguineus (*Cuv. & Val.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	10th August 1936	3 P.M.	200	Indistinguishable.	Immature	0·4	40 20 20 20	Crustacean remains. *Leucifer* sp. Fish scales. Teleost remains.
2	Do.	3 P.M.	185	Do.	Do.	0·2	80 10 10	Crustacean parts. Gastropod remains. Pedunculate Cirripede fragments.

TABLE 7.—*Details of Size, Sex, Stomach-contents, etc., of Three Specimens of* Lutianus lutianus (*Bloch*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	10th August 1936	3 P.M.	164	Indistinguishable.	Immature	0·8	75 20 5	Vertebral column and other parts of a Teleost, probably a Carangid. Two otoliths. *Oscillatoria* sp.
2	Do.	3 P.M.	155	Do.	Do.	0·4	100	Teleost remnants (*Ambassis* sp.)
3	Do.	3 P.M.	148	Do.	Do.	0·2	80 10 10	Fish pulp. Algal matter. Digested matter.

TABLE 8.—*Details of Size, Sex, Stomach-contents, etc., of Ten Specimens of* Lutianus lineolatus *(Rüpp.) with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	10th September 1936	2 P.M.	115	Indistinguishable.	Immature	0·2	100	Pulpy digested mass.
2	Do.	2 P.M.	133	Do.	Do.	0·2	100	Fish pulp
3	Do.	2 P.M.	115	Do.	Do.	1	50	Remains of *Equula* sp.
							50	Digested matter.
4	23rd September 1936	11 A.M.	124	Do.	Do.	0·1	100	Unidentifiable speck.
5	Do.	11 A.M.	133	Do.	Do.	0·1	100	Digested matter.
6	9th October 1936	10 A.M.	133	Do.	Do.	1	90	Teleostean remains.
							10	Digested matter.
7	Do.	10 A.M.	141	Do.	Do.	0·4	90	Parts of *Equula insidatrix.*
							10	Pulp.
8	Do.	10 A.M.	124	Do.	Do.	0·2	60	Clupeid remains.
							40	Digested matter.
9	Do.	10 A.M.	146	Do.	Do.	0·1	100	Teleost parts.
10	Do.	10 A.M.	108	Do.	Do.	0·2	60	Teleost remnants.
							40	Digested matter.

TABLE 9.—*Details of Size, Sex, Stomach-contents, etc., of Two Specimens of* Lutianus johnii *(Bl.) with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	25th November 1936	2 P.M.	297	Indistinguishable.	Immature	0·6	50	Crushed Teleostean head.
							20	Chitinous test.
							30	Digested matter.
2	Do.	2 P.M.	285	Do.	Do.	0·2	100	Grapsoid remains.

TABLE 10.—*Details of Size, Sex, Stomach-contents, etc., of Eight Specimens of* Epinephelus tauvina *(Forsk.) with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	10th September 1936	2 P.M.	165	Indistinguishable.	Immature	1	100	Four Brachyurans, a *Neptunus pelgicus* and a Portumnid crab.
2	28th September 1936	10 A.M.	192	Do.	Do.	0·1	80 20	A Macruran (*Metapenaeus monoceros*). Remains of *Neptunus* sp.
3	23rd October 1936	2 P.M.	90	Do.	Do.	0·6	70 30	Remains of Pleuronectid fish. Brachyuran appendages.
4	3rd November 1936	3 P.M.	210	Do.	Do.	1	99 1	Teleost remains. Macruran appendages.
5	24th November 1936	4 P.M.	220	Do.	Do.	1+	95 5	A large Xanthid crab. Penaeid remains.
6	Do.	4 P.M.	152	Do.	Do.	0·4	40 9 6 10 35	Two Portumnid crabs. A megalopa crab. Abdomen of an *Acetes* sp. Penaeid remains. Crustacean remnants (Macruran).
7	20th January 1937	3 P.M.	140	Do.	Do.	0·2	60 25 15	Broken up *Penaeus Indicus*. Fish scales. Teleost remains.
8	20th February 1937	3 P.M.	140	Do.	Do.	0·6	70 25 5	*Leander* sp. Young Teleost of the genus *Equula*. Fish pulp.

