

"GHOL-DARA" FISHERY OFF BEDI PORT IN THE GULF OF KUTCH

BY Y. M. BHATT*, M. NARAYANAN KUTTY, K. VENKATA SUBBA RAO AND
D. M. PUNWANI

(Central Marine Fisheries Research Institute)

INTRODUCTION

Trawling done along the Saurashtra coast has shown that fishing grounds off Dwarka near the mouth of the Gulf of Kutch compare favourably with some of the richest ones in the world (Jayaraman *et al.* 1959). There is a steady fishery for most of the trawl fishes in the fishing grounds throughout the year. It is significant that three of the most commercially important fishes, namely 'Dara', *Polydactylus indicus* (Shaw), 'Ghol', *Pseudosciaena diacanthus* (Lacépède) and 'Koth', *Otolithoides brunneus* (Day), caught along this coast support good inshore fisheries, though for a very short duration, in the Gulf of Kutch and are collectively referred to as the "Ghol-Dara fishery". The fishery lasts for about six weeks from March to May and is peculiar in that it is made up exclusively of adult fishes, which grow to large sizes (1,000 to 1,500 mm.) and are being caught by a highly selective, large-meshed gill net operated at the bottom.

The main area of activity of this fishery is off Bedi Port (long. 70° 2' E, lat. 22° 31' N) situated inside creek near Jamnagar in the Gulf of Kutch.

These investigations were taken up with a view to throwing light on some aspects of the trawl fisheries of Maharashtra and Gujarat coasts, and further the development of the local fishery.

GENERAL FEATURES OF THE FISHERY

It is of interest that even though the area is quite rich, the local fishermen along the coastline of the Gulf of Kutch do not fully exploit these resources. Men engaged for this fishery at Bedi Port alone would number about 800; and almost all these men come from outside areas, mainly Southern Gujarat (Kolak, Umersadi and Pardi) and Northern Maharashtra (Satpati and Dahanu).

The majority of the boats operated are non-mechanised ones. The mechanised boats are usually few. In 1959 season 61 boats (6 mechanised); in 1960, 93 boats (16 mechanised); and in 1961, 85 boats (17 mechanised) were engaged in this fishery.

* Dr. Bhatt passed away in January, 1967 while he was on the staff of Bhabha Atomic Research Centre, Bombay.

Since the establishment of the Ice Factory and Cold Storage Plant at Bedi Port, Jamnagar by the State Fisheries Department in 1959 the transportation of fresh fish to markets of Bombay and other cities has been greatly facilitated. In spite of this, a major portion of the catch is salt dried while the vessels stay out in the Gulf of Kutch itself.

Of subsidiary economic importance is the export of air-bladders of these fishes. In 1958 alone 5,740 kg. of dried air-bladders worth about Rs. 26,800 were exported.

FISHING OPERATIONS

The fishery at Bedi Port is a spring tide fishery. The day to day fluctuations in the landings of 'Dara' at Bedi Port by 20 boats under the management of Shri D. N. Kahar, a fish merchant at Jamnagar are shown in Fig. 1. The same boats were examined on all the days of the fishing season (1960). It can be seen that the catches tend to be very good around the new moon and full moon days. In between two spring tide periods there is a period of 4-6 days when the fishermen do not go out for fishing, as the catch returns are known to be generally meagre. Similar instances of lunar periodicity of high catch returns have been reported earlier in the case of East Anglian herring (Hickling, 1956). It is of interest to note that Jayaraman *et al.* (*loc. cit.*) have observed that the catch rate for 'Dara' in the trawling grounds of Dwaraka (mostly between 31 and 50 metres) was higher in the spring tide periods during January and May and in the neap tide period in all other months.

The craft used in the Bedi fishery are Gujarat 'Vahan' or 'Matada' mostly used by the fishermen of Southern Gujarat (Srivatsa, 1953) and the Satpati and Dahanu boats used by Maharashtra fishermen. The Gujarat 'Vahan', a description of which is given by Srivatsa (*loc. cit.*), is a sturdy plank built boat with overall length of 32 to 45 ft., depth of 6 to 7½ ft., beam of 9½ to 12½ ft., and a draft of 3½ to 6 ft. The Dahanu sailing boat or 'Padav' is 30 to 35 ft. in length. A few mechanised boats also operate here. Each boat takes 8 men on board. While some boats in which facilities are available for bringing fish for sun drying, keep away from the shore for 8 to 9 days, other boats return with their catches every day.

The tackle used for fishing is a large-meshed gill-net operated at the bottom, made of Italian hemp, a description of which is given by Srivatsa (*loc. cit.*). The net is weighted with sinkers at the lower margin and operated at the bottom usually at depths ranging from 15 to 30 metres. Many pieces of nets are tied together, the number of pieces in one net or unit varying from 80 to 90. Each piece of net has 12 or more wooden floats attached to the upper margin at an interval of 1,250 mm. The dimensions of nets used by

