THE PERCH-FISHERY BY SPECIAL TRAPS IN THE AREA AROUND MANDAPAM IN THE GULF OF MANNAR AND PALK BAY

By M. S. Prabhu

Central Marine Fisheries Research Station, Mandapam Camp

I. Introduction

One of the indigenous methods of fishing prevalent in the Gulf of Mannar and Palk Bay is by the employment of traps, known locally by the name 'Koodu'. These traps are primarily intended for catching percoid fishes which abound in localities with hard bottom formed of rocks and corals characteristic of the inshore waters of the Gulf of Mannar and Palk Bay. As these areas are shallow, with rocks and corals scattered about, neither shore seines nor gill nets could be operated successfully in most of them, which probably explains the development of perch trapping in this part of the country as an organised fishery. A detailed investigation of the method of fishing and the fishes caught therefrom was undertaken with a view to determining the composition of the catches, the factors affecting the yield per trap and the total yield, the differences in yield from Gulf of Mannar and Palk Bay, the sexual maturity, relative weight and food of various species of fishes caught in these traps.

II. The Fishery

(*a*) *The traps.*—The perch-traps have been described by Hornell (1950) who refers to the skill with which Rameswaram fishermen construct them; these traps have also been noted in Ceylon (Pearson, 1922). Trap fishing is very common along the coasts of Ramnad District in South India, especially at Kilakarai and the adjacent localities. The traps are either made out of split branches of *Acacia planifrons* W. & A. which is commonly grown extensively in the Ramnad District, or out of thin bamboo reepers and mid-ribs of palmyrah leaves. Traps made out of the split stems of *Acacia*, however, are more durable. The material for making the traps is soaked in water prior to weaving them into traps. The Rameswaram fishermen have evolved an elaborate method of weaving a stellate form of this trap with a spacious side chamber in each of the arms with 3 to 5 entrances provided to the undivided interior. The traps are made out of 2 sheets of basket work which are woven so ingeniously that one of the pieces forms the bottom and the other, with flaps and extensions constitutes, when bent and shaped in a particular way, not only the top but also the sides of the finished trap. The lower edges of the sheet of basket work forming the top and the sides are laced to the edges of the bottom and the trap is completed by inserting the entrance funnels and tying them in position. The shape of the 2 sheets varies with the number of entrances (Plate II). The meshes are hexagonal in shape, with each side of the mesh having a length of 1–1½ inches. There are different types of traps in which the number of entrances varies from 1–5. The length, breadth and height of the traps vary from 2–5, 2–4 and ½–1½ feet respectively.

(*b*) *Fishing.*—Two ways of operating the traps, depending on the condition of the bottom at the fishing place, are prevalent in the Gulf of Mannar and Palk Bay.

Sandy bottom.—About 50 traps, usually those with single openings, are tied to a long rope at an interval of 10–12 yards with bait and stones inside, the latter to help the traps sink to the bottom and remain stationary. At either end of the rope, a float is also attached to help detection of the traps on the following day. The traps are taken to the fishing place in a canoe or a catamaran by 2 fishermen and dropped to the bottom to depths varying from 3 to 8 feet in a line parallel to the shore. The distance of the fishing place from the shore varies from 20 to 300 yards. The bait used is often dried or decaying holothurians (*Holothuria atra*) and pieces of crab (*Neptunus pelagicus*). The traps are removed after 24 hours, one by one, by pulling the rope which fastens all the traps in a line and the contents

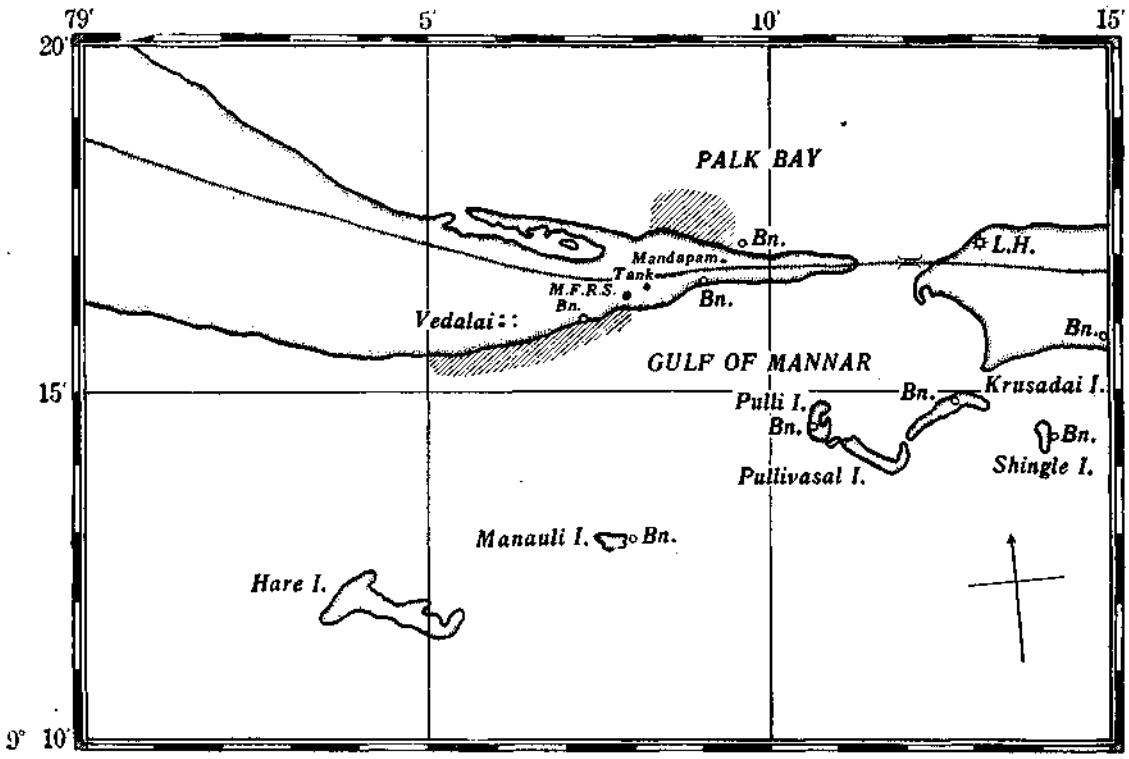


FIG. 1. Shaded areas around Mandapam in the Gulf of Mannar and Palk Bay indicate the localities where the experimental trapes were operated. (Bn. : Beacon; L.H. : Light House ; M.F.R.S. : Central Marine Fisheries Research Station campus)

removed into the canoe by unlacing one of the corners of the trap. Immediately after removing the catches, fresh bait is introduced, the edges laced and the traps again set under water at a different place. At an interval of 10 to 12 days, the traps are taken to the shore, sun-dried for a day or two to make them more durable, and again used.

Rocky bottom.—Traps operated on the rocky bottom are usually larger with one or more entrances. After introducing baits and stones, they are taken by 2 fishermen in a boat or catamaran to the fishing place and laid at the bottom in scattered places near rocks, without any floats attached to the traps, at depths varying from 6 to 8 feet. The distance of the fishing place from the shore varies from 600 to 800 yards. Every time a trap is to be set under water, one of the fishermen dives down with the trap and leaves it near some rock or coral and comes up, the total time taken for diving, setting the trap and coming up being 40 to 60 seconds. Similarly, diving

is resorted to when the catches are removed. The catches are removed as usual after 24 hours and the traps are dried at an interval of 10 or 12 days. In this operation, clupeid fishes, jelly fishes and dried holothurians are used as baits. Great skill is shown by fishermen in detecting the traps even in turbid waters.

Trap fishing is carried out in and around Mandapam from September to March in the Gulf of Mannar and from April to August in Palk Bay. About 500 to 600 traps are operated daily in the Gulf of Mannar along the coasts of Mandapam, Vedalai, Pullivasal, Pudumadhom, Muthupet and Kilakarai, and about the same number on the Palk Bay Coast for about 3–4 miles northeast of Mandapam towards Theedai village and also south-east along the Rameswaram Island near the Rameswaram temple. Each fisherman owns about 30 to 40 traps and the number of fishermen operating such traps is about 10 to 15 only along either side of Mandapam. Although fishing is conducted regularly by all those who possess the traps, it has been observed that this type of fishing forms only a part-time occupation for the majority of the fishermen along both the coasts. The landings through these traps constitute one of the important sources of fresh fish supply for the local population especially when almost all the bigger and popular varieties of fishes such as seer, dorab, mackerel and big-jawed-jumper landed by boat seines and shore seines are exported to interior markets and towns, in the fresh as well as in the cured condition.

III. Methods of Sampling and Material

A set of 50 single entrance traps belonging to the local fishermen was selected in the Gulf of Mannar for collection of data. Owing to unfavourable weather and strong currents on certain days, data from all the 50 traps could not always be obtained; but whenever possible, data from the selected traps was supplemented by that collected from other traps also. While continuing the investigation in Palk Bay, arrangements were made for the operation of the departmental traps of assorted types with the number of entrances varying from one to four, along with some more traps belonging to the local fishermen. As the method of operation of the larger type of traps was difficult (as described under fishing at places with rocky bottom) the data from that type of traps obtained each day was restricted to only 8–12. On each day of collection, the actual fishing place was visited on a canoe and special instructions were given to the fishermen to operate the traps at different depths and with different baits. As soon as each trap was lifted out of water and the catches emptied into the canoe the following points were noted: (1) the total number of fishes caught in each trap, (2) number of individuals of each species in each trap and (3) individual total length of all the fishes. When all the traps were emptied into the canoe, the total weight of the day's catches was

recorded. Specific gravity and temperature of the sea-water at the fishing place were also noted down. A random sample of about 15 to 20 fishes was brought to the laboratory to collect data on: (1) individual weight of different size groups of various species; (2) condition of gonads; (3) size of gonads and intra-ovarian eggs; and (4) the gut contents. Data on these lines were collected during 22 field trips to the actual fishing place. Eleven collections each were made from Gulf of Mannar and Palk Bay extending from January to April and May to end of June 1951, respectively. In the Gulf of Mannar, observations on perch-trap operations were restricted to a set of traps under operation opposite Vedalai village though on two occasions data from one set of traps at Pudumadhom and another set near Krusadai Island were also recorded. On Palk Bay side all the observations were made from another set of traps operated off Mandapam (Fig. 1).

IV. Composition of Catches and Estimation of Yield

(*a*) *Composition of catches*

During the course of the present investigation, the total number of traps examined in the Gulf of Mannar and Palk Bay was 390 and 81 respectively (Table I). Altogether 23 species of fishes belonging to 15 families have been found to occur in the traps. Of these 23 species, only 18 are true perches belonging to the first 10 families given in the following list,* whereas the rest are non-perches.

	Classification according to Weber and Beaufort	Classification according to Day
Sub-class	Teleostei	Teleostei
Family	Lethrinidæ	Sparidæ
Genus	*Lethrinus* Cuvier	*Lethrinus* Cuvier
Species 1.	*Lethrinus cinereus* Valenciennes	*Lethrinus cinereus* Cuvier & Valenciennes
Family	Serranidæ	Percidæ
Genus	*Epinephelus* Bloch	*Serranus* Cuvier
Species 2.	*Epinephelus tauvina* (Forskål)	*Serranus salmoides* (Lacepede)
3.	*Epinephelus lanceolatus* (Bleeker)	*Serranus lanceolatus* (Bloch)
4.	*Epinephelus bœnack* (Bleeker)	*Serranus bœnack* (Bloch)

* The generic and specific names of the different species according to Weber and Beaufort (*Fishes of the Indo-Australian Archipelago*) and Day (*Fauna of British India*) are given in the list.