TABLE 11.—*Details of Size, Sex, Stomach-contents, etc., of Three Specimens of* Epinephelus undulosus (*Q. & G.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Amount of feed.	Per cent.	Stomach-contents.
1	22nd October 1936	2 P.M.	135	0·1	15 85	Polychaete setae. Crustacean remnants (crabs, 24 per cent. and other Decapods, 61 per cent.).
2	Do	2 P.M.	140	0·4	75 21 4	Part of fish belonging to the genus *Sciaena*. Brachyuran remains (*Pinnotheres* genus). Part of young *Alpheus malabaricus*.
3	23rd October 1936	2 P.M.	75	1+	100	*Alpheus malabaricus*.

TABLE 12.—*Details of Size, Sex, Stomach-contents, etc., of Two Specimens of* Epinephelus maculatus (*Bl.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Amount of feed.	Per cent.	Stomach-contents.
1	22nd October 1936	2 P.M.	126	0·4	100	A Macruran of the genus *Leander*.
2	Do.	2 P.M.	170	0·2	50 50	Macruran remains of genus *Leander*. Digested matter.

TABLE 13.—*Details of Size, Sex, Stomach-contents, etc., of Three Specimens of* Epinephelus boenack (*Bl.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Amount of feed.	Per cent.	Stomach-contents.
1	9th March 1937	5 P.M.	217	0·2	40 40 20	Small Brachyuran crabs. A young *Alpheus malabaricus.* Digested matter.
2	Do.	5 P.M.	214	0·2	94 6	Portion of a Penaeid. Sand particles.
3	Do.	5 P.M.	230	0·4	75 21 4	Brachyurans of genus *Neptunus.* Carangid remains. Digested matter.

TABLE 14.—*Details of Size, Sex, Stomach-contents, etc., of a Single Specimen of* Epinephelus lanceolatus (*Bl.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Amount of feed.	Per cent.	Stomach-contents.
1	18th September 1936	10 A.M.	370	0·4	80 20	A berried female of the genus *Leander.* Digested matter.

TABLE 15.—*Details of Size, Sex, Stomach-contents, etc., of Seventeen Specimens of* Pomadasys maculatus *(Bl.) with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	24th November 1936	9 A.M.	115	Male	Immature	1	82	Several specimens of *Acetes erythraeus.*
							3	Polychaete remains.
							3	Ophiuroids.
							3	An Amphipod (*Grandedierella gilesi*).
							2	*Ligia exotica.*
							4	A young Teleostean of genus *Opisthopterus.*
							3	Fish scales.
2	Do.	9 A.M.	124	Female	Do.	0·2	60	An *Acetes erythraeus.*
							20	Appendages of tiny Brachyuran.
							20	Polychaete remains.
3	Do.	9 A.M.	115	Male	Do.	0·4	80	Fish scales.
							10	Polychaete remains.
							2	*Grandedierella gilesi.*
							5	Crustacean remains.
							1	Gastropod shell fragment.
							2	Sand.
4	27th November 1936	10 A.M.	113	Do.	Do.	0·4	80	Fish scales.
							5	Crustacean appendages.
							3	Hydrozoans.
							2	*Grandedierella gilesi.*
							10	Digested matter.
5	Do.	10 A.M.	106	Do.	Do.	0·6	75	Five specimens of *Acetes erythraeus.*
							15	*Penaeus indicus.*
							5	Fish scales.
							5	Partly digested fish fragments.