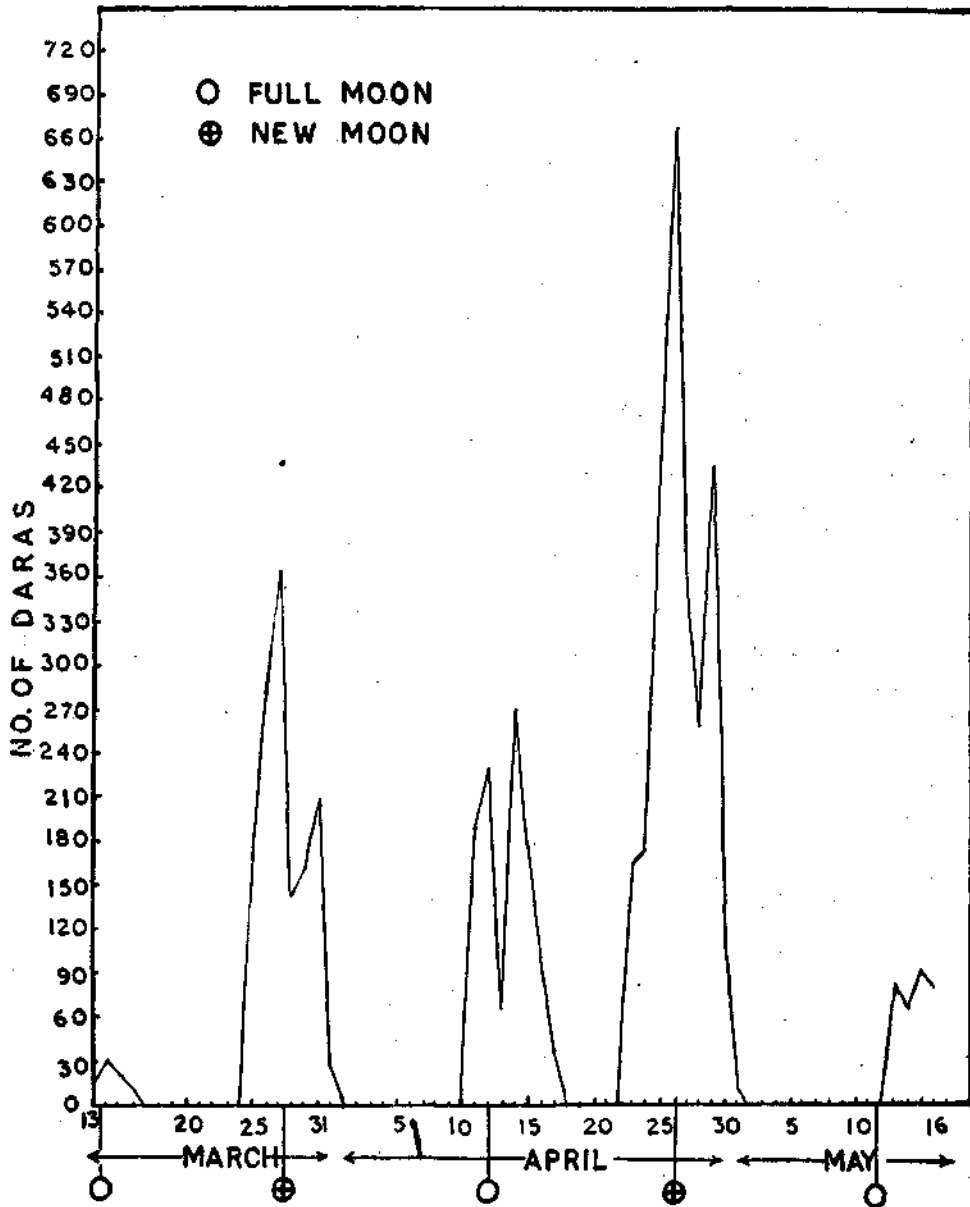


FIG. 1. Daily landing of 'Dara' by 20 boats under the management of Shri D. N. Kahar at Bediport during the 1960 season.

Kolak-Umersadi fishermen and Satpati-Dahanu fishermen show some minor differences as given in Table I.

TABLE I—Measurements of gill nets

Type of net	Kolak-Umersadi net	Satpati-Dahanu net
Mesh-size (diagona')	180 to 185 mm	185 to 190 mm
Height	2,100 to 2,200 mm	1,700 to 1,750 mm
Length of one piece	16,000 to 18,000 mm	15,000 mm
Number of pices in one unit	80 or less	80 to 90

The local fishermen of the coast use another type of gill net known as 'Halar Rachh' of different mesh sizes for catching mullets, pomfrets, sciaenids, polynemids, sharks etc., Srivatsa (*loc. cit.*). Fishing by this gear during 'Ghol-Dara season' is comparatively very little. Another type of net used locally is the 'Add' which is a barrier net used in the tidal regions.

At Sachana about 18 miles from Jamnagar, 'Dara', 'Ghol' and 'Koth' are captured in fairly good numbers in 'Wadas', which are boulder-walled tidal fish traps. These are circular enclosures with a diameter of 100 to 150 metres, which let in water during the high tide. The single opening facing the sea is closed during the ebbing tide when water flows out through the stone-walls entrapping the fishes. According to Hornell (1950, p. 154) this is one of the most primitive methods of capturing fish.

FISH LANDINGS

The fish landings (in kg.) at Bedi Port during the 'Ghol-Dara season', from 1957 to 1961, as from the records of the State Fisheries Department are given below in Table II.

TABLE II—Fish landings (in kg) from 1957 to 1961.

Fishes	1957	1958	1959	1960	1961
'Dara'	3,18,960 (72.3)	3,93,498 (83.1)	3,24,970 (91.0)	1,90,944 (90.4)	4,20,714 (95.0)
'Ghol'	7,956 (1.8)	7,758 (1.8)	7,128 (2.0)	7,038 (3.3)	15,030 (3.4)
'Koth'	55,656 (12.6)	55,246 (13.6)	10,692 (3.0)	5,688 (2.7)	7,218 (1.6)
Others	58,716 (13.3)	6,354 (1.5)	14,292 (4.0)	7,524 (3.6)	not available
	4,41,288	4,62,856	3,57,082	2,11,194	4,42,962*

Figures in brackets indicate their percentage in the total catch. *The total catch given for 1961 does not include 'others'.

OBSERVATIONS ON THE BIOLOGY OF 'DARA', 'GHOL' AND 'KOTH'

The length measurements given in this paper refer to the furcal length *i.e.*, from the tip of the snout to the forked portion of the caudal fin in the case of 'Dara', and to the total length *i.e.*, from the tip of the snout to the longest ray of the caudal fin for 'Ghol' and 'Koth'. The techniques followed in the examination of the material are given in the course of the paper under respective sections.

'Dara' — *Polydactylus indicus* (Shaw)

Length frequency distribution.—The length frequency distribution of 'Dara' for the seasons 1957, 1959, 1960 and 1961 is shown in figs. 2, 3 and 4. The size range of 'Dara' landed was from 800 to 1,110 mm. It can be seen from the figures that the length frequency polygons show a unimodal distribution for

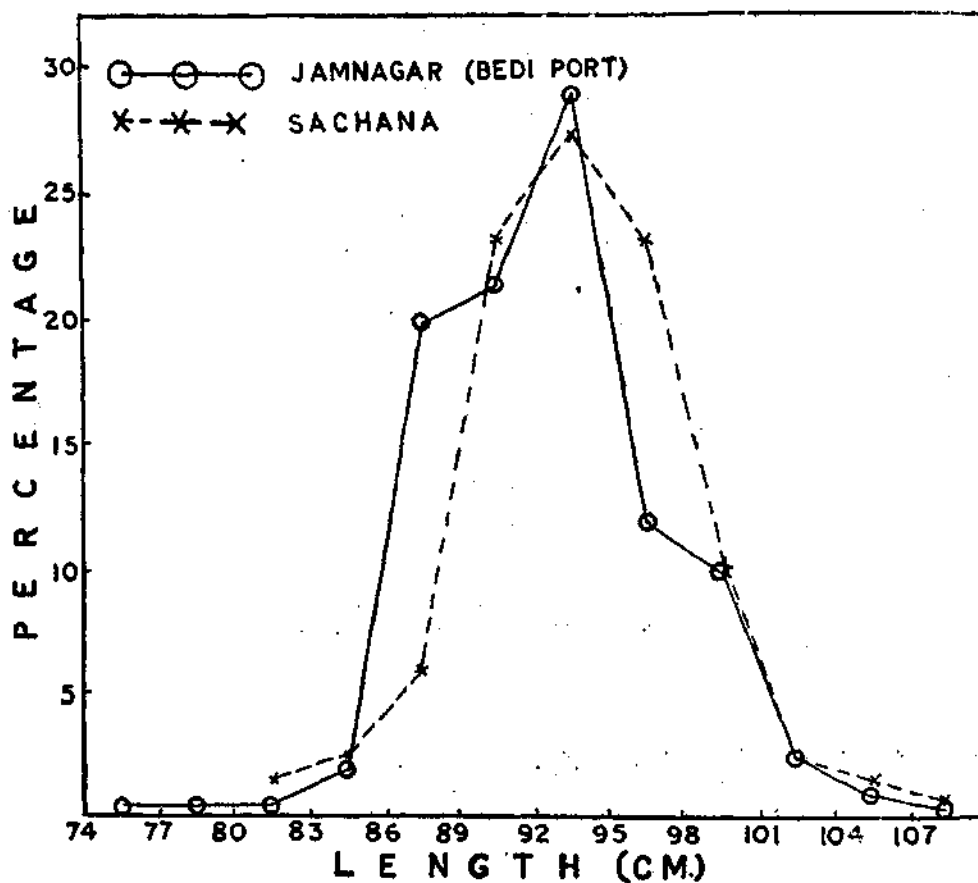


FIG. 2. Length-frequency distribution of 'Dara' from the gill net catches at Bedi port and from the catches of 'Wadas' (tidal fish traps) at Sachana in April 1957.