		Classification aecording to Weber and Beaufort	Classification according to Day
Family		Lutjanidæ	Percidæ
Genus		*Lutjanus* Bloch	*Lutjanus* Bloch
Species	5.	*Lutjanus johnii* (Bloch)	*Lutjanus johnii* (Bloch)
	6.	*Lutjanus* sp.	*Lutjanus* sp.
Family		Centropomidæ	Percidæ
Genus		*Psammoperca* Richardson	*Psammoperca* Richardson
Species	7.	*Psammoperca waigiensis* Cuvier	*Psammoperca waigiensis* (Cuvier & Valenciennes)
Family		Plectorhynchidæ	Percidæ
Genus		*Plectorhynchus* Lacepede	*Diagramma* Cuvier
Species	8.	*Plectorhynchus schotaf* (Forskål)	*Diagramma griseum* Cuvier & Valenciennes
	9.	*Plectorhynchus pictus* Thunberg	*Diagramma punctatum* Cuvier & Valenciennes
Family		Leiognathidæ	Percidæ
Genus		*Gerres* Cuvier	*Gerres* Cuvier
Species	10.	*Gerres* sp.	*Gerres* sp.
Family		Theraponidæ	Percidæ
Genus		*Pelates* Cuvier	*Therapon* Cuvier
Species	11.	*Pelates quadrilineatus* (Bleeker),	*Therapon quadrilineatus* (Bloch)
Genus		*Therapon* Cuvier	
Species	12.	*Therapon puta* Cuvier	*Therapon puta* Cuvier & Valenciennes
Family		Teuthidæ	Teuthidæ
Genus		*Teuthis* Linnaeus	*Teuthis* Linnaeus
Species	13.	*Teuthis marmorata* Quoy & Gaimard	*Teuthis marmorata* (Quoy & Gaimard)
	14.	*Teuthis oramin* Gunther	*Teuthis oramin* Gunther
Family		Mullidæ	Mullidæ
Genus		*Parupeneus* Bleeker	*Upeneus* Cuvier & Valenciennes
Species	15.	*Parupeneus indicus* (Shaw)	*Upeneus indicus* (Shaw)
	16.	*Parupeneus macronema* (Lacepede)	*Upeneus macronema* (Lacepede)
Genus		*Upeneoides* Bleeker	*Upeneoides* Bleeker
Species	17.	*Upeneoides tragula* Richardson	*Upeneoides tragula* (Richardson)

		Classification according to Weber and Beaufort	Classification according to Day
Family		Chætodontidæ	Squamipinnes
Genus		*Chætodon* Linnaeus	*Chætodon* Linnaeus
Species	18.	*Chætodon* sp.	*Chætodon* sp.
Family		Labridæ	Labridæ
Genus		*Halichœres* Ruppell	*Platyglossus* Gunther
Species	19.	*Halichœres* sp.	*Platyglossus* sp.
Family		Scaridæ	Labridæ
Genus		*Callyodon* Bloch	*Pseudoscarus* Bleeker
Species	20.	*Callyodon ghobban* (Forskål)	*Pseudoscarus ghobban* (Forskål)
Family		Acanthuridæ	Acanthuridæ
Genus		*Acanthurus* Bleeker	*Acanthurus* Bleeker
Species	21.	*Acanthurus* sp.	*Acanthurus* sp.
Family		Plotosidæ	Siluridæ
Genus		*Plotosus* Lacepede	*Plotosus* Lacepede
Species	22.	*Plotosus* sp.	*Plotosus* sp.
Sub-Class		Selachii	Chondropterygii
Family		Scyllidæ	Orectolobidæ
Genus		*Chiloscyllium* Müller & Henle	*Chiloscyllium* Müller & Henle
Species	23.	*Chiloscyllium indicum* (Gmelin)	*Chiloscyllium indicum* (Gmelin)

TABLE I

Showing the Total Number of Traps Examined, Fishes Landed, Their Total Weight, Range in Depth at the Fishing Place and its Distance From the Shore, Range in Surface Water Temperature and Specific Gravity, Nature of Bottom and Average Catch per Trap in Gulf of Mannar and Palk Bay

	Gulf of Mannar	Palk Bay
Total number of traps examined	390	81
Total number of fishes landed ..	997	561
Total weight of landings ..	105 lb.	87 lb.
Range of distance from shore to the fishing place	10–300 yds.	250–800 yds.
Range in depth at the fishing place	3–8 ft.	6–10 ft.
Range in surface water temperature	25·5–30·5° C.	27·5–30·5° C.
Range in specific gravity ..	1·019–1·021	1·019–1·023
Nature of bottom	Sandy with algæ and rarely rocky	Rocky with corals and rarely with algæ
Average catch per trap ..	0·3 lb.	1·1 lb.

(b) Percentage composition of the different species

Although 23 species of fishes were observed to be usually caught in traps, only a few species were found to constitute the majority of the catch. It is evident from Table II that *Lethrinus cinereus* and *Callyodon ghobban* are the commonest species caught in perch-traps in Gulf of Mannar, whereas on

TABLE II

Showing the Range in Size and Number of Specimens Caught in Perch-Traps from Gulf of Mannar and Palk Bay

Species	Gulf of Mannar		Palk Bay	
	Range in size (cm.)	No. of fishes examined	Range in size (cm.)	No. of fishes examined
Lethrinus cinereus ..	9·0–25·7	567	11·2–36·5	263
Callyodon ghobban ..	9·0–22·7	259	Nil	Nil
Lutjanus johnii	9·7–17·8	46	Nil	Nil
Lutjanus sp.	10·1–13·6	8	14·5	1
Pelates quadrilineatus ..	10·9–13·8	9	Nil	Nil
Therapon puta	7·5–17·1	40	Nil	Nil
Psammoperca waigiensis ..	15·0–28·0	18	22·0–29·5	13
Epinephelus tauvina ..	15·0–25·9	17	Nil	Nil
Epinephelus lanceolatus ..	16·0	1	11·6–31·8	6
Epinephelus bœnack ..	18·6–22·0	3	Nil	Nil
Teuthis marmorata ..	10·0–22·0	19	6·8–21·8	267
Teuthis oramin	13·0–22·5	2	Nil	Nil
Plectorhynchus schotaf ..	22·4	1	Nil	Nil
Plectorhynchus pictus ..	29·5	1	Nil	Nil
Parupeneus indicus ..	26·8	1	18·0–33·0	4
Parupeneus macronema ..	22·8	1	Nil	Nil
Upeneoides tragula ..	17·8	1	17·8	1
Halichœres sp.	12·7	1	Nil	Nil
Chiloscyllium indicum ..	51·0–62·0	2	Nil	Nil
Plotosus sp.	Nil	Nil	40·0	1
Gerres sp.	Nil	Nil	17·0	1
Chaetodon sp.	Nil	Nil	5·8–9·3	3
Acanthurus sp.	Nil	Nil	25·0	1

the Palk Bay side, *Lethrinus cinereus* and *Teuthis marmorata* predominate in the catches. A study of the percentage composition of the different species in the total catches from Gulf of Mannar and Palk Bay (Table III) reveals that *L. cinereus* forms 53·27%, the next important being *T. marmorata* forming 18·36% and the third important species *C. ghobban* forming 16·62%. Further, it has been observed that *L. cinereus* is the commonest species

TABLE III

Showing the Percentage Composition of the Different Species including Non-Perches Caught in Perch-Traps in Gulf of Mannar and Palk Bay

Species	Gulf of Mannar		Palk Bay		Percentage of the total from G.M. & P.B.
	No. of fishes	Percentage of the total	No. of fishes	Percentage of the total	
Lethrinus cinereus ..	567	56·87	263	46·88	53·27
Callyodon ghobban ..	259	25·98	..	..	16·62
Lutjanus johnii	46	4·61	..	..	2·95
Therapon puta	40	4·01	..	..	2·57
Psammoperca waigiensis ..	18	1·81	13	2·32	1·99
Epinephelus tauvina ..	17	1·71	..	..	1·10
Teuthis marmorata ..	19	1·91	267	47·59	18·36
Others	31	3·11	18	3·21	3·15

Percentage of non-perches in the total from the Gulf of Mannar = 26·28.
" " " Palk Bay = 0·36.
Percentage of non-perches in the total landings from Gulf of Mannar and Palk Bay = 16·94.

abundant in the catches from both the areas, whereas *T. marmorata* has been found to replace *C. ghobban* in the Palk Bay catches. In this connection it is interesting to note that *T. marmorata* forming 47·59% of the Palk Bay catches, is caught only occasionally on the Gulf of Mannar side, whereas *C. ghobban* forming 25·98% and *Lutjanus johnii, Therapon puta* and *Epinephelus tauvina* forming lesser percentages of the catches on Gulf of Mannar side, have never been found in the Palk Bay landings. *Psammoperca waigiensis*, one of the most important species caught in perch-traps, has been found to occur both in Gulf of Mannar and Palk Bay catches. These observations clearly indicate certain significant differences in the distribution of some of the species caught in traps in two adjacent and connected areas.

(*c*) *Occurrence of non-perches in perch-traps*

The 5 species of non-perches which occur in traps were found to form 26·28% and 0·36% of the catches from Gulf of Mannar and Palk Bay respectively and the percentage of non-perches in the total catches from both the areas was found to be 16·94 (Table III). However, it is evident that the high percentage value for non-perches on Gulf of Mannar side was

mainly due to the occurrence of *C. ghobban* forming 25·98% of the total landings on that side. In Palk Bay the percentage of non-perches was only 0·36. Thus the percentages of non-perches excluding *C. ghobban* caught in perch-traps were more or less uniform, *i.e.*, 0·30 and 0·36 in the Gulf of Mannar and Palk Bay respectively. The occurrence of non-perches other than *C. ghobban*, such as *Chiloscyllium indicum*, *Plotosus* sp. and *Acanthurus* sp., in perch-trap catches is either accidental or occasional since they have been found only in very small numbers, either 1 or 2 in each species, but *C. ghobban* which is caught in large numbers is well known to inhabit coral seas and it is even reported that its snout is modified for pecking at corals. Another reason may be that the feeding habits of *C. ghobban* are similar to those of true perches and consequently the baits used in perch-traps attract not only perches but also this species.

(d) Variation in the daily average catch per trap

The daily average catch per trap on different days from 24–1–1951 to 26–6–1951 was calculated in pounds and the data are given in Table IV from which it is evident that the average landing per trap does not show constant figures and that the range in the daily average catch per trap varies from 0·07 to 1·86 lb. on different days. The average catch per trap for the whole season was found to be 0·71 lb., standard deviation of the daily means $\pm$ 0·5118 and the standard error of the final mean $\pm$ 0·11. It could be seen from Table IV that there is an increase in the daily average catch per trap from 7–4–1951 from which date the data relate to the catches from Palk Bay side. Thus it was found necessary to divide the whole season extending from 24–1–1951 to 26–6–1951 into two periods (1) from 24–1–1951 to 12–4–1951 with a low average catch per trap and (2) from 17–5–1951 to 26–6–1951 with a high value for the average catch per trap. The average catch per trap for these 2 periods was calculated separately and it was found that in the former period the value was 0·3 lb. and in the latter 1·1 lb. (Table I), thereby showing that the catches were comparatively better in Palk Bay than in Gulf of Mannar.