6	28th November 1936	10 A.M.	122	Female	Do.	0·2	92 8	Partly digested Crustacean remains. Tubes of *Owenia* sp.
7	30th November 1936	9 A.M.	110	Do.	Do.	0·1	100	*Owenia* sp.
8	20th January 1937	3 P.M.	146	Male	Ripening	0·4	100	Parts of Teleostean of genus *Equula.*
9	Do.	3 P.M.	121	Female	Do.	0·2	100	Partly digested fish remains.
10	21st January 1937	3 P.M.	112	Do.	Immature	1	60 10 10 20	Malacostracan remains, probably of some Penaeid. Brachyuran appendages. An *Acetes erythraeus.* An Anomuran of genus *Albunia.*
11	25th January 1937	10 A.M.	117	Do.	Do.	0·2	98 2	Three fish scales. Digested matter.
12	17th February 1937	11 A.M.	120	Male	Do.	0·2	70 30	Partly digested Crustacean appendages. Digested matter.
13	Do.	11 A.M.	118	Female	Do.	0·1	10 5 45 40	A fish scale. *Grandedierella magnae.* Partly digested Crustacean. Digested matter.
14	Do.	11 A.M.	125	Male	Mature	0·2	60 15 15 10	Pectinibranchiate larva. Polychaete remains. Larvacae. *Grandedierella magnae.*
15	Do.	11 A.M.	122	Female	Immature	0·2	95 5	Polychaete remains. Eggs, probably of the above.
16	4th April 1937	6 P.M.	140	Male	Mature	0·4	100	Digested pulpy matter.
17	19th April 1937	2 P.M.	121	Do	Immature	0·2	95 5	Polychaete remains. Fragments of *Stomatopod* larva.

TABLE 16.—*Details of Size, Sex, Stomach-contents, etc., of Four Specimens of* Pomadasys olivaceus (*Day*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	7th October 1936	2 P.M.	125	Male	Immature	0·4	24	*Penaeus indicus.*
							12	*Paracalliope fluviatilis.*
							12	Brachyuran young of genus *Scylla.*
							12	Crustacean remnants.
							40	Digested matter.
2	Do.	2 P.M.	128	Female	Do.	0·4	90	Polychaete remains.
							10	Digested pulpy matter.
3	14th October 1936	11 A.M.	130	Do.	Do.	0·6	100	Polychaete remains.
4	18th October 1936	10 A.M.	122	Male	Do.	0·4	20	Crustacean appendages.
							10	Polychaete parts.
							70	Digested pulpy matter.

TABLE 17.—*Details of Size, Sex, Stomach-contents, etc., of Five Specimens of* Apogon nigripinnis *Cuv. & Val. with Food.*

No.	Date.	Time of catch.	Length of fish in mm	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	15th August 1936	10 A.M.	82	Female	Mature	0·4	25	A Macruran of genus *Leander.*
							75	Other Macruran appendages.
2	Do.	10 A.M.	90	Do.	Do.	0·4	80	Remains of young Penaeids.
							20	Part of Teleostean of genus *Sciaena.*
3	21st September 1936	2 P.M.	85	Male	Do.	0·4	50	Macruran of genus *Leander.*
							50	*Penaeus carinatus.*
4	Do.	2 P.M.	88	Female	Do.	0·2	45	Penaeid appendages.
							5	Teleostean remains.
							50	Digested matter.
5	Do.	2 P.M.	78	Do.	Do.	0·2	75	Macruran of genus *Leander.*
							25	Digested pulpy matter.

TABLE 18.—*Details of Size, Sex, Stomach-contents, etc., of Four Specimens of* Ambassis gymnocephalus (*Lacép.*) *with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach-contents.
1	8th November 1937	11 A.M.	60	Female	Mature	0·2	30	Two specimens of *Rhopalophthalmus egregius.*
							70	Digested pulpy matter.
2	Do.	11 A.M.	68	Male	Do.	0·4	50	Seven specimens of *Rhopalophthalmus egregius.*
							28	Digested matter.
							12	Algal matter.
							10	Sand.
3	11th February 1937	2 P.M.	57	Female	Immature	0·6	50	*Cyclops.*
							50	*Acartia southwelli.*
4	Do.	2 P.M.	65	Do.	Do.	0·2	10	*Pseudodiaptomus annandalei.*
							90	Digested pulpy matter.