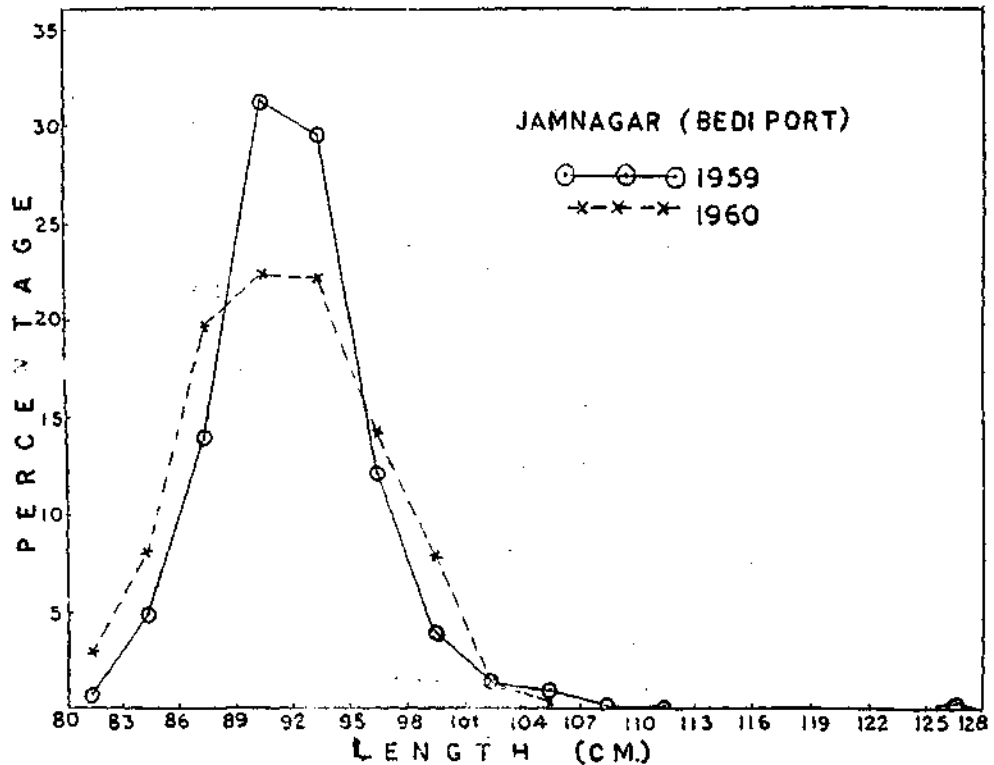


FIG. 3. Length-frequency distribution of 'Dara' from the gill net catches at Bedi port during the 1959 and 1960 seasons.

all the four years. In 1957, both at Bedi Port and Sachana 920 to 950 mm. group was dominant with the mode at 935 mm. While in 1959, 1960 and 1961 at Bedi Port 890 to 920 mm. group was dominant, the modal position being at 905 mm. (The length frequency of some 'Daras' caught at Sachana are given in fig. 2). The smaller size groups are not caught since a highly selective gear with a mesh of 180 to 190 mm. is used and 'Dara' above 800 mm. in length only are caught in this.

Nayak (1959) assigns the group 896 to 995 mm. to the fourth year class. According to Mohamed (1955) those with a modal position at 900 mm. come under the fifth year group. It is of interest to note that this group with the mode at 900 mm. is completely absent in the trawl catch from the Kutch region according to the observations of Mohamed (1965), while in the present investigation, the size groups 890 to 920 mm. and 920 to 950 mm. have been predominant in the bottom-set gill nets operated in the Gulf of Kutch and their catches landed at Jamnagar. The non-availability of these size groups in the trawler catch in the Kutch region outside the Gulf during the months of March and April and their predominance in the bottom-set gill net catches inside the Gulf

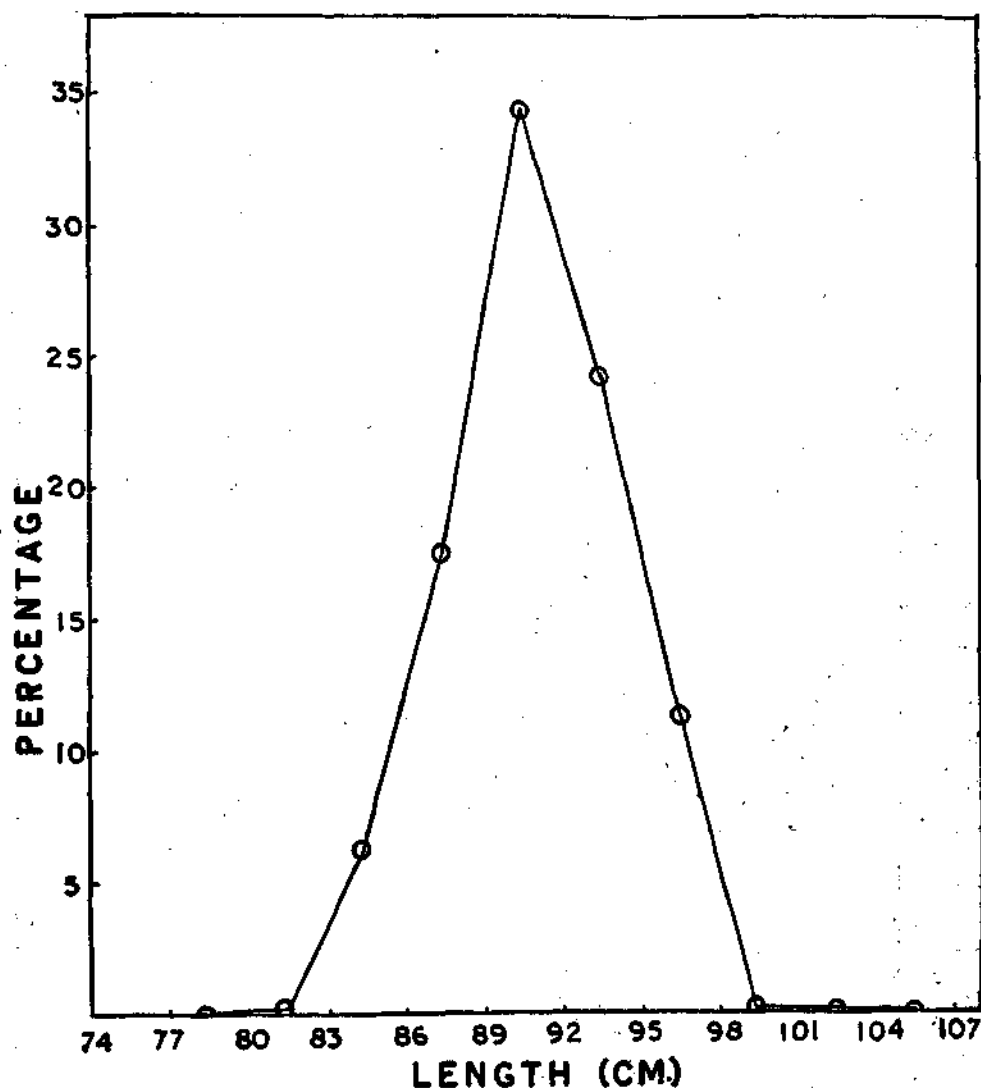


FIG. 4. Length-frequency distribution of 'Dara' from the gill-net catches at Bedi port in April, 1961.

of Kutch in these months (1957, 1959, 1960 and 1961) suggests that the individuals of these size groups may have been migrating into the shallower waters of the Gulf of Kutch.