(e) Estimated annual yield through perch-traps

From the data gathered on the fishes caught in traps during the 2 periods, one from Gulf of Mannar and the other from Palk Bay, and from the calculated average catch per trap during these two periods, it is possible to compute roughly the total landings through these traps. If the total number of traps operated per day in Gulf of Mannar and Palk Bay are about 500 each (as gathered from a general survey of the extent of the fishery in these

TABLE IV

Showing the Dates and Places of the Experimental Perch-Trap Operations, the Depth at the Fishing Place, Its Distance from Shore, Nature of Bottom, Number of Traps Operated, Number of Fishes Caught in each Species, Total Weight, Average Catch per Trap, Temperature, Salinity and Specific Gravity of Water at the Fishing Place, Baits Used on Different Days, Average Catch per Trap, Standard Deviation of the Daily Means and the Standard Error of the Final Mean

Dates	Place of fishing	Distance from shore (Yards)	Nature of bottom Grades*	Depth (Feet)	No. of traps operated	No. of species caught	Total No. of fishes	Total wt. in lb.	Ave. catch per trap (lb.)	Sp. gr. of S. W.†	Salinity	Temp. (°C.)	Bait used‡
					GULF OF MANNAR								
24-1-1951	Vedalai	15-20	I	3-4	42	6	25	3·5	0·08	1019	30·01	27·00	P.C.
3-2-1951	do	15-20	I	3-4	45	7	65	7·0	0·16	1021	32·10	26·00	P.C.
8-2-1951	do	35-50	I	3-4	43	4	35	3·0	0·07	1019	29·27	25·50	P.C.
15-2-1951	do	250-300	I	5	60	5	334	29·0	0·48	1020	31·98	28·50	P.C. & D.H.
20-2-1951	Kundugal	10-15	II	3-5	8	5	8	2·5	0·31	1021	32·48	26·50	D.H.
23-2-1951	Pudumadhom	20-30	III	6	10	7	106	12·0	1·20	1021	32·48	26·50	D.H.
27-2-1951	Vedalai	200-220	I	6-8	53	9	219	22·0	0·42	1021	32·68	27·00	D.H.
8-3-1951	do	275-300	I	6-8	55	6	135	10·0	0·18	1020	31·78	28·00	P.C.
14-3-1951	do	100-150	I	6-8	36	7	43	5·5	0·15	1020	31·78	28·00	P.C.
7-4-1951	do	100-150	I	4-6	20	4	18	3·5	0·18	1020	32·79	30·25	No bait
12-4-1951	do	100-120	I	4-6	18	5	9	7·0	0·39	1020	31·98	28·53	No bait

PALK BAY

17-5-1951	Off Mandapam	250-300	III	6	4	2	20	5·0	1·25	1020	32·66	30·00	Y.C.
21-5-1951	do	500-600	IV	6	9	5	104	9·0	1·00	1020	32·43	29·50	P.C., J.F. & D.H
23-5-1951	do	500-600	IV	6-8	9	3	36	6·0	0·67	1019	31·56	30·50	D.H.
27-5-1951	do	600-800	IV	6-8	7	4	66	10·0	1·43	1021	34·00	30·00	Y.C. & J.F.
1-6-1951	do	600-800	IV	6-8	7	7	68	7·0	1·00	1021	33·33	28·50	No bait
4-6-1951	do	700-800	IV	8-10	9	4	86	13·5	1·50	1020	32·22	29·00	D.H.
12-6-1951	do	700-800	IV	8-10	7	4	81	13·0	1·86	1021	32·90	27·50	D.H.
15-6-1951	do	700-800	IV	8-10	8	4	21	4·0	0·50	1021	32·90	27·50	D.H.
21-6-1951	do	700-800	IV	8-10	7	3	36	7·5	1·07	1023	35·79	28·00	D.H.
23-6-1951	do	700-800	IV	8-10	4	2	20	3·0	0·75	1023	36·00	28·50	No bait
26-6-1951	do	700-800	IV	8-10	10	3	23	9·0	0·90	1022	34·47	27·75	No bait

Average catch per day for the season = 0·71 lb.
Standard deviation of the daily means = 0·5118
Standard error of the final mean = 0·11

* Grade I—Sandy with algæ ; Grade II—Sandy with coral nearby ; Grade III—Rocky with algæ; Grade IV—Rocky with corals.

† S. W.—Sea water.

‡ Bait used: P.C.– Pieces of crabs ; D.H.—Dried holothurians ; J.F.—Jelly fish ; Y.C.—Young clupeids.

two areas) during two successive seasons in a year, leaving a margin of 1 month on either side as the transitional period of the changing of directions of the monsoons when no fishing is carried out owing to unfavourable weather, the total estimated landings for 5 months each in Gulf of Mannar and Palk Bay, were found to be 22,500 lb. (10·45 tons) and 82,500 lb. (36·83 tons) respectively. Considering the fact that perch trapping is only a part-time work of a few fishermen, the probable total annual yield of 1,05,000 lb. (47·28 tons) is a valuable contribution to the fish supply of Mandapam.

(f) Variations in the mean size, standard deviation and standard error of means in different species in different months

The grouped data on the individual measurements of 1558 fish of different species recorded during the course of this investigation (Table V) indicate that the frequency of occurrence of most of the species other than *L. cinereus*, *P. waigiensis*, *C. ghobban*, *L. johnii* and *T. marmorata* is very low and so the data on these 5 species alone were taken into consideration to study the movement of the mean size with its standard error on different days and months. The mean size of *L. cinereus* was found to increase from 7–4–1951 from which date the data relate to the landings from Palk Bay side. However, the range in standard error was more than 1 only on 3 days, *i.e.*, 21st, 23rd and 26th June and on the other days it was less than 1. Although the standard error was less than 1 in the individuals caught from Gulf of Mannar also, the mean size of the fishes on different days was observed to be much less than the mean size of the individuals landed on the Palk Bay side, the range in mean size being 13·14 to 15·83 cm. in Gulf of Mannar and 14·08 to 19·69 in Palk Bay. The individuals of *L. cinereus* occurring in Palk Bay are larger than those occurring in the Gulf of Mannar. In *C. ghobban*, a species caught exclusively from Gulf of Mannar, the highest mean was found to be in those individuals caught in the month of February 1951. In *P. waigiensis* also the increase in the mean size of the specimens was observed in those caught from Palk Bay in May 1951. The values for standard error of means were also found to be less, both in *C. ghobban* and *P. waigiensis*, during the periods when their mean sizes were high. In *L. johnii*, the increase in the mean length was towards the end of February 1951 and in *T. marmorata* a steady increase in the mean size was observed from May 1951. Though a high value for the mean size, *i.e.*, 16·6 cm., was observed on 20–2–1951 for *T. marmorata*, the standard error was also found to be very high, *i.e.*, $\pm$ 1·401. In all these cases, except in *P. waigiensis*, the increase in the mean length and low values for standard error of means in different months or during specific periods did not show any relation either

TABLE V

Showing the Number of Specimens Caught in Different Days, their Range in Size, Mean Size, Standard Deviation and Standard Error of Means

Date	Species	No. of specimens	Range in size	Mean	S.D.	S.E.
24–1–1951	*Epinephelus bœnack* ..	1	19·3	..	..	..
	Lutjanus johnii	5	10·0–17·8	14·92	3·520	1·5740
	Lutjanus sp.	8	10·1–13·6	12·71	1·716	0·6052
	Callyodon ghobban ..	9	9·1–13·8	11·36	1·66	0·5533
	Halichœres sp.	1	12·7	..	..	..
	Lethrinus cinereus ..	1	10·0	..	..	..
3–2–1951	*Psammoperca waigiensis* ..	1	19·7	..	..	..
	Epinephelus tauvina ..	2	17·8 & 25·2	21·50	4·375	3·0940
	Plectorhynchus pictus ..	1	29·5	..	..	..
	Pelates quadrilineatus ..	1	12·0	..	..	..
	Callyodon ghobban ..	39	9·6–16·0	12·78	1·502	0·2405
	Lutjanus johnii	10	9·7–17·3	12·87	2·6367	0·8339
	Lethrinus cinereus ..	11	11·0–18·3	14·90	2·8830	0·8692
8–2–1951	*Lethrinus cinereus* ..	25	9·8–17·3	13·70	2·210	0·4420
	Lutjanus johnii	7	10·1–14·6	12·09	1·754	0·6626
	Epinephelus tauvina ..	2	15·0 & 22·0	18·50	4·950	3·5000
	Callyodon ghobban ..	1	10·7	..	..	..
15–2–1951	*Lethrinus cinereus* ..	209	9·0–20·0	13·98	1·708	0·1181
	Callyodon ghobban ..	85	11·0–14·0	12·28	0·850	0·0922
	Lutjanus johnii	6	11·6–16·0	13·98	1·900	0·7758
	Therapon puta	25	11·0–17·2	13·14	1·741	0·3482
	Psammoperca waigiensis ..	9	15·0–22·5	19·03	1·953	0·6510
20–2–1951	*Psammoperca waigiensis* ..	3	20·8–28·0	24·03	3·655	2·1110
	Parupeneus indicus ..	1	26·8	..	..	..
	Parupeneus macronema ..	1	22·8	..	..	..
	Lutjanus johnii	1	17·9	..	..	..
	Tuethis marmorata ..	2	15·2 & 18·0	16·60	1·980	1·4010
23–2–1951	*Callyodon ghobban* ..	95	10·4–22·7	13·14	1·856	0·2076
	Lethrinus cinereus ..	4	11·5–14·5	13·23	1·273	0·6370
	Epinephelus bœnack ..	1	22·0	..	..	..
	Teuthis marmorata ..	1	22·0	..	..	..
	Teuthis oramin	2	13·0 & 22·5	17·75	6·719	4·7520
	Lutjanus johnii	2	14·0 & 16·0	15·25	1·768	1·2510
	Plectorhynchus schotaf ..	1	22·4	..	..	..

