# SOME ASPECTS OF THE BIOLOGY OF THE LONG FINNED HERRING, *OPISTHOPTERUS TARDOORE* (CUVIER) FROM THE INSHORE REGIONS AT KARWAR

By N. RADHAKRISHNAN
(*Central Marine Fisheries Research Institute*)

## INTRODUCTION

*Opisthopterus tardoore* is a small sized fish commonly growing to about 170 mm to 190 mm in length, the maximum size recorded during the course of the present work being 216 mm. As regards its distribution, Day (1899) mentions it "from Gwadur in Bellochistan and Sind, through the seas of India to the Malaya Archipelago". The *Opisthopterus tardoore* fishery at Karwar (N. Kanara) is restricted to a short period. It commences in May and end-either in September or early October. The main fishery season extends from June to September with a peak generally falling in the month of July. The most important gear used for the capture of this species is the shore seine. It is also fished by gill net, cast net and drag net The present paper deals with the observations on length frequency distribution of this species and incorporates the results of investigation carried out at Karwar from 1956 to 1960. Brief notes on length-weight relationship and food analysis of this species are also given. Details