Maturation and spawning.—Three specimens in stage VI (running) of maturity were observed in the bottom-set gill net catches landed at Jamnagar on 15-4-1961 and after noting the length and breadth, the ovaries were preserved in 5% formalin. The ovaries were fully swollen and light yellow in colour.

Ova could be pressed out under stripping pressure on the abdomen. While preserving the ovaries, some of the ripe ova had fallen from their follicles into the atlas jar. The ovaries contained (i) immature ova ranging from 0.01 to 0.30 mm. in diameter; (ii) maturing ova full of yolk ranging from 0.30 to 0.60 mm. in diameter; and (ii) mature ova completely transparent ranging from 0.60 to 1.30 mm. in diameter. The mature ovum contains a large oil globule of 0.24 to 0.34 mm. in diameter. Besides this large oil globule, some ova contain 2 or 3 smaller oil globules (globulets).

In fig. 5A & B are shown the ova diameter frequency polygons of one of these specimens. The procedure adopted was similar to that of Clark (1934).

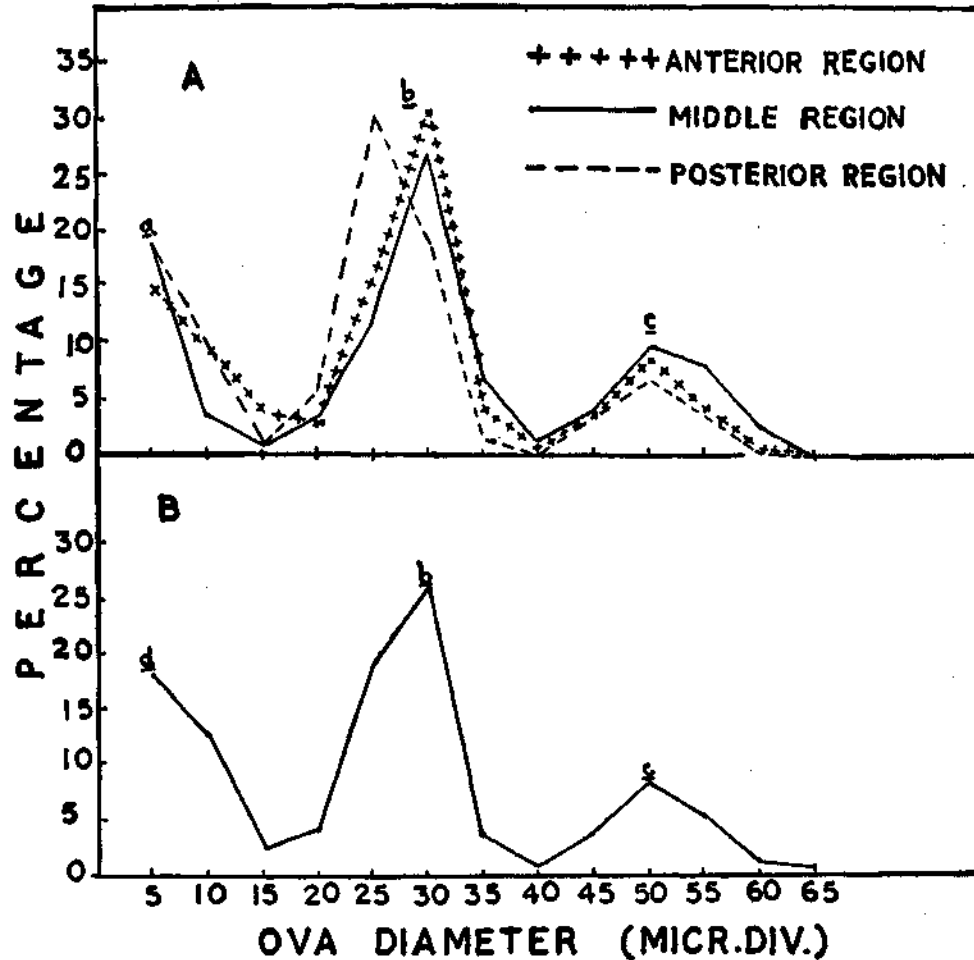


FIG. 5. Ova diameter frequency curves of *Polydactylus indicus*. A. Ova-diameter frequency curves for the anterior, middle and posterior regions of the ovary. B. Pooled ova-diameter frequency curve of the 3 regions.

DeJone (1939) and Prabhu (1956). Diameters of 930 ova, roughly 300 from each of the anterior, middle and posterior regions separately were taken and are presented in fig. 5A. It can be seen from the figure that there is not much difference in the ova diameter frequency distributions in the 3 regions of the ovary. Hence in fig. 5B is represented the pooled ova diameter frequency for the 3 regions combined. Three modes *a*, *b* and *c* can be clearly made out. The mode at *a* represents the immature ova. The ova under mode *b* at 0.60 mm. (30 md.) comprise those which are fully opaque (maturing), while those under mode *c* at 1.00 mm. (50 md.) are fully ripe ones ready to be spawned. Some of these ripe ova had already burst out from their follicles and fallen into the atlas jar. That is probably why the mode at *c* is not very prominent. The ova under mode *c* are likely to be shed immediately, possibly in a few days. The ova under mode *b* are also in a sufficiently advanced stage of development (mature stage IV) and may be spawned subsequently and the time interval may not be long. They may probably be shed by June or July. The ova under mode *a* form the stock for the next season. This is in agreement with the observations of Mohamed (1955), Nayak (1959) that from June onwards the spent individuals predominate the trawl catches. The 'Dara' catch in the trawlers was mostly obtained from the Dwaraka and nearby regions. Mohamed (*loc. cit.*) also refers to the specimens reported to be in roe in March-April caught off Jamnagar while the single running specimen in stage VI observed by Nayak (*loc. cit.*) was collected from Sachana near Jamnagar, in April 1954.

The present observations indicate that *P. indicus* may have a prolonged breeding season and that the ova may be shed in more than one batch. Karekar and Bal (1960) have observed that the V or penultimate stage of maturity is present in most of the months of the year and that spent individuals occur during the months of April to November. In this connection it is of interest to note that Nayak (*loc. cit.*) has stated that the first spawning season of 'Dara' extends from April to June followed probably by a second spawning in October to December.

In the light of the available knowledge of breeding periodicity of *P. indicus*, it may be stated that it has a prolonged spawning extending from April to about November/December and that the individual members of the species spawn more than once in a season.

Fecundity.—The fecundity estimates of the ovary calculated separately from the right and left lobes were 37,22,827 and 37,19,810 respectively. The ova count per gram sample of the ovary from the right and left lobes worked out to be 5,463 and 4,303 respectively. Karekar and Bal (*loc. cit.*) have observed individuals with 4,000 to 8,500 ova count per gram sample; probably these gonads have discharged one or two batches of ova. According to the above

authors the number of mature ova spawned in one batch may vary between 2,550 and 4,000 per gram sample.