TABLE V—*Continued*

Date	Species	No. of specimens	Range in size	Mean	S.D.	S.E.
27-2-1951	*Lethrinus cinereus* ..	175	9·2–21·0	14·48	1·548	0·1170
	Lutjanus johnii	8	14·0–16·5	15·48	0·927	0·3278
	Callyodon ghobban ..	14	9·9–13·7	11·57	6·964	1·8610
	Therapon puta	12	11·5–17·1	14·00	1·669	0·4461
	Pelates quadrilineatus ..	3	10·9–12·0	11·47	0·5508	0·3181
	Psammoperca waigiensis ..	3	15·8–18·5	16·83	1·457	0·8414
	Epinephelus tauvina ..	2	17·0 & 17·7	17·35	0·495	0·3501
	Epinephelus lanceolatus ..	1	16·0	..	..	..
	Upeneoides tragula ..	1	17·8	..	..	..
8–3–1951	*Lethrinus cinereus* ..	108	8·9–17·3	13·14	2·086	0·2008
	Lutjanus johnii	4	11·5–16·9	13·45	2·371	1·1860
	Therapon puta	2	13·5 & 13·6	13·55	0·0707	0·0500
	Pelates quadrilineatus ..	5	11·1–13·8	11·32	0·2169	0·0970
	Teuthis marmorata ..	1	10·5	..	..	..
	Callyodon ghobban ..	15	9·0–12·4	10·90	0·8795	0·2781
14–3–1951	*Lethrinus cinereus* ..	20	12·2–19·5	15·83	4·067	0·9098
	Lutjanus johnii	2	11·0 & 15·2	13·10	2·970	2·1010
	Epinephelus tauvina ..	4	18·2–23·5	19·80	2·461	1·2310
	Epinephelus bœnack ..	1	18·6	..	..	..
	Callyodon ghobban ..	1	13·3	..	..	..
	Teuthis marmorata ..	14	10·0–16·9	11·86	1·696	0·4532
	Therapon puta	1	7·5	..	..	..
7–4–1951	*Lethrinus cinereus* ..	10	13·8–21·8	16·68	2·023	0·6396
	Epinephelus tauvina ..	6	17·5–25·9	20·05	3·027	1·3090
	Psammoperca waigiensis ..	1	18·5	..	..	..
	Teuthis marmorata ..	1	12·7	..	..	..
12–4–1951	*Lethrinus cinereus* ..	4	15·7–25·7	19·10	4·554	2·2720
	Lutjanus johnii	1	14·2	..	..	..
	Epinephelus tauvina ..	1	16·8	..	..	..
	Psammoperca waigiensis ..	1	21·4	..	..	..
	Chiloscyllium indicum ..	2	51·0 & 62·0	56·50	7·779	5·5010
17–5–1951	*Lethrinus cinereus* ..	20	12·0–30·0	17·35	3·167	0·7082
	Psammoperca waigiensis ..	2	23·0 & 25·8	24·40	1·980	1·4010
21–5–1951	*Lethrinus cinereus* ..	31	12·0–21·5	14·08	1·832	0·2614
	Psammoperca waigiensis ..	7	22·0–26·5	24·26	1·454	0·5494
	Teuthis marmorata ..	62	10·0–13·8	11·63	1·0714	0·1718
	Epinephelus lanceolatus ..	2	25·0 & 31·8	28·40	4·809	3·4010
	Chætodon sp.	2	8·4 & 9·3	8·85	0·6365	0·4502

TABLE V—*Continued*

Date	Species	No. of specimens	Range in size	Mean	S.D.	S.E.
23–5–1951	*Lethrinus cinereus* ..	26	11·5–25·7	16·62	3·806	0·7465
	Teuthis marmorata ..	8	10·1–15·8	12·04	1·793	0·6340
	Psammoperca waigiensis ..	2	22·0 & 23·5	22·75	1·060	0·7501
27–5–1951	*Lethrinus cinereus* ..	21	12·7–23·7	17·83	2·805	0·6120
	Teuthis marmorata ..	43	9·0–21·8	14·13	2·923	0·4458
	Epinephelus lanceolatus ..	1	25·0	..	..	..
	Acanthurus sp.	1	25·0	..	..	..
1–6–1951	*Lethrinus cinereus* ..	19	11·2–23·0	15·45	3·174	0·7281
	Psammoperca waigiensis ..	1	29·5	..	..	..
	Teuthis marmorata ..	42	9·2–17·3	12·00	2·218	0·3422
	Gerres sp.	1	17·0	..	..	..
	Parupeneus indicus ..	1	18·8	..	..	..
	Chætodon sp.	3	8·5–9·3	8·87	0·4042	0·2334
	Lutjanus sp.	1	14·5	..	..	..
4–6–1951	*Lethrinus cinereus* ..	44	11·3–36·5	17·93	4·690	0·7068
	Teuthis marmorata ..	40	6·8–16·4	11·63	2·201	0·3480
	Parupeneus indicus ..	1	18·0	..	..	..
	Epinephelus lanceolatus ..	1	13·5	..	..	..
12–6–1951	*Lethrinus cinereus* ..	41	12·6–29·6	16·21	3·659	0·5715
	Teuthis marmorata ..	38	9·6–16·0	12·03	1·733	0·2811
	Epinephelus lanceolatus ..	1	29·6	..	..	..
	Plotosus sp.	1	40·0	..	..	..
15–6–1951	*Lethrinus cinereus* ..	16	12·8–25·2	16·25	3·898	0·9743
	Teuthis marmorata ..	3	13·0–13·5	13·23	0·2518	0·1454
	Parupeneus indicus ..	1	19·0	..	..	..
	Psammoperca waigiensis ..	1	24·5	..	..	..
21–6–1951	*Lethrinus cinereus* ..	16	14·0–32·7	19·69	5·239	1·3100
	Teuthis marmorata ..	19	15·0–16·3	15·55	0·4867	0·1117
	Upeneoides tragula ..	1	17·8	..	..	..
23–6–1951	*Lethrinus cinereus* ..	8	11·8–23·5	18·89	3·883	1·3730
	Teuthis marmorata ..	12	10·0–15·3	12·75	1·831	0·5287
26–6–1951	*Lethrinus cinereus* ..	21	11·6–29·5	19·69	4·690	1·0230
	Parupeneus indicus ..	1	33·0	..	..	..
	Epinephelus lanceolatus ..	1	11·6	..	..	..

(S. D. & S. E. denote standard deviation and standard error of means respectively.)

to their gonadic condition or to any other biological factor such as variation in their feeding activity. The increase in the mean size could not even be correlated to the comparative abundance or depletion in the catch of the different species. The only reason that could be ascribed is that the increase in the mean size with a low value for the standard error of means might be due to the occurrence of bigger individuals in a particular area or period, mainly depending on the condition of the bottom and availability of food in the respective localities. In *P. waigiensis*, during the period when the mean length was high, *i.e.*, in May, the gonads were in maturing or recovering condition with ovaries containing yolky eggs, the largest intra-ovarian eggs measuring 0·694 mm. in diameter. In all the other species the gonads were immature.

V. SEXUAL MATURITY OF FISHES CAUGHT IN TRAPS

In Table VI are included some additional data gathered on fishes caught in traps operated in the vicinity of the place where experimental traps were operated. A random sample of fishes from these extra traps was taken whenever available, to study the gonadic condition of the different species which were normally the same as those caught in the experimental traps. The ovaries were grouped into 4 convenient stages of maturity, namely (1) immature, (2) maturing, (3) mature and (4) spent.

(1) *Immature.*—Ovaries with minute transparent ova as they arise from the germ cells from the time they could be distinctly recognised as possessing nucleus and a protoplasmic layer.

(2) *Maturing.*—Ovaries with small opaque ova in which yolk formation has just commenced but not fully yolked.

(3) *Mature.*—Ovaries with mature opaque ova full of yolk.

(4) *Spent.*—Ovaries which appear flabby with traces of hæmorrhage, containing mostly immature ova and a few unspent mature ova.

All specimens of *L. cinereus*, the chief species occurring in perch-traps both in the Gulf of Mannar and Palk Bay, ranging in size from 10·1 to 36·5 cm., were found to be immature as judged from the intra-ovarian eggs. Even in the largest eggs measuring 0·108 mm. in diameter, there was no trace of yolk formation. In *L. johnii* also, all specimens were immature. The range in size of *P. waigiensis* varies from 10·5 to 29·5 cm., and in this species, gonads in all the different stages of maturity were observed. This species was found to attain sexual maturity at a length of 21 to 22 cm. However, no correlation could be made between the percentage of occurrence of this species caught in traps and their gonadic condition, since specimens with

gonads in all the different stages of maturity were found to occur in the catches through traps throughout the period of the investigation. In *T. marmorata*, caught exclusively from Palk Bay, the gonads were asymmetrical and immature in all the specimens ranging in size from 9·6 to 21·8 cm. *T. puta*, ranging in size from 5·0 to 17·2 cm., were found to have gonads in immature and maturing condition. Gonads in all stages of maturity were observed in *Pelates quadrilineatus*. One specimen of *Upeneoides tragula* measuring 17·8 cm. was found to be in maturing condition. All the other species, namely *Epinephelus tauvina*, *E. lanceolatus*, *Plectorhynchus pictus*, *Parupeneus macronema* and *Parupeneus indicus* examined from random samples, were found to be immature.

It has been found that most of the species caught in perch-traps are immature and very few in maturing, mature and spent conditions. From observations made on the habits, habitats, distribution and feeding habits of most of the species caught in traps, it was found that the non-appearance of some species in advanced stages of maturity may be due to the large size at which some species like *L. cinereus* and *Ephinephelus* spp. attain sexual maturity. These fishes in advanced stages of maturity have been observed only in hook and line catches from localities where the depth varied from 20 to 30 fathoms. As the diameter of the funnel-like entrances into perch-traps is not more than 4-6 inches, those species which mature at a large size, would not occur in the traps in mature condition. The change in feeding habits in the mature specimens of certain species such as *C. ghobban* in which the immature specimens have been found to be typical browsers, may be another reason for their non-appearance in the traps.

VI. Relative Weight and Length-Weight Relationships in Different Species

(*a*) *Relative weight of different species in different size groups*

In order to study the relative weight of different species of fishes in different size groups, the data collected on the individual weights of specimens of different species were grouped into one-cm. groups and the average weight of each species in each size group was calculated. The entire range in size, varying from 8·1 to 37 cm., was conveniently divided into 29 one-cm. size groups which have been numbered serially from 1–29 in Table VII.