TABLE 19.—*Details of Size, Sex, Stomach-contents, etc., of Five Specimens of* Gerres punctatus *Cuv. & Val. with Food.*

No.	Date.	Time of catch.	Length of fish in mm.	Sex.	Condition of gonads.	Amount of feed.	Per cent.	Stomach contents.
1	28th November 1936	9 A.M.	147	Male	Mature	0·4	40	Eunicid Polychaetes.
							55	Part of a worm of genus *Chaetopterus.*
							5	A larval Cephalochordate.
2	29th November 1936	9 A.M.	145	Female	Do.	0·4	100	Chaetopterid remains.
3	Do.	9 A.M.	148	Male	Do.	0·2	95	Crustacean fragments.
							5	A few *Temora turbinata.*
4	Do.	9 A.M.	142	Do.	Do.	0·6	100	Crustacean appendages.
5	30th November 1936	10 A.M.	129	Do.	Do.	0·4	90	Polychaete remains.
							10	Bivalve fragments.

DIET TABLES.

DIET TABLE 1.—*Volumetric Percentages of the Food-components in* Therapon puta *Cuv. & Val.*

Month.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	TOTAL.
No. Specimens Examined.	4	17	3	26	8	20	4	82
No. with food-contents	2	9	..	13	4	10	..	38
CRUSTACEA	..	56·32	..	60·85	33	36·5	..	Monthly Average 37·34
ENTOMOSTRACA	..	0·22	..	0·08	1·75	..	..	0·41
Copepods	..	..	..	0·08	1·75	..	..	0·37
Cirripedes	..	0·22	..	..	..	..	..	0·04
MALACOSTRACA	..	56·1	..	44·23	17·5	36·5	..	30·87
Mysids	..	..	..	0·15	..	..	..	0·03
Isopods	..	..	..	..	1·25	..	..	0·25
Amphipods	..	0·22	..	0·08	..	0·5	..	0·16
Decapods	..	55·88	..	44	16·25	36	..	30·43
Macrurans	..	40·78	..	37·85	10	33·5	..	24·42
Anomurans	..	0·33	..	..	..	2	..	0·47
Pagurids	..	..	..	4·23	..	..	..	0·85
Brachyurans	..	6·44	..	..	2·5	..	..	1·79
Crab eggs	..	8·33	..	..	..	..	..	1·67
Decapod parts	..	..	..	1·92	3·75	0·5	..	1·23
Crustacean parts	..	..	..	16·54	13·75	..	..	6·06
POLYCHAETA	95	15·11	..	18·46	..	0·1	..	25·73
Eunicids	..	4·22	..	..	..	..	..	0·84
Polychaete parts	95	10·89	..	18·46	..	0·1	..	24·89
TELEOSTEI	..	27·68	..	17·77	45	30	..	24·09
Scales	..	9·79	..	9·31	15	..	..	6·82
Clupeids	..	..	..	..	..	29·0	..	5·8
Teleost parts	..	17·89	..	8·46	30	1	..	11·47
MOLLUSCA	..	0·56	..	1·62	17·5	1·5	..	4·24
Bivalves	..	..	..	0·08	17·5	1·5	..	3·82
Cephalopods	..	0·56	..	1·54	..	..	..	0·42
Hydrozoan colonies	..	..	..	..	..	30·5	..	6·1
Campanularia zooids	..	..	..	1·3	..	..	..	0·26
Salpa	..	..	..	..	..	1	..	0·2

DIET TABLE 1.—*Volumetric Percentages of the Food-components in* Therapon puta *Cuv. & Val.*—contd.