Sex ratio.—Out of 98 specimens examined in April 1961, 95 were males and 3 females. Landings on some days consisted of only males. This preponderance of males suggests more or less a complete segregation of sexes in the adults (mature). All the males were in mature condition and the smallest mature male was 800 mm. in length. The three females in the running condition were in stage VI. Since all the males and females examined were in advanced stage of maturity, it appears quite likely that '*Dara*' may be spawning inside the Gulf of Kutch. The same has been suggested by Mohamed (*loc. cit.*) Srivatsa (1953) mentions that Jew fishes and Indian Salmons enter the Gulf of Kutch for spawning in March.

Mohamed (*loc. cit.*) has also observed that the inshore catches of *P. indicus* on the 17th and 18th April 1953 from Satpati, a fishing village about 60 miles North of Bombay consisted almost entirely of mature males while the trawler catches from Cambay region consisted of mostly females, males being almost completely absent.

Food and feeding.—Mohamed (1955) and Karekar and Bal (1958) have made observations on the food and feeding habits of *P. indicus*. During the present investigations 93 specimens in 1960 and 114 specimens in 1961 season of the size ranging from 800 to 1,040 mm. were examined for the study of food and feeding habits. The number of individuals with empty stomachs was 16 (17.20%) and 9 (7.89%) in 1960 and 1961 respectively, while others had food in varying degrees of fullness. Both the qualitative and quantitative analysis of the gut contents have been made. The quantitative analysis was made by the Points method and the Occurrence method (Hynes, 1950). The percentage composition of different items of food is shown in Table III and fig. 6A & B.

TABLE III

Percentage composition of the different food items in the stomach contents of P. indicus during the seasons 1960 and 1961 analysed by the points and occurrence methods

Food item	1960		1961	
	Points method	Occurrence method	Points method	Occurrence method
Prawns	51.53	60.18	69.69	90.31
Unidentified prawns	17.45	34.40	15.55	35.96
<i>Parapenaeopsis sp.</i>	1.60	1.07	19.77	20.17

TABLE III—contd.

	1960		1961	
	Points method	Occurrence method	Points method	Occurrence method
<i>P. sculptilis</i>	14.36	6.45	22.36	20.17
<i>P. hardwickii</i>	..	..	7.29	6.14
<i>P. styliferates</i>	..	..	0.64	0.87
<i>Metapenaeus affinis</i>	9.01	3.22	1.62	1.75
<i>Acetes indicus</i>	0.11	1.07	0.64	1.75
<i>Solenocera indicus</i>	0.69	2.15	1.45	2.63
<i>Leander sp.</i>	1.94	3.22	0.32	0.87
<i>Leander sp.</i>	1.94	3.22	0.32	0.87
<i>Hippolytina ensirostris</i>	6.39	8.60	..	..
Other crustacea	15.05	25.80	18.47	33.32
<i>Squilla sp.</i>	12.31	20.43	13.45	21.05
Unidentified crabs	0.23	1.07	2.75	8.77
<i>Charybdis sp.</i>	..	..	2.26	3.50
<i>Neptunus pelagicus</i>	2.51	4.30	..	..
Fishes	32.96	40.84	11.83	10.48
Unidentified fish and fish remains, scale, bones, otoliths, etc.	10.26	24.73	2.10	3.50
<i>Coilia dussumieri</i>	5.36	5.38	0.64	0.87
<i>Sillago sihama</i>	3.19	3.22	..	..
Sciaenids	2.96	3.22	0.81	0.87
<i>Trichiurus sp.</i>	4.79	2.15	..	..
<i>Harpodon nehereus</i>	4.56	1.07	5.34	3.50
<i>Arius sp.</i>	..	..	0.81	0.87
Eels	..	..	2.10	0.87
Gobiids	1.83	1.07	..	..
Unidentified matter	0.46	3.22	..	..

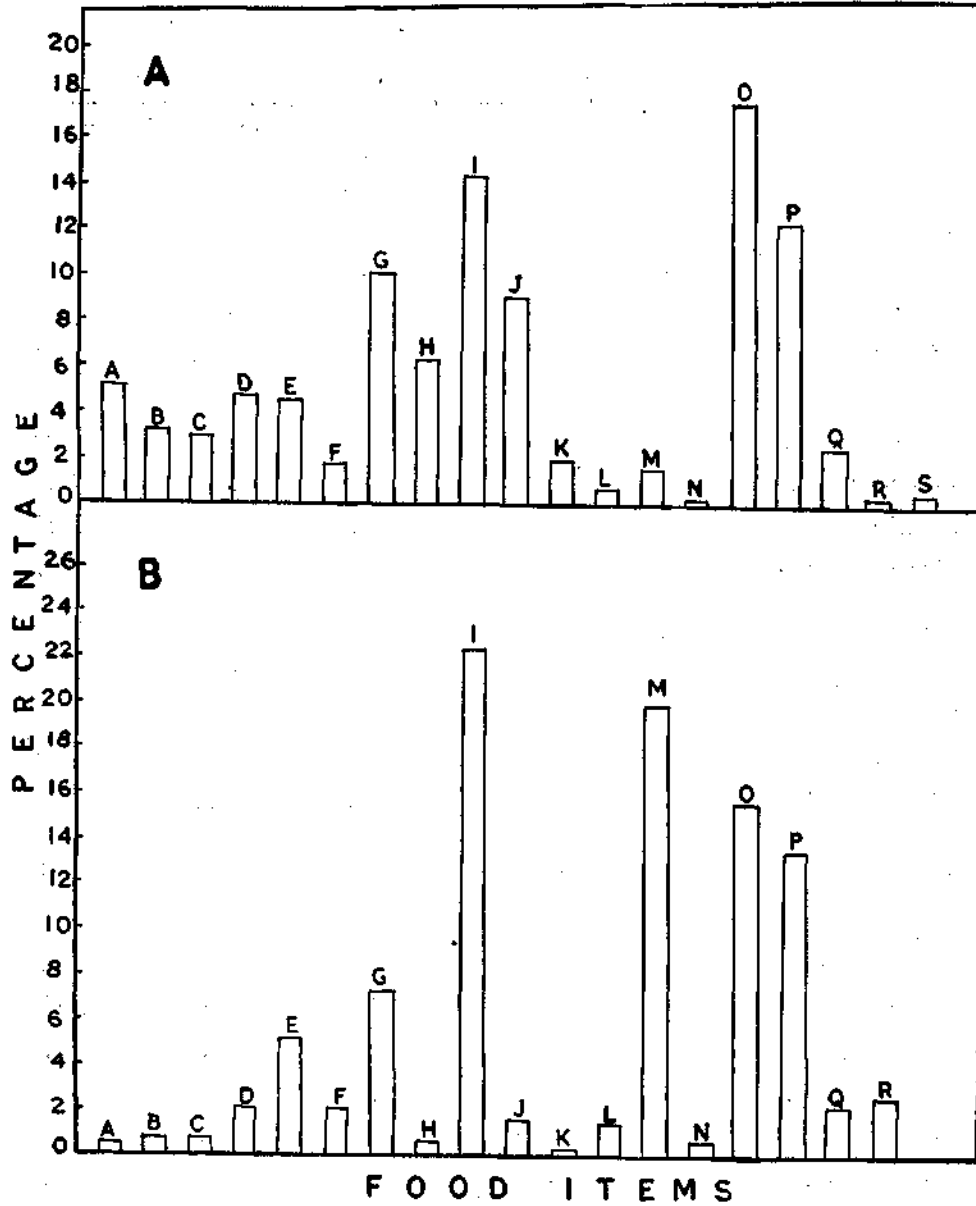


FIG. 6. A: Percentage composition of the different food items of 'Dara' landed at Bedi port during the 1960 season.