In the first two size groups, *Chætodon* sp. is obviously heavier than all the other species. Among the different species in the subsequent size groups up to 23 cm., *C. ghobban* has been found to weigh relatively more than the other species. In all the size groups ranging from 23·1 to 32 cm., *Lethrinus cinereus* is the comparatively heavier species, the next in importance being

TABLE VI

Showing the Different Species, Their Range in Size, Number of Specimens Examined, Range of Length and Width of Gonads, Condition of Gonads, Range in Size of the Average Diameter of the Largest Eggs, Range in Quantity and Important Items of Gut Contents

Species	Range in size of specimens (cm.)	No. of fishes examined		Range in length of gonads (cm.)		Range in width of gonads (cm.)		Condition of gonads	Range in size of the average diameter of the largest eggs (mm.)	Range in quantity of gut contents (c.c.)	Important items of gut contents
		M.	F.	M.	F.	M.	F.				
Lutjanus johnii	10·6—17·9	4	10	1·2 to 2·2	1·0 to 2·2	0·1 to 0·4	0·1 to 0·3	Immature	0·036—0·084	0·5—4·0	Remains of post-larval teleosts, prawns, crustacean eggs, ctenoid scales, algæ and sand grains
Lethrinus cinereus	10·1—36·5	50	91	1·0 to 4·5	1·0 to 4·5	0·1 to 0·4	0·1 to 0·5	Immature	0·030—0·108	0·25–18·0	Crustacean and fish eggs, shells of *Modiola* sp., crustacean remains, cycloid and ctenoid scales, otoliths and sand grains
Therapon puta	5·0—17·2	35	65	1·0 to 2·7	0·7 to 4·5	0·1 to 0·4	0·1 to 0·8	Immature and Maturing	0·030—0·430	0·25-1·0	Remains of post-larval teleosts, crustaceans, polychætes, holothurians, Ostracods, fish scales and sand grains
Pelates quadrilineatus	5·3—14·0	74	42	0·7 to 2·8	0·8 to 4·3	0·1 to 0·4	0·1 to 0·6	Immature, Maturing, Mature and Spent	0·038—0·430	0·25–1·0	Crustaceans, young teleosts, gastropods, ostracods, fish scales, algæ, otoliths, and sand grains
Epinephelus tauvina	16·8—51·5	9	3	2·2 to 4·5	.. 3·5	.. 0·2	.. 1·2	Immature	0·720	0·5—3·0	Remains of young crabs, clupeids and algæ

Epinephelus lanceolatus	14·8—31·8	2	0	2·4 to 5·2	..	0·1 to 0·2	..	Immature	..	0·5—5·0	Remains of young squids, teleosts and clupeid scales
Psammoperca waigiensis	10·5—29·5	9	22	3·0 to 4·5	1·6 to 6·5	0·3 to 0·5	0·1 to 2·0	Immature, Maturing, Mature and Spent	0·100—0·694	0·5—5·0	Remains of crabs, crustaceans, young *Lactarius* sp., shells of *Pyrazus* sp., cycloid scales and algæ
Callyodon ghobban	10·7—15·5	2	8	1·1	1·3 to 1·8	0·1	0·1 to 0·2	Immature	0·028—0·050	0·5—1·0	Small pieces of corals, sand particles and algæ
Parupeneus indicus	18·8—33·0	4	0	1·7 to 2·0	..	0·2	..	Immature	..	1·0—2·0	Post-larval teleosts and prawns
Parupeneus macronema	22·8	1	0	2·2	..	0·2	..	Immature	..	..	Nil
Upeneoides tragula	17·8	0	1	..	3·7	..	0·7	Maturing	0·214	..	Nil
*Teuthis marmorata**	9·6—21·8	7	4	0·4 to 3·0	0·5 to 2·0	0·1 to 0·5	0·1 to 0·4	Immature	0·028—0·13	1·0	Remains of crustaceans and sea weeds
Plectorhynchus pictus	29·5	1	0	3·5	..	0·2	..	Immature	..	2·0	Remains of prawns, Polychætes and algal matter

* Gonads of *Teuthis marmorata* are asymmetrical and hence the average lengths of gonads are given. (*M*, denotes male and *F*, female).

TABLE VII

Showing the Relative Weight in gm. of Different Species in 1 cm. Size Groups

Sl. No.	Size groups (cm.)	*Lethrinus cinereus*	*Psammoperca waigiensis*	*Terithis marmorata*	*Terithis oramin*	*Callyodon ghobban*	*Lutjanus johnii*	*Therapon puta*	*Pelates quadrilineatus*	*Epinephelus lanceolatus*	*Epinephelus hamack*	*Epinephelus tauvina*	*Plectorhynchus picus*	*Plectorhynchus schotaf*	*Parupeneus indicus*	*Parupeneus macronema*	*Upeneoides tragula*	*Acanthurus* sp.	*Chaetodon* sp.	*Halicheres* sp.	*Gerres* sp.	*Lutjanus* sp.
		WEIGHT IN GM.																				
1	8·1–9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	22·0	..	..	..
2	9·1–10	14·3	..	12·0	..	15·0	..	..	..	..	..	..	..	..	..	..	..	..	28·0	..	..	..
3	10·1–11	16·3	..	..	..	21·9	16·7	..	20·7	..	..	..	..	..	..	..	..	..	..	..	..	..
4	11·1–12	23·5	..	20·0	..	28·5	27·0	24·3	17·3	..	..	..	..	..	..	..	..	..	..	..	..	..
5	12·1–13	28·0	..	30·0	32·0	34·0	30·4	..	..	..	..	..	..	..	..	..	..	..	..	28·0	..	..
6	13·1–14	35·8	..	33·0	..	42·9	38·0	27·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	14·1–15	44·9	..	42·5	..	55·0	47·0	34·0	..	..	..	43·0	..	..	..	..	..	..	..	..	..	40·0
8	15·1–16	54·5	..	48·3	..	64·3	53·5	44·0	..	53·0	..	..	..	..	..	..	..	..	..	..	..	..
9	16·1–17	62·9	49·0	62·0	..	..	63·0	..	..	..	..	64·0	..	..	..	..	..	..	..	..	62·0	..
10	17·1–18	75·9	..	71·0	..	..	87·0	57·0	..	..	..	64·3	..	..	..	..	64·0	..	..	..	..	..
11	18·1–19	88·9	82·0	..	..	..	..	..	..	..	..	79 3	..	..	76·0	..	..	..	..	..	..	..
12	19·1–20	102·8	104·0	..	..	..	..	..	..	..	103·0	90·0	..	..	..	..	..	..	..	..	..	..
13	20·1–21	126·3	117·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	21·1–22	148·3	131·5	149·0	..	..	..	..	..	..	168·0	116·5	..	..	..	..	..	..	..	..	..	..

15	22·1–23	154·6	149·0	..	78·0	182·0	..	..	..	..	..	..	..	139·0	..	124·0	..	..	..	..	..	..
16	23·1–24	187·5	166·0	..	..	..	..	..	..	..	..	148·0	..	..	..	..	..	..	..	..	..	..
17	24·1–25	227·5	196·7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	235·0	..	..	..	..
18	25·1–26	258·4	200·0	..	..	..	..	..	..	..	..	202·0	..	..	..	..	..	..	..	..	..	..
19	26·1–27	296·5	227·0	..	..	..	..	..	..	..	..	..	..	..	275·0	..	..	..	..	..	..	..
20	27·1–28	..	274·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	28·1–29	345·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	29·1–30	379·0	297·0	..	..	..	..	..	..	..	..	..	289·0	..	..	..	..	..	..	..	..	..
23	30·1–31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
24	31·1–32	..	..	..	..	..	..	..	..	470·0	..	..	..	..	..	..	..	..	..	..	..	..
25	32·1–33	488·0	..	..	..	..	..	..	..	..	..	..	..	..	504·0	..	..	..	..	..	..	..
26	33·1–34	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	34·1–35	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	35·1–36	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	36·1–37	775·0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

P. waigiensis and *P. pictus*. *Parupeneus indicus* weighing less than *L. cinereus* in the 11th and 19th size groups, probably has an accelerated increase in weight after the 19th size group. This abrupt increase in weight in *P. indicus* at a length of 26 cm. could not be correlated to any biological factor such as attainment of gonadic maturity, since this species even at a length of 33 cm. has been found to possess immature gonads. Thus, from these

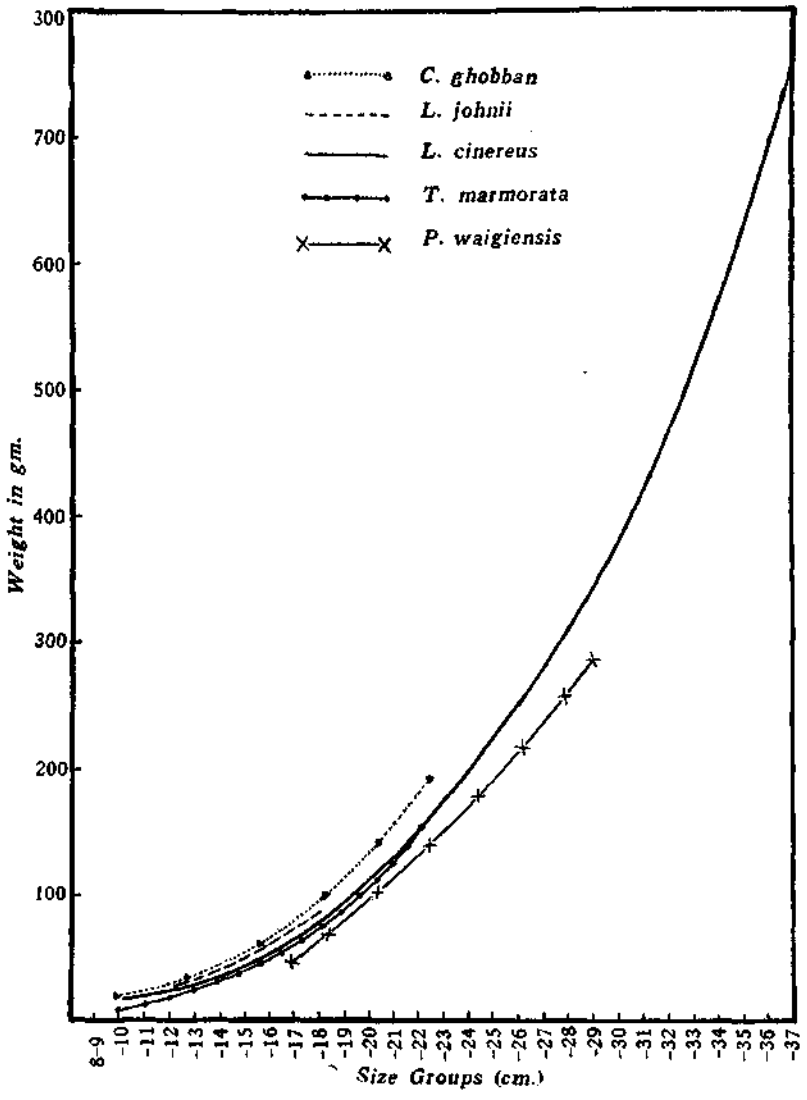


FIG. 2. Showing the relative weights of five important species, namely, *Lethrinus cinereus*, *Teuthis marmorata*, *Lutjanus johnii*, *Callyodon ghobban* and *Psammoperca waigiensis*, in different size groups.

observations, the following conclusions could be made: (1) in the smallest size groups, *Chætodon* sp. weighs more than all the other species; (2) in the subsequent size groups ranging from 10·1 to 23 cm., *C. ghobban* has a relatively greater weight; (3) in the size groups ranging from 23·1 to 32 cm., *L. cinereus* is the comparatively heavier species and (4) *P. indicus* weighing less than *L. cinereus* in the earlier size groups, has an accelerated increase in weight in the later size groups.

(*b*) *Length-weight relationship in some important species*

With a view to finding out whether the rate of growth of these bottom living percoid fishes caught in traps, corresponds to the usual growth pattern in other teleosts, the length-weight relationship in five important species, namely, *Lethrinus cinereus, Callyodon ghobban, Psammoperca waigiensis, Lutjanus johnii* and *Teuthis marmorata* were determined by fitting the general equation $W = AL^B$ to the data for each species. In this equation, 'W' and 'L' represent the weight and length of the fish respectively and 'A' and '^{B}' the constants to be found out. The length-weight relationship formulæ for each species was found to be:

L. cinereus	$W = 0{\cdot}00826\ L^{3{\cdot}1901}$
P. waigiensis	$W = 0{\cdot}01611\ L^{2{\cdot}9153}$
C. ghobban	$W = 0{\cdot}02256\ L^{2{\cdot}8935}$
L. johnii	$W = 0{\cdot}0223\ \ L^{2{\cdot}8274}$
T. marmorata	$W = 0{\cdot}01478\ L^{2{\cdot}9630}$

The value for '^{B}' in each case was found to be nearly 3. When the observed and the theoretical values for 'W' were plotted against their respective values for 'L' in different species (Figs. 3 to 7), it was found from the two curves in each species that there is a close agreement between the two sets of values. The length-weight relationship was thus found to show the normal pattern, the weight increasing as the cube of the length.