Month.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	TOTAL.
FORAMINIFERA	..	..	..	..	0·25	..	..	0·05
DIGESTED MATTER.	..	..	..	..	4·25	..	..	0·85
PLANT	5	..	..	..	..	0·4	..	1·08
Algae	2	..	..	..	..	0·4	..	0·48
Sea weed	3	..	..	..	..	..	..	0·6
SAND	..	0·33	..	..	..	..	..	0·06

DIET TABLE 2.—*Volumetric Percentages of the Food-components in* Therapon jarbua (*Forsk.*).

Month.	Jan.	Apl.	May.	Sept.	Oct.	TOTAL.
No. Specimens Examined	9	3	5	41	101	159
No. with food-contents	5	2	2	11	51	71
CRUSTACEA	37·4	50	..	31·36	74·29	Monthly Average 38·61
ENTOMOSTRACA	..	..	..	7·27	8·82	3·218
Copepods	..	..	..	7·27	8·82	3·218
MALACOSTRACA	37·4	50	..	24·09	65·47	35·392
Macruran Decapods	19·6	..	..	..	3·33	4·586
Mysids	17	..	..	1·82	..	3·764
Squilla	..	..	..	..	4·52	0·904
Amphipods	..	..	..	0·46	57·62	11·616
Caprella	..	..	..	7·27	..	1·454
Eggs of Crustacea	..	..	..	7·27	..	1·454
Crustacean remains (Malacostraca).	0·8	50	..	7·27	..	11·614
TELEOSTEI	58	10	100	30·91	4·76	40·734
Scales	37·8	10	100	12·73	4·76	33·058
Fish	20·2	..	..	9·09	..	5·858
Eggs of fish	..	..	..	9·09	..	1·818
ZOOTHAMNIUM.	..	..	..	29·09	..	5·818
POLYCHAETA	1	..	..	7·27	5·59	2·772
INSECTA	3·6	..	..	0·91	5·83	2·068
EGG MASSES	..	..	..	..	0·72	0·144
DIGESTED MATTER	..	40	..	0·46	6·22	9·336
PLANT	..	..	..	..	2·59	0·518

DIET TABLE 3.—*Volumetric percentages of the Food-components in* Pelates quadrilineatus (*Bl.*).

Month.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	TOTAL.
No. Specimens Examined.	10	7	11	64	7	28	13	140
No. with food-contents	4	2	2	44	..	19	8	79
CRUSTACEANS	92·5	94	20	54·42	..	72·39	52·73	Monthly Average 64·34
ENTOMOSTRACA	..	..	..	0·67	..	0·79	5	1·08
Ostracods	..	..	..	0·34	..	0·53	..	0·15
Copepods	..	..	..	0·33	..	0·26	5	0·93
MALACOSTRACA	87·5	94	20	51·64	..	63·6	22·13	56·47
Mysids	2·5	..	10	..	..	..	..	2·08
Isopods	..	..	..	0·25	..	..	..	0·04
Amphipods	45	55	10	2·42	..	16·7	20·7	24·97
Caprellines	..	20	..	..	..	..	..	3·33
Decapods	40	9	..	48·97	..	46·9	1·43	24·38
Macrurans	40	..	..	48·83	..	46·9	1·43	22·86
Prawns	25	..	..	..	..	..	..	4·17
Acetes	12·5	..	..	48·5	..	38·69	1·43	16·85
Leucifer	2·5	..	..	..	..	..	..	0·42
Alpheus	..	..	..	..	..	4·21	..	0·7
Macruran parts	..	..	..	0·33	..	4	..	0·72
Brachyurans	..	..	..	0·14	..	..	..	0·02
Decapod parts	..	9	..	..	..	..	..	1·5
Stomatopoda	..	10	..	..	..	..	..	1·67
Crustacean parts	5	..	..	2·11	..	8	25·6	6·79

DIET TABLE 3.—*Volumetric percentages of the Food-components in* Pelates quadrilineatus (*Bl.*)—contd.