- A. *Coilia dussumieri*; B. *Sillago sihama* C. *Sciaenids*; D. *Trichurius* sp;
 E. *Harpodon nehereus*; F. *Gobiids*; G. Unidentified fish remains;
 H. *Hippolytismata ensirostris*; I. *Parapenaeopsis sculptilis*;
 J. *Metapenaeus affinis*; K. *Palaemon (Leander)* sp. L. *Solenocera indicus*;

- M. *Parapenaeopsis* sp. N. *Acetes indicus*; O. Unidentified prawn remains;
 P. *Squilla* sp.; Q. *Neptunus pelagicus*; R. Unidentified crab remains;
 S. Miscellaneous (unidentified) matter.
- B: Percentage composition of the different food items of 'Dara' landed at Bedi port during April 1961.
- A. *Coilia dussumieri*; B. Cat-fish (*Arius* sp.); C. Sciaenids; D. Eels.
 E. *Harpodon nehereus*; F. Unidentified fish remains; G. *Parapenaeopsis hardwickii*; H. *Parapenaeopsis stylifera*; I. *Parapenaeopsis sculptilis*; J. *Metapenaeus affinis*; K. *Palaeomon (Leander)* sp.;
 L. *Solenocera indicus*; M. *Parapenaeopsis* sp.; N. *Acetes indicus*;
 O. Unidentified prawn remains; P. *Squilla* sp.; Q. *Charybdis* sp.;
 B. Unidentified crabs.

During the seasons 1960 and 1961 the crustaceans constituted the largest single item of food consumed (66.58% and 88.16% for respective years), while fish formed 32.96% in 1960 and 11.83% in 1961. Amongst crustaceans, prawns formed 51.53% and 69.69% of the diet in 1960 and 1961 respectively, *Squilla* spp. and crabs coming next in order of abundance. *Coilia dussumieri*, *Sillago sihama*, Sciaenids, *Trichiurus* spp., *Harpodon nehereus*, *Arius* spp., Eels, Gobies were the fish components observed in the stomach contents besides unidentified fish and fish remains which were in an advanced stage of digestion. *Coilia dussumieri* (5.36%) ranked first amongst fish items in 1960 followed by *Trichiurus* spp., and *Harpodon nehereus* (4.79% and 4.56% respectively). During 1961, *Harpodon nehereus* formed 5.34%, Eels 2.1% and the other fishes formed only very small part of the food. It is interesting to note that during both the seasons (1960 and 1961) *Parapeneopsis sculptilis* ranked first amongst the prawn items (14.36% and 22.36%) in the food analysed separately by two of the present authors. The feeding intensity was observed to be low during both the seasons, the average number of points being 4.7 and 5.4 in 1960 and 1961 respectively. The average fullness of stomach worked out to be 1/5 to 1/4 in both the seasons.

'Ghol' — *Pseudosciaena diacanthus* (Lacépède)

Length frequency distribution.—Observations on 'Ghol' were mainly made during the 1961 season. The length frequency distributions of 'Ghol' for 1957 and 1961 are given in fig. 7. Three modes could be made out in the 1961 data at 925 mm., 1,050 mm. and 1,175 mm., while the 1957 data shows a distribution with a single mode at 1,125 mm. In this connection it may be mentioned that 'Ghol' above 1,050 mm. in length are rare in the catches of the trawlers and those above 1,110 mm. were not encountered in the bull-trawler catches landed from the Kutch region. The larger size groups above 1,050 mm. are quite common in the 'dol' net catches at Versova and Sassoon Docks (Bombay) from February to April. Whether this is due to gear selection or differential distribution of the size groups is not clear. The dominance of

the larger size groups in the gill net catches may be due to the larger mesh while their presence in the 'dol' net may not be due to mesh size since juveniles of 30 to 50 mm. and big 'Ghol' of 1,200 mm. in length are taken in it. Particularly the intermediate size groups not caught in the 'dol' net and gill net are caught in good numbers by the trawlers.

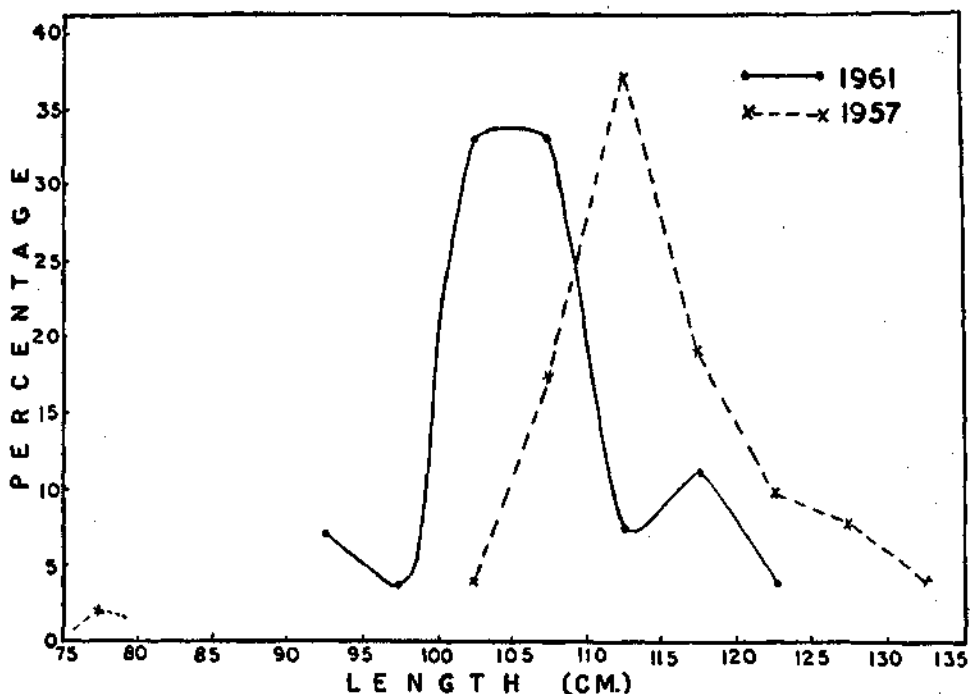


FIG. 7. Length-frequency distribution of 'Ghol' from the gill-net catches at Bedi port during the 1957 and 1961 (April) seasons.

Maturity and spawning.—Only three specimens could be studied for gonadal condition and maturity. All the three were females in stage IV of maturity. In others it was not possible to observe the gonadal condition since the gonads were removed along with the entrails in order to keep the catch fresh. The fecundity estimates for two specimens of 1,030 mm. and 1,000 mm. in length were 6,703,924 and 4,826,775 respectively.

As the few females examined for maturity were only in stage IV during April the fish is expected to spawn under normal conditions probably by June. It has been observed from the catches of bull-trawlers of New India Fisheries Ltd., Bombay that the spawning season of 'Ghol' is protracted, extending from June to September (Rao, K. V. S. under publication). With the available data, it is not possible to state whether 'Ghol' like 'Dara' spawns in the Gulf of Kutch.