VII. Food of Fishes Caught in Traps

A study of the gut contents of the fishes caught in traps showed mostly remains of bait used for perch trapping. Since traps are set one morning after an interval of 24 hours, it is quite probable that the fishes which might have been trapped soon after the traps were set under water might have completely or partly digested the food taken by them by the time they are removed from the traps. Thus in most of the cases, only remains of the bait used were found in the guts, but some very general observations made on the feeding habits of some of the species caught in perch-traps were mainly

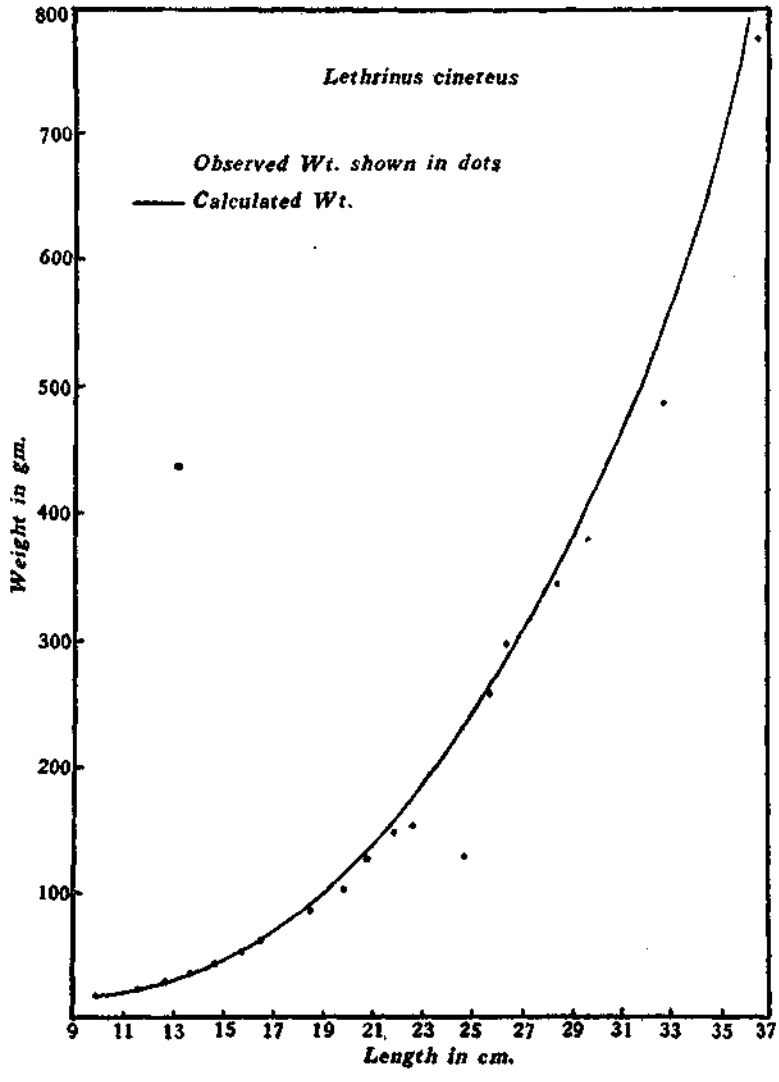


FIG. 3. Calculated length-weight curve fitted to the average observed length-weight values for *Lethrinus cinereus*.

from a study of the gut contents of those fishes which might have been caught just prior to the removal of the traps. From Table VI it could be seen that most of the species are piscivorous in their feeding habits. *Callydon ghobban* was found to be a typical browser as judged from the gut contents constituted by small pieces of corals and sand particles and occasionally small quantities of algal matter. *Lethrinus cinereus* seems to be another species which feeds on organisms living attached to rocks and dead

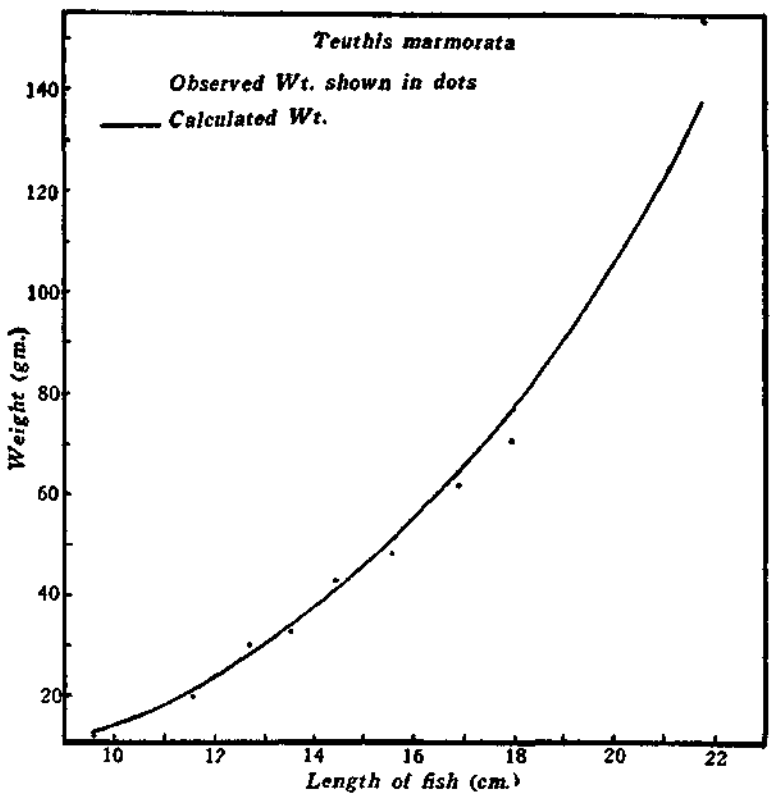


FIG. 4. Calculated length-weight curve fitted to the average observed length weight values for *Teuthis marmorata*.

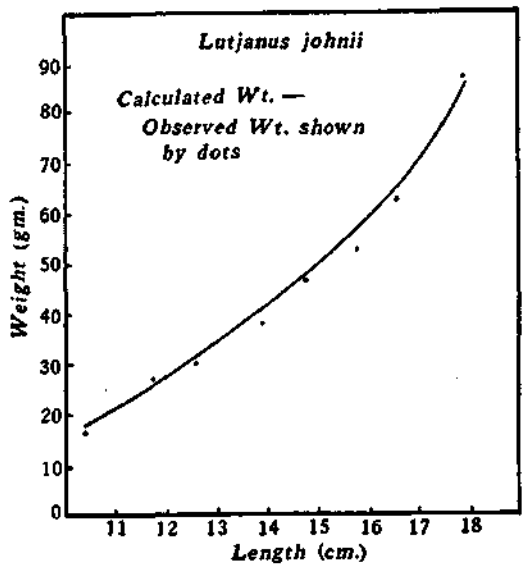


FIG. 5. Calculated length-weight curve fitted to the average observed length-weight values for *Lutjanus johnii*.

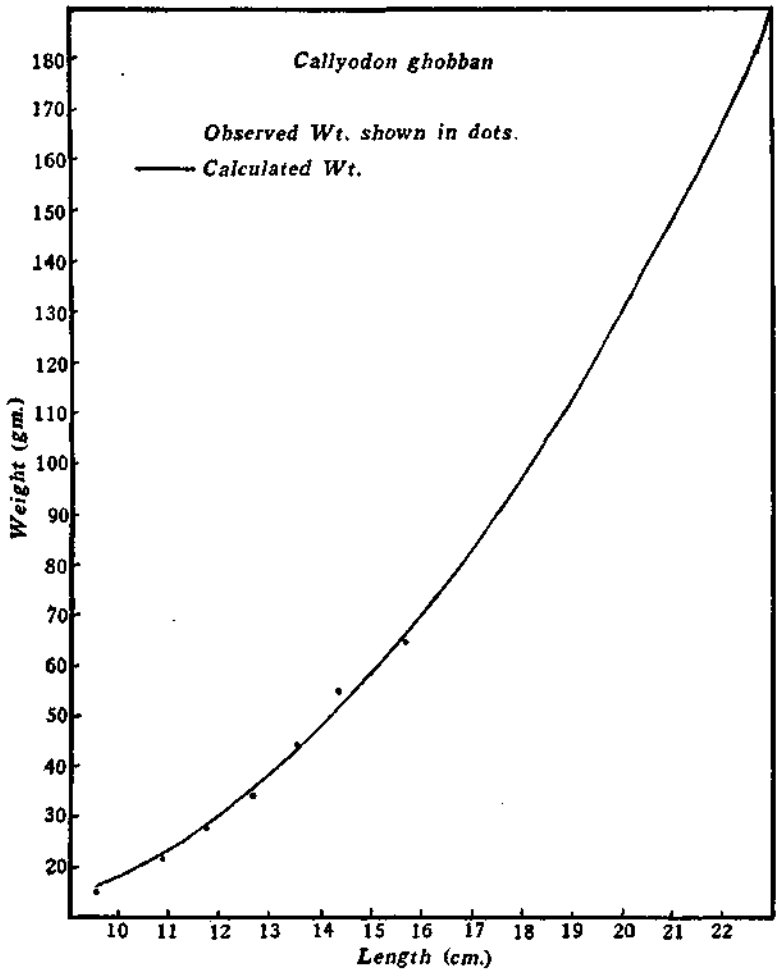


FIG. 6. Calculated length-weight curve fitted to the average observed length-weight values for *Callyodon ghobban.*

corals, as is evident from the presence of shells of *Modiola* sp. *Teuthis marmorata* was found to feed exclusively on young crustaceans and seaweeds. In *Psammoperca waigiensis* also the gut contents contained shells of *Pyrazus* sp. indicating that this species also is a browser. From the details of analyses of gut contents of the different species shown in Table VI it has been observed that almost all the species are either bottom feeders or browsers.