Month.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	TOTAL.
POLYCHAETA	..	3	80	34·55	..	9·7	1·7	21·49
Owenia	..	..	80	30·3	..	..	..	18·38
Sabellids	..	..	..	..	..	3·7	..	0·61
Polychaete larvae	..	..	..	0·25	..	..	..	0·04
Polychaete parts	..	3	..	4	..	6	1·7	2·45
MOLLUSCA	1·75	3	..	0·33	..	0·05	0·7	0·97
Bivalves	0·5	..	..	0·08	..	..	0·7	0·21
Gastropods	1·25	3	..	0·25	..	0·05	..	0·76
TELEOSTEI	..	..	..	..	..	2·1	..	0·35
ECHINODERMATA	..	..	..	0·6	..	1·1	0·14	0·31
Ophiuroids	..	..	..	..	..	1·05	0·14	0·2
Echinoids	..	..	..	..	..	0·05	..	0·01
Echinoderm parts	..	..	..	0·6	..	..	..	0·1
POLYZOA	..	..	..	0·6	..	..	..	0·1
FORAMINIFERA	..	..	..	..	..	..	0·7	0·12
DIGESTED ANIMAL MATTER.	4·5	..	..	8·91	..	9·51	39·83	10·46
NEMATODA	..	..	..	0·03	..	0·47	..	0·08
TREMATODA	1·25	..	..	..	..	..	..	0·21
PLANT	..	..	..	0·14	..	2	0·7	0·47
Algae	..	..	..	0·14	..	2	..	0·35
Sea Weed	..	..	..	..	..	..	0·7	0·12
SAND	..	..	..	0·42	..	2·68	3·5	1·1

DIET TABLE 4.—*Volumetric percentages of the Food-components in* Lutianus vaigiensis (*Q. & G.*).

Month.	Aug.	Sept.	Oct.	Nov.	Jan.	Apl.	TOTAL.
No. Specimens Examined	16	33	20	6	6	7	88
No. with food contents	6	10	6	2	3	2	29
CRUSTACEA	77	71	92·1	97	99	100	Monthly Average 89·42
ENTOMOSTRACA	0·2	..	0·4	..	..	..	0·1
Copepods	0·2	..	0·4	..	..	..	0·1
MALACOSTRACA	72	44·3	56·7	97	99	100	78·17
Mysids	5	0·5	0·5	..	..	..	1
Amphipods	1	0·2	3	..	..	..	0·7
Decapods	66	42·6	53·2	97	99	100	76·3
Macrurans	45	23	21	97	99	..	47·5
Alpheus	..	..	6	..	..	..	1
Acetes	45	7	..	97	99	..	41·33
Macrurans parts	..	16	..	..	..	..	2·67
Penaeus	..	..	15	..	..	..	2·5
Anomurans	..	10	1·7	..	..	100	18·62
Hermit crabs	..	10	1·7	..	..	..	1·95
Hippa	..	..	..	..	..	100	16·67
Brachyuran Crabs	21	9·6	30·5	..	..	..	10·18
Crustacean remnants	4·8	27·7	35	..	..	..	11·25
POLYCHAETA	9	5	4	..	..	..	3
Sabellids	4	..	..	..	..	..	0·67
Pectinaria	5	..	..	..	..	..	0·83
Eunicids	..	5	1·5	..	..	..	1·08
Terebellids	..	..	2·5	..	..	..	0·42
TELEOSTEI	5	24	..	2·5	..	..	5·25
ECHINODERMATA	5	..	..	..	..	..	0·84
PLANT	4	..	3·9	0·5	1	..	1·57
Algae	4	..	3·9	..	1	..	1·49
Sea weed	..	..	..	0·5	..	..	0·08

DIET TABLE 5.—*Volumetric percentages of the Food-components in* Lutianus sanguineus (*Cuv. and Val.*).