Food and feeding.—The stomach contents of only 4 specimens could be examined in April 1961. Digested prawns and prawn remains were observed in their stomachs.

Age and growth.—Scales and otoliths of this species show annual growth checks which are useful in age determination (Rao, 1961). Scale samples from 27 fish caught in the gill nets at Bedi, Jamnagar, in April 1961 were studied. Scales from two fish could not be read and the frequency distribution of the growth rings in the scales of 25 fish which could be read is given in Table IV.

TABLE IV

Frequency distribution of the growth rings in the scales of 'Ghol' P. diacanthus collected at Bedi (Jamnagar) in April 1961

Length group (cm.)	No. of fish examined	Number of rings in the scales				
		IV	V	VI	VII	VIII
90—94.9	1	1	..	..	..	..
95—99.9	2	1	1	..	..	..
100—104.9	7	1	6	..	..	..
105—109.9	9	..	4	5	..	..
110—114.9	2	..	..	1	1	..
115—119.9	3	..	..	..	3	..
120—124.9	1	..	..	..	..	1
Average length (cm.) of fish with rings.		97.0	103.21	107.71	115.61	122.0

It can be seen from table IV that age groups IV to VIII were present in the sample collected in April 1961. The V and VI age groups (i.e., five and six year olds) dominated the catch forming 44% and 24% respectively. Age groups IV, VII and VIII formed 12%, 16% and 4% respectively. 'Ghol' formed a small part of the catch at Bedi, Jamnagar, and hence only limited material could be examined.

'Koth' — Otolithoides brunneus (Day)

The fishery for 'Koth' is much less than that for 'Dara'. In the years 1959, 1960 and 1961 'Koth' formed 3%, 2.7% and 1.6% respectively of the total catch of fish at Bedi Port from the gill net catches. However, the occurrence

of adults only in the fishery is of much significance. From the observations made by one of the authors (M. N. Kutty) it is known that 'Koth' occurring in the inshore waters of Bombay were mainly young juveniles. In the waters off Gujarat there is a steady trawl fishery for 'Koth', the maximum abundance being reported from areas off Dwarka in the months of December, January and February (Jayaraman *et al.* 1959), but it is of interest that most of these catches were represented by juveniles of 'Koth'. From the catches at Bedi Port and nearby fishing centres, it is observed that only adult 'Koth', as is the case with 'Dara', congregate in these areas. In the gill net catches, the adults were probably fished selectively but since the catches at the nearby centres obtained in other type of gear also did not show young 'Koth', it appears that mostly the adults only enter the Gulf of Kutch from adjoining areas during the season.

Size frequency distribution of 'Koth' from the catches at Bedi Port for the 1960 and 1961 seasons are given in Fig. 8. The 1960 curve is bimodal with the modes at 1,340 mm. and 1,380 mm. respectively. In 1961 the curve has also two modes, a prominent one at 1,360 mm. and another very minor mode at 1,48 mm. The 1960 sample is larger and hence more reliable.

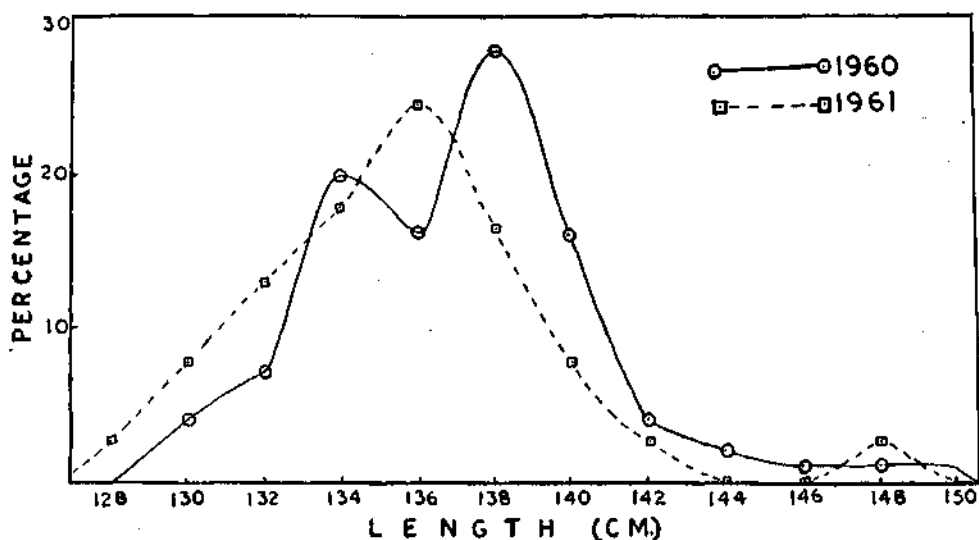


FIG. 8. Length-frequency distribution of 'Koth' from the gill-net catches at Bedi port during April 1960 and 1961.

Scale samples of both years were studied for reading the growth checks. Growth studies made previously on 'Koth' (Kutty, 1961) have shown that the scales can be used for determining the age of this fish. Further studies have shown that the scale rings are true annuli. The scale samples of 'Koth' obtained at Bedi Port are used here for determining the age of the fish. 110 fish studied from the catches were grouped into age classes and it was found that the age

of the fish ranged from 6 to 11 years. The frequency distribution of the different age classes of 'Koth' examined in 1960 and 1961 are given in Table V and fig. 9. It is found that about 84% of the catches at Bedi Port were of 7, 8 and 9 year olds, their strength in the catches being 20.0%, 39.1% and 24.6% respectively.

TABLE V

Distribution of scale annuli for the different size groups of 'Koth' from the gill-net catches taken off Bedi, Jamnagar.

Size groups in cm.	Number of scale annuli						No. of Fish
	VI	VII	VIII	IX	X	XI	
127.0—128.9	..	..	..	..	..	..	..
129.0—130.9	1	1	1	..	..	..	3
131.0—132.9	1	4	4	..	..	..	9
133.0—134.9	4	3	10	2	1	..	20
135.0—136.9	1	4	6	4	..	..	15
137.0—138.9	..	8	14	11	1	..	34
139.0—140.9	..	2	5	8	3	1	19
141.0—142.9	..	..	2	2	1	..	5
143.0—144.9	..	..	1	..	..	1	2
145.0—146.9	..	..	..	..	1	..	1
147.0—148.9	..	..	..	..	1	..	1
149.0—150.9	..	..	..	..	..	1	1
Number of fish in age groups	7	22	43	27	8	3	110
Percentage	6.4	20.0	39.1	24.6	7.3	2.7	100.1
Mean fish size (cm.)	133.07	135.37	136.28	137.85	140.71	144.67	136.33

"Catch curve" of the fishery at Bedi Port drawn by plotting the logarithms of the frequency of individuals of 'Koth' at different ages as suggested by Ricker (1948) is shown in Fig. 9. It is realised that the conditions laid down by Ricker (*loc. cit.*) are not entirely fulfilled in interpreting the catch curve drawn, but it is being attempted with the hope that this would help to a better understanding of the nature of the fishery. The age groups 6 - 8, forming the ascending left limb and dome of the curve indicate the selectivity of the gear. (In this case the tackle being large meshed gill net, fish up to a certain size are incompletely fished). The descending right limb of the curve is steep and signifies high mortality rate.