VIII. FACTORS AFFECTING THE YIELD PER TRAP

As it was observed that the average yield per trap on different days varied considerably, it was deemed worthy to examine the various factors

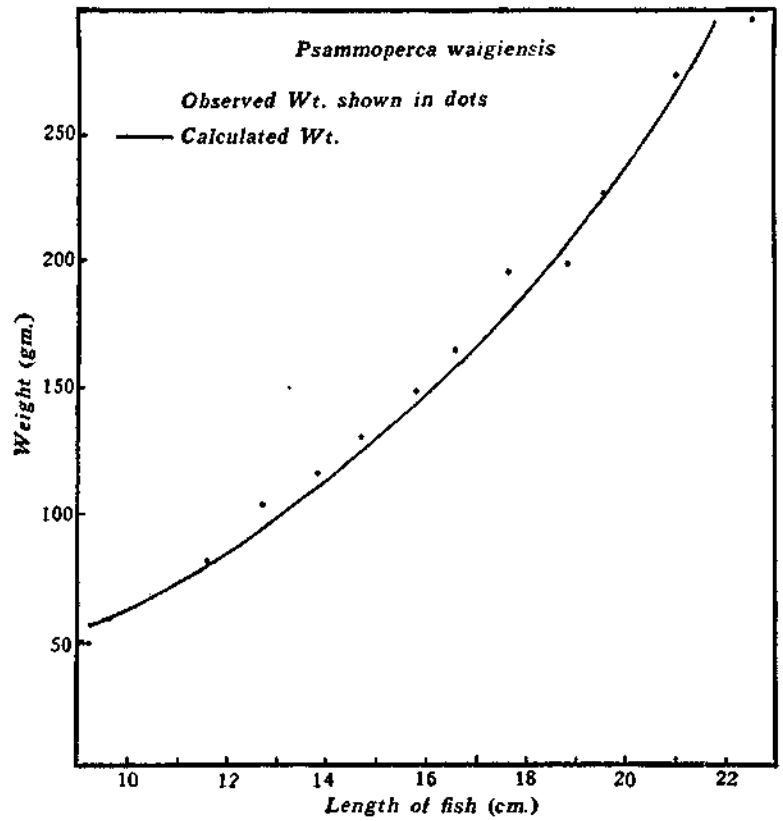


FIG. 7. Calculated length-weight curve fitted to the average observed length-weight values for *Psammoperca waigiensis*.

responsible for such a high rate of variation in the perch catches through traps. In this connection, the nature of bottom in areas where the traps were operated was classified broadly into four categories:

Nature of bottom	Description	Grade
Soft	Sandy with algæ	I
Medium	Sandy with corals nearby	II
Hard	Rocky with algæ	III
Very Hard	Rocky with corals	IV

Similarly, for the convenience in plotting the figure, the mid-points of the range in depth at the fishing place (in feet) and the range in its distance from the shore (in yards) were also calculated.

(a) Site of laying the traps

It is obvious from Fig. 8 that the average weight per trap was high on all those days when the traps were operated at a fairly great depth, away from the shore and in localities where the bottom was ' hard ' or ' very hard'. On 20–2–1951 the nature of the bottom was of Grade II but the depth at the place was low and consequently the average weight per trap also showed a slight decline as also on 27–2–1951, 8–3–1951 and 14–3–1951, when the depth was more but the nature of the bottom was only ' soft'. Similarly, the distance of the fishing place from the shore also seems to have

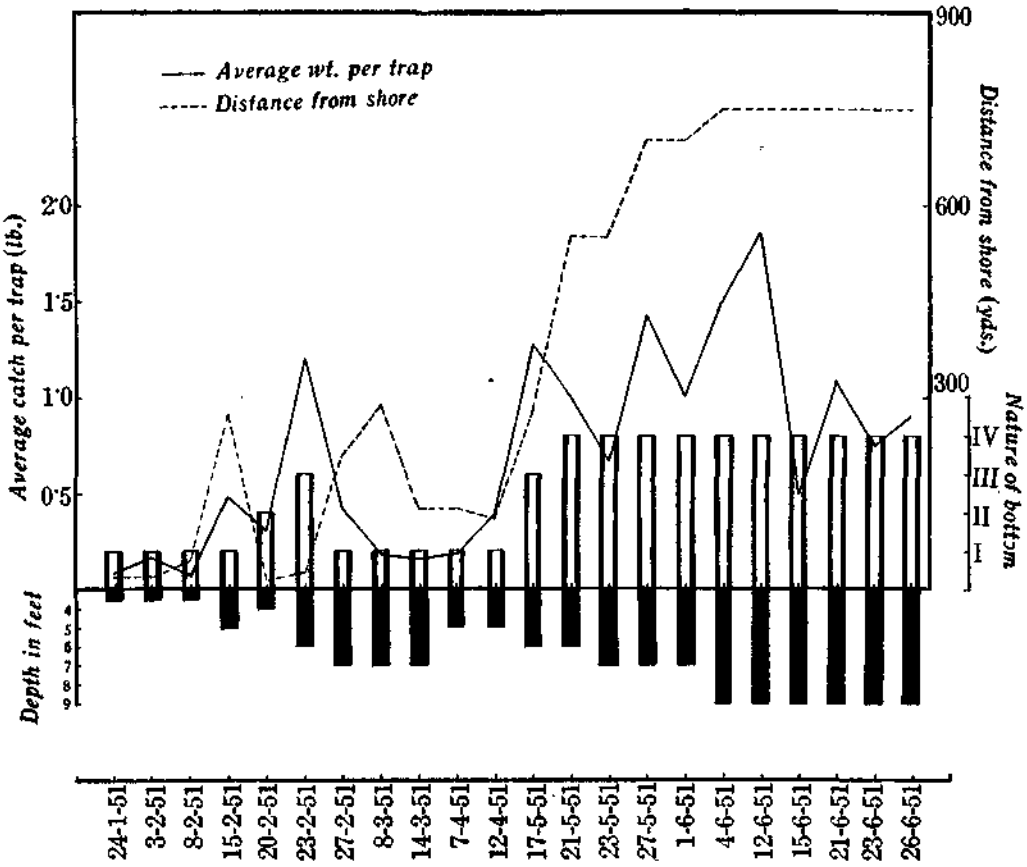


FIG. 8. Showing the nature of bottom at the fishing place, its depth and distance from shore and average catch per trap on different days.

a direct correlation to the average catch per trap. However, it is also apparent that these factors do have significant influence on the average weight per trap not independently but only collectively. Thus, it has been inferred that the average catch per trap per day has more or less a good correlation to (1) the nature of bottom, (2) the depth at the fishing place and (3) the distance of the fishing place from the shore. The greater the depth at the fishing place, its distance from shore and the degree of hardness at the bottom, the higher was the daily average catch per trap.

(b) Temperature and specific gravity

The specific gravity and temperature of surface water at the fishing place on different days are shown in Table IV and Fig. 9. The specific gravity of sea water was found to vary from 1019 to 1021 in the Gulf of Mannar side and 1019 to 1023 on the Palk Bay side and the temperature variations were 25·5° to 30·5° C. in the Gulf of Mannar and 27.5° to 30.5°C. in the Palk Bay. However, from Fig. 9 it could be seen that the fluctuations in the specific gravity and temperature of sea water on different days do not have any definite correlation to the average catch per trap on the respective days. Hence

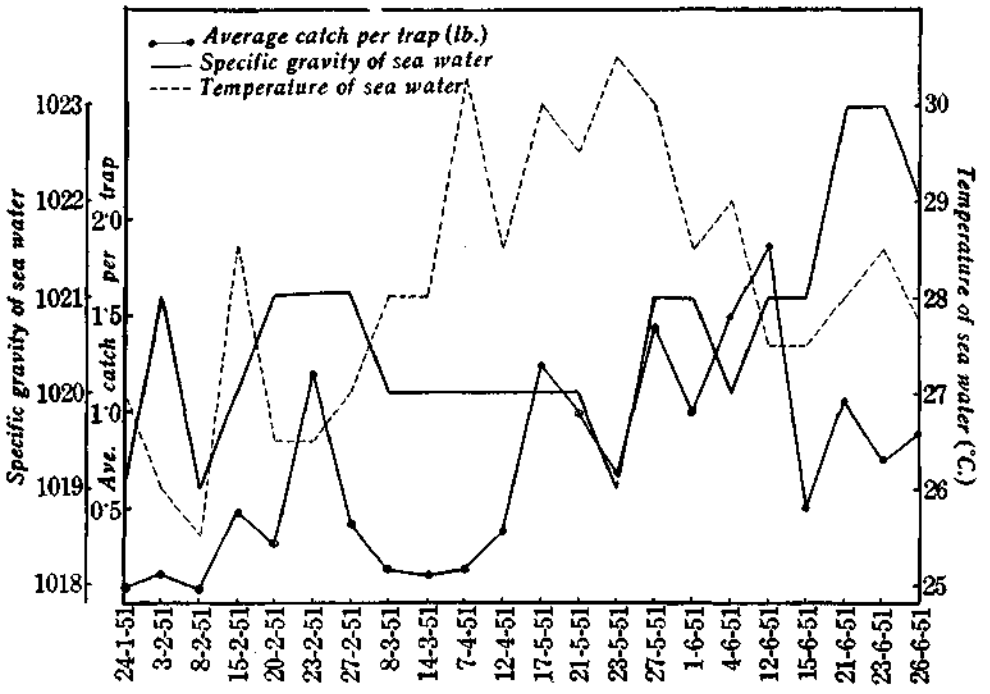


FIG. 9. Showing the specific gravity and temperature of sea water and the average catch per trap on different days.

it has been observed that both these factors do not exercise any appreciable influence on the average catch per trap. There is a limitation to this conclusion owing to the fact that temperature and specific gravity observations have been confined to surface waters and not the deeper waters where the traps are laid.

(c) Differences in bait

Generally in perch-trap operations, the baits used are pieces of crabs, dried holothurians, young clupeid fishes and jelly fishes. The use of different baits on different days depends mostly on the availability of any particular type of bait on that day. It is quite likely that the low values for the average catch per trap in Gulf of Mannar may have some correlation to the baits used, *i.e.*, dried holothurians and pieces of crabs, whereas, it has been found that the use of young clupeid fishes and jelly fishes as bait give better yield as on Palk Bay side, but as the latter types of baits were not used on Gulf of Mannar side, it could not conclusively be determined whether the use of such baits would give better yield in Gulf of Mannar side also. However, one significant observation made on the yield of different species caught by employing different baits was that jelly fishes when used as bait was found to attract *Teuthis* spp. in particular which of course are relatively unimportant in value in the total yield. On the 21st and 27th May, jelly fish was used exclusively as bait in two traps on each day and from a total of 104 and 66 fishes caught, 62 and 43 fishes belonging to the species *Teuthis marmorata* were caught on the respective days. *Lethrinus cinereus*, the chief species caught in perch-traps, both from Gulf of Mannar and Palk Bay, was found to be trapped irrespective of the type of bait used, but the percentage of this species in the total catch was found to be less on the days when jelly fish was used as bait. Although all the types of bait were found to yield slightly varying amounts of catches, from actual observations made on the total yield of fishes on different days, the four types of baits used in trapping perches could be arranged in the following order of preference: (1) dried holothurians, (2) young clupeid fishes, (3) pieces of crabs and (4) jelly fishes.

(d) Comparative efficiency of different types of traps

From the data gathered on the number of fishes caught through perch-traps with varying number of entrances, an attempt was made to study the relative efficiency of catches through traps with 1, 2, 3 and 4 entrances. Traps with entrances varying from 1 to 4 were operated from 21–5–1951 to 26–6–1951 in Palk Bay. The data gathered on the number of fishes caught on 10 different days were grouped, but the number of traps operated on each day was only one each with 2, 3 and 4 entrances whereas all the rest were one entrance

traps, the number of which varied from 2 to 7, so that in Table VIII, the average of the number of fishes caught in 1 entrance traps and the actual number of fishes caught in 2, 3 and 4 entrances each day are given.