	August.
No. examined	7
No. with food	2
	Per cent.
CRUSTACEA	75
Leucifer	10
Pedunculate Cirripede	5
Crustacean remains	60
TELEOSTEI	20
MOLLUSCS	5
	100

DIET TABLE 6.—*Volumetric percentages of the Food-components in* Lutianus lutianus *Bl.*

	August.
No. examined	6
No. with food	3
	Per cent.
TELEOSTEI .	85
DIGESTED MATTER	10
VEGETABLE MATTER	5
	100

DIET TABLE 7.—*Volumetric percentages of the Food-components in* Lutianus lineolatus (*Rüpp.*).

	Sept.	Oct.	Total.
No. examined	10	10	20
No. with food	5	5	10
			Per cent.
TELEOSTEI .			55
DIGESTED MATTER			45
			100

DIET TABLE 8.—*Volumetric percentages of the Food-components in* Lutianus johnii (*Bl.*).

	Nov.
No. examined	5
No. with food	2
	Per cent.
CRUSTACEA	50
Brachyurans	50
TELEOSTEI .	25
MISCELLANEOUS	10
DIGESTED MATTER	15
	100

DIET TABLE 9.—*Volumetric percentages of the Food-components in* Epinenphelus tauvina (*Forsk.*).

Month.	Sept.	Oct.	Nov.	Jan.	Feb.	TOTAL.
No. Specimens Examined	5	5	5	3	3	21
No. with food-contents	2	1	3	1	1	8
CRUSTACEA	100	30	67	60	70	Monthly Average 65·4
ENTOMOSTRACA	..	..	..	..	..	..
MALACOSTRACA	100	30	67	60	70	65·4
Macrurans	40	..	19	60	70	37·8
Acetes	..	..	2	..	70	14·4
Other Macrurans	40	..	5	60	..	21
Macruran remnants	..	..	12	..	..	2·4
Brachyura	60	30	48	..	..	27·6
Neptunus	60	30	45	..	..	27
Dromeacean crabs	..	..	3	..	..	0·6
TELEOSTEI	..	70	33	40	30	34·6

DIET TABLE 10.—*Volumetric percentages of the Food-components in* Epinephelus undulosus (*Q. & G.*).

	Oct.
No. examined	9
No. with food	3
	Per cent.
CRUSTACEA	70
Brachyurans	15
Alphaeids	1·33
Other Macrurans	33·34
Other Decapods	20·33
TELEOSTEI	25
POLYCHAETES	5
	100

DIET TABLE 11.—*Volumetric percentages of the Food-components in* Epinephelus maculatus (*Bl.*).

	Oct.
No. examined	5
No. with food	2
	Per cent.
CRUSTACEA	75
Macrurans . .	75
DIGESTED MATTER	25
	100

DIET TABLE 12.—*Volumetric percentages of the Food-components in* Epinephelus boenack (*Bl.*).

	Sept.	Mar.	Total.
No. examined	2	3	5
No. with food	..	3	3
			Per cent.
CRUSTACEA			83
Brachyurans			38·33
Alphaeids			44·67
TELEOSTEI .			7
DIGESTED MATTER			8
SAND			2
			100

DIET TABLE 13.—*Volumetric percentages of the Food-components in* Epinephelus lanceolatus (*Bl.*).

	Sept.
No. examined	2
No. with food	1
	Per cent.
CRUSTACEA	80
Macrurans . .	80
DIGESTED MATTER	20
	100

DIET TABLE 14.—*Volumetric percentages of the Food-components in* Pomadasys maculatus (*Bl.*).