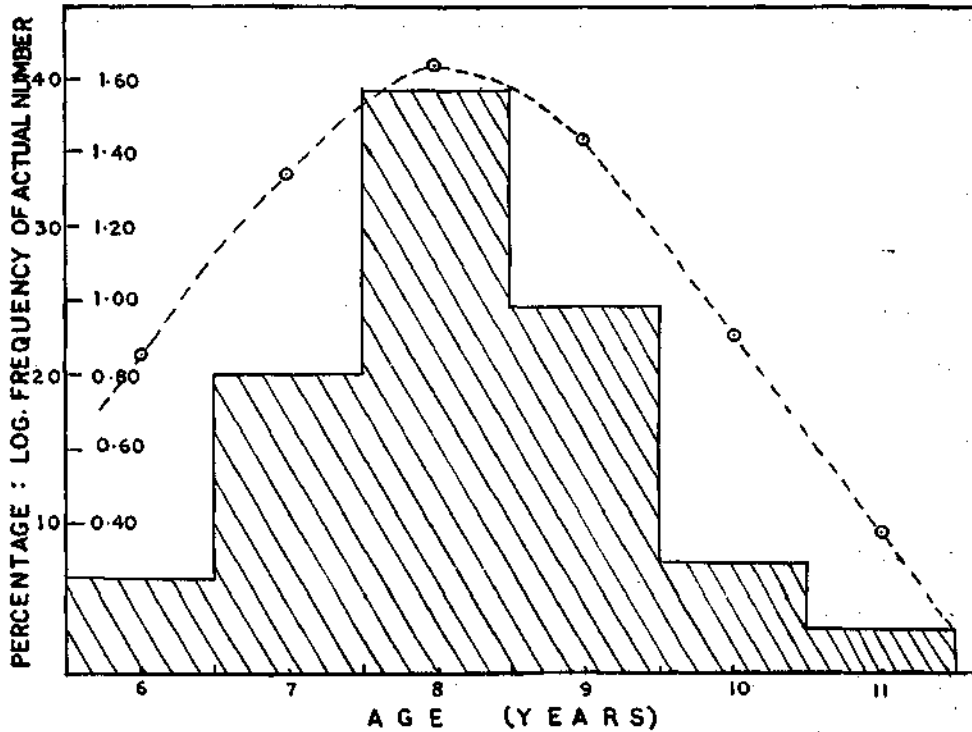


FIG. 9. Age frequency distribution percentage of 'Koth' (*Otolithoides brunneus*) from the gill-net catches of the 1960 and 1961 seasons (combined) at Bedi port. The broken line represents the catch curve of 'Koth' (See text).

Observations on the sex and maturity stages and food could not be made in detail as most of the fishes were brought to the shore after gutting. However, it is seen from the available data that there is a tendency for 'Koth' in this region, during the period under observations, to segregate into different sex groups as most of the specimens were found to be males. Only two ovaries could be collected and both were in stage IV of the maturity scale.

Stomach contents of 'Koth' analysed showed that most of the fishes are with empty stomachs. A few stomachs contained mainly prawns and crabs.

DISCUSSION

It is seen that the 'Ghol-Dara fishery' begins in the Gulf of Kutch, with Bedi Port near Jamnagar as its main centre of activity by about the middle of March and lasts only for about 6 weeks. It is noteworthy that the fishery in the Gulf of Kutch begins soon after the trawl fishery for the species especially 'Dara' and 'Koth' declines. The best catches in the trawls are taken off the mouth of Gulf of Kutch and Dwarka in December, January and February (Jayaraman *et al.* 1959). It is possible that these fishes migrate into the Gulf of Kutch from the open areas outside in the month of March, as already suggested. This is not definitely known, for it is possible that the fishes exist inside the Gulf of Kutch even earlier to March, but are not exploited before, as the 'Ghol-Dara fishermen' begin their main operations only by the middle of March. The same may be true after the middle of May, because the fishery ceases and the fishermen who come from South to fish in these areas return to their homes before the onset of monsoon. The fishermen appear to move southwards to fish in richer areas off Jaffrabad for Bombay duck fishery.

Therefore, it appears that one of the prime necessities is to fix the extent to which 'Dara', 'Ghol' and 'Koth' stay inside the Gulf of Kutch. It is quite possible that these fisheries could be exploited more fully if experimental fishing is undertaken and the available resources estimated.

Another aspect of interest is to find out the periodicity in the occurrence of juveniles of 'Dara', 'Ghol' and 'Koth' inside the Gulf of Kutch. At present the large-meshed gill net is chiefly employed in the fishery and this being highly selective, it catches only the bigger fishes. In studying the populations of 'Dara', 'Ghol' and 'Koth' the availability of younger fish along with adults is of much importance. The waters of the Gulf of Kutch have to be thoroughly explored with different tackles such as trawl nets and small-meshed gill nets simultaneously with usual gear. Many parts of the Gulf of Kutch have rocky or coral bottom and it may be necessary to use special type of gears to study the details of the population.

The problem of much interest is to find out what induces the fishes to move into the waters of the Gulf of Kutch. The maturation studies clearly indicate that 'Dara' spawns in these areas. It is possibly a spawning migration. As the few 'Ghol' and 'Koth' examined were found to be mature (stage IV) during the fishing season, it is possible that they spawn in the areas at a later time by about May or June. The spawning areas of these fishes could be

much more correctly known if regular plankton observations are made in these areas during and after the 'Ghol-Dara' season' looking out for the eggs and larvae of these fishes. Another interesting feature of the fishery was the almost complete sex segregation in the case of 'Dara' and 'Koth'. The catch consisted of only males on many days of the season.

There is a good fishery for adult 'Dara' at Satpati, Dahanu and other fishing villages from Kolak to Datiwiri in the Thana District from November-December to May and again for a short period of 6 weeks soon after the end of monsoon. It is not known whether 'Dara' contributing to the fishery of the Gulf of Kutch and the Dahanu District are of the same stock or of different stocks.

SUMMARY

The fishery for 'Dara', *Polydactylus indicus* (Shaw), 'Ghol', *Pseudosciaena diacanthus* (Lacépède) and 'Koth', *Otolithoides brunneus* (Day) in the Gulf of Kutch lasting for about six weeks from March to May is a commercially important fishery, which is probably not fully exploited. It is significant that the fishery consists entirely of large sized adult fishes. This is a spring-tide fishery wherein highly selective bottom-set gill nets and boulder walled tidal fish traps 'Wadas' are used. Almost 90% of the fish of the 'Ghol-Dara fishery' comprises of 'Dara'.

'Dara' observed in the gill net catches inside the Gulf of Kutch are of very large size groups which are not normally obtained in the trawl catches outside the Gulf. Prawns formed the major food item of this fish. The ova-diameter frequency studies indicate a protracted spawning. As fish of both sexes have been found to be in a highly advanced stage of maturity it appears that 'Dara' enters the Gulf of Kutch for the purpose of spawning.

The specimens of 'Ghol' examined from the gill net catches belonged to the age groups 4 to 8, the 5 and 6 year-old fish dominating the catches. Catches of 'Koth' were constituted by fish of age-groups 6 to 11, about 80% of the catch being of 7-9 year-old fish. Both 'Ghol' and 'Koth' were observed with gonads of maturing stage during April 1961.

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