TABLE VIII

Table showing the Average Number of Fishes Caught in 1 *Entrance Traps and the Actual Number of Fishes Caught in* 2, 3 *and* 4 *Entrance Traps*

Date	Average No. of fish from 1 entrance traps	Number of fishes caught in		
		2 entrance traps	3 entrance traps	4 entrance traps
21–5–1951 ..	7	47	8	10
23–5–1951 ..	2	3	10	10
27–5–1951 ..	5	8	25	14
1–6–1951 ..	5	12	17	21
4–6–1951 ..	5	32	5	22
12–6–1951 ..	7	15	29	10
15–6–1951 ..	2	4	8	1
21–6–1951 ..	1	0	25	6
23–6–1951 ..	3	10	5	Not observed
26–6–1951 ..	2	2	5	5
Total ..	39	133	137	99

The chief aim in making a study of the relative efficiency of catches through traps with varying number of entrances was to find out (1) whether the yield from traps with more number of entrances was greater than that from traps with 1 entrance only and (2) whether the yield varies among traps having 2, 3 and 4 mouths. From the totals of Table VIII, it is seen that the mean catch among the multifaced traps do not vary appreciably,

TABLE IX

Analysis of Variance

Sources of variation	Degrees of freedom	Sum of squares	Mean square	F
Between multi-faced traps ..	2	35·59	19·79	
Between multi- and single-faced traps	1	579·00	579·00	6·20*
Within traps	35	3269·10	93·40	
Total ..	38	3887·69	692·19	

* Indicates significant difference at 5% level.

although the difference between 1-faced and multi-faced traps is apparent. This is confirmed by the analysis of variance presented above.

From the analysis of variance, it is seen that the variation between the multi-faced traps is not significant, but the variation between the multi-faced traps and 1-faced traps is significant at 5% level. The conclusion that can be drawn therefore is that though multi-faced traps is superior to the single-faced trap in catching ability, there is no evidence of gain in superiority by increasing the number of faces in the multi-faced trap.

(*e*) *Total number of traps operated on different days*

From Table IV and Fig. 10 it could be seen that the average catch per trap is more or less inversely proportional to the total number of traps operated. From 24–1–1951 to 12–4–1951 the number of traps operated was fairly high except on 20th and 23rd February and during this period the average catch per trap was found to be less than 1 lb. per trap except on 23–2–1951. From 17–5–1951 onwards the total number of traps operated was only 10 or less than 10 but the average catch per trap had increased and it was 1 lb. or more on most days thereby indicating that the average catch per trap was directly affected by the total number of traps operated on the

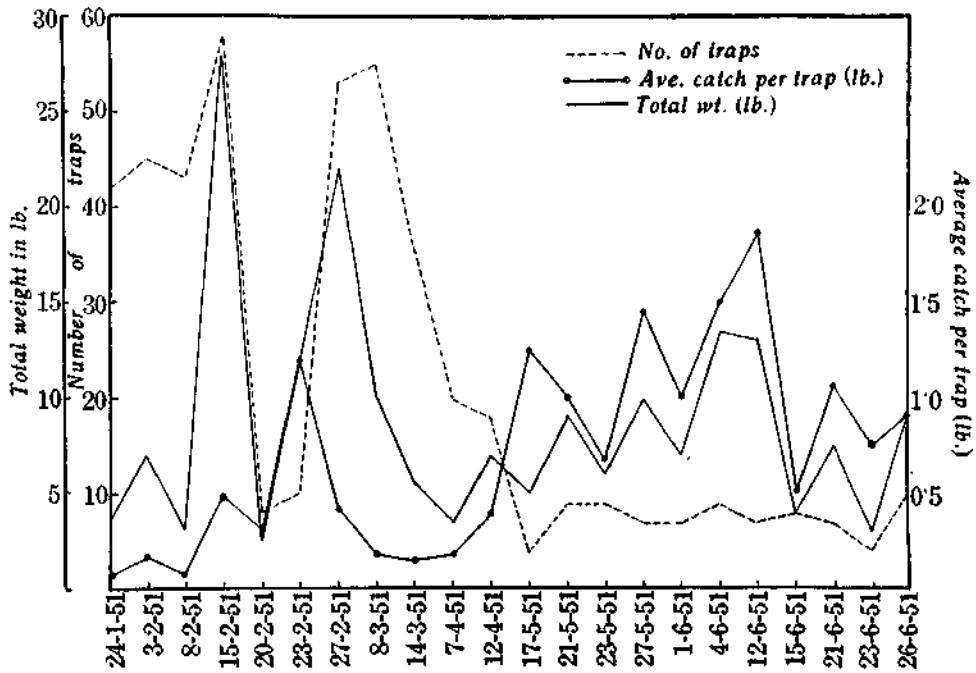


FIG. 10. Showing the total number of traps, total weight of landings and average catch per trap on different days.

respective days. Thus it could be concluded that the efficiency of perch-trapping might not be affected by employing less number of traps in a particular locality.

IX. Differences in the Yield from Gulf of Mannar and Palk Bay

Considering the average catch per trap per day and per season in the Gulf of Mannar and Palk Bay as indexes to judge the relative perch fishery resources in these two areas, it could easily be determined that the perch fishing, by employing special traps, in Palk Bay is comparatively more productive. At the same time it becomes necessary to find out the reasons, if any, contributing to such a disparity between the perch fishery resources in these two areas which are adjacent to each other and connected throughout the year by the Pamban Pass. The data collected on the various aspects indicate that the conspicuous disproportion in the yield may probably be due to the following factors, namely (1) the use of different types of baits, (2) the setting of traps at varying depths, (3) the distance of the fishing place from the shore, (4) the nature of bottom at the fishing place and (5) the method of fishing, *i.e.*, setting the traps in a line tied to a rope at intervals as on the Gulf of Mannar side and leaving the traps scattered at different places as on Palk Bay side. In Palk Bay, the use of young clupeid fishes and dried holothurians as bait, setting of traps at greater depths and at a greater distance from shore than in Gulf of Mannar and leaving the traps near rocks and corals, have been found to be some of the factors that are probably responsible for a high average catch per trap. It is also possible that there are more fish in the Palk Bay area at the depths at which the traps are laid but this may not be owing to the fact that Palk Bay area is underfished and Gulf of Mannar overfished, as long as the intensity of fishing in both the areas is almost same. However, the determination of the causes regarding the occurrence of certain species like *C. ghobban* in Gulf of Mannar alone and *T. marmorata* in such large numbers in Palk Bay catches, is deemed beyond the scope of the present investigation, and from the data gathered on the various aspects, it has not been possible to offer any satisfactory explanation.

X. Summary

An account of the perch-fishery by special traps and the different methods of operating them in the Gulf of Mannar and Palk Bay around Mandapam is given. Among the 23 species of fishes caught in perch-traps, only 18 species were true perches. From a study of the percentage composition of the different species caught in perch-traps, *Lethrinus cinereus* was found to be the

main species occurring in the catches from both the areas and the second important species *Callyodon ghobban* in the catches from Gulf of Mannar was found to be replaced by *Teuthis marmorata* in Palk Bay.

The percentage of non-perches in the traps in the Gulf of Mannar catches was 26·28; *C. ghobban*, a non-perch, alone forming 25·98%, whereas in Palk Bay catches it was only 0·36 corresponding to 0·3% excluding *C. ghobban* from Gulf of Mannar.

The daily average catch per trap per day was found to vary from 0·07 to 1·86 lb. and the average catch per trap per day in Gulf of Mannar was observed to be 0·3 lb. and in Palk Bay 1·1 lb. The average catch per trap per day was found to have a good correlation to the nature of bottom, the depth at the fishing place and its distance from the shore. The average catch per trap per day for the whole season was calculated to be 0·71 lb., with standard deviation of the daily means 0·5118 and standard error of the final mean 0·11.

The annual total yield through perch-traps in the Mandapam area of the Gulf of Mannar and Palk Bay was estimated to be 1,05,000 lb. (47·28 tons).

Observations made on the gonadic condition of the different species have shown that most of the species caught in perch-traps are immature except *Psammoperca waigiensis*, *Pelates quadrilineatus*, *Therapon puta* and *Upeneoides tragula* in which gonads in advanced stages of maturity were also observed.

The length-weight relationship in 5 important species caught in perch-traps was found to show the normal pattern, the weight increasing as the cube of the length.

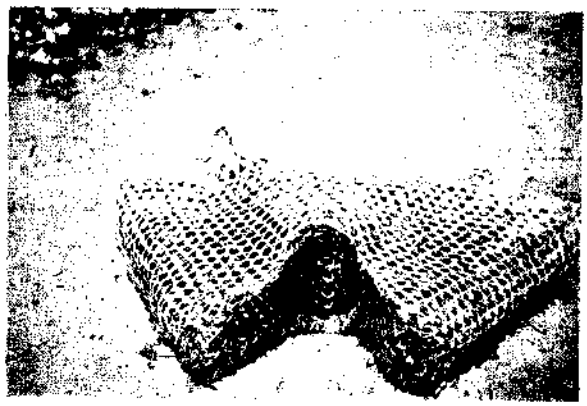
Examination of the stomach contents of the different species indicate that all the species caught in traps are either bottom feeders or browsers.

Temperature and specific gravity of sea water at the fishing place were not found to have any influence on the average catch per trap.

Effect of different kinds of baits on perch catches has been discussed.

From analysis of variance, it has been observed that though the multi-faced trap is superior to the single-faced trap in catching ability, there is no evidence of gain in superiority by increasing the number of faces in the multi-faced trap.

A comparison between the perch fishery resources from Gulf of Mannar and Palk Bay indicates that the latter is more resourceful than the former



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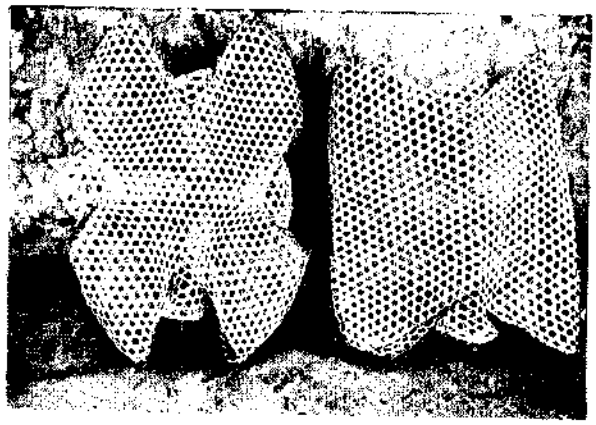

(*b*)

(*a*) A trap with 3 entrances. (*b*) Traps with 4 and 2 entrances

Perch Traps from the vicinity of Mandapam

and some of the probable factors likely to cause a disparity in the perch catches between these two areas are discussed.

XI. Acknowledgements

The work was carried out at the Central Marine Fisheries Research Station, Mandapam, during the year 1951. My sincere thanks are due to Dr. N. K. Panikkar, the Chief Research Officer, for guidance and criticism throughout the period of this work and for going through the manuscript and suggesting improvements. I am grateful to Shri S. K. Banerji, Statistician, Central Marine Fisheries Research Station, for the unfailing help he has rendered on the statistical aspects of this investigation.

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