Month.	Nov.	Dec.	Jan.	Feb.	Apl.	TOTAL.
No. Specimens Examined	14	4	8	10	14	50
No. with food-contents	7	..	4	4	2	17
CRUSTACEA	51·86	..	25	32·5	2·5	Monthly Average 27·955
ENTOMOSTRACA	..	..	..	..	..	..
MALACOSTRACA	51·86	..	25	32·5	2·5	27·95
Isopods	0·29	..	..	..	..	0·07
Amphipods	1	..	..	3·75	..	1·19
Penaeus	2·14	..	..	..	..	0·53
Acetes	31	..	2·5	..	..	8·37
Anomurans	..	..	5	..	..	1·25
Brachyuran crabs	2·86	..	2·5	..	..	1·34
Stomatopods	..	..	..	..	2·5	0·625
Malacostracan remains	14·57	..	15	28·75	..	14·58

DIET TABLE 14.—*Volumetric percentages of the Food-components in* Pomadasys maculatus (*Bl.*)—contd.

Month.	Nov.	Dec.	Jan.	Feb.	Apl.	TOTAL.
POLYCHAETA	20·14	..	..	28·75	47·5	24·097
TELEOSTEI	25·28	..	49·5	2·5	..	19·32
MOLLUSCANS	0·14	..	..	15	..	3·79
OPHIUROIDS	0·43	..	..	..	..	0·11
HYDROZOA	0·43	..	..	..	..	0·11
LARVACEAE	..	..	..	3·75	..	0·94
DIGESTED MATTER	1·43	..	25·5	17·5	50	23·61
SAND	0·29	..	..	..	..	0·07

DIET TABLE 15.—*Volumetric percentages of the Food-components in* Pomadasys olivaceus (*Day*).

	Oct.
No. examined	6
No. with food	4
	Per cent.
CRUSTACEA	20
Amphipods	3
Macrurans	6
Brachyurans	3
Crustacean remains	8
POLYCHAETES .	50
DIGESTED MATTER	30
	100

DIET TABLE 16.—*Volumetric percentages of the Food-components in* Apogon nigripinnis *Cuv. & Val.*

	Aug.	Sept.	Total.
No. examined	5	4	9
No. with food	2	3	5
			Per cent.
CRUSTACEA			80
Macrurans			80
TELEOSTEI			5
DIGESTED MATTER .			15
			100

DIET TABLE 17.—*Volumetric percentages of the Food-components in* Ambassis gymnocephalus (*Lacép.*).

	Nov. 1937.	Feb. 1938.	Total.
No. examined	8	4	12
No. with food	2	2	4
			Per cent.
CRUSTACEA			47·5
Mysids			20
Copepods			15
Crustacean remains			12·5
DIGESTED MATTER			47
SAND			2·5
ALGAE			3
			100

DIET TABLE 18.—*Volumetric percentages of the Food-components in* Gerres punctatus *Cuv. & Val.*

	Nov. 1937.	Feb. 1938.	Total.
No. examined	10	4	14
No. with food	5		5
			Per cent.
CRUSTACEA			40
Copepods			1
Crustacean remains			39
POLYCHAETES			57
Eunicids			8
Chaetopterids			31
Polychaete remains.			18
MOLLUSCS			2
CEPHALOCHORDATE LARVA			1
			100

DIET TABLE 19.—*Volumetric percentages of the Food-components for the Perches of the Madras Coast as represented by the eighteen species studied.*

(The proportions are the results of dividing the totals of the percentages of the different food items of individual fishes by the total number of perches with food in stomach.)

No. examined	641
No. with food	286
	Per cent.
CRUSTACEA	57·07
Copepods	2·33
Schizopods	0·89
Amphipods	13·69
Decapods	31·01
Macrurans	24·35
Anomurans	1·23
Brachyurans	4·02
Decapod remains	1·41
Miscellaneous Crustacean remains	9·15
INSECTA .	1·11
POLYCHAETA	13·29
TELEOSTEI	14·04
MOLLUSCS	0·79
MICELLANEOUS ANIMAL MATTER	3·34
PLANTS	0·96
SAND	0·41
MATTER DIGESTED BEYOND IDENTIFICATION	8·99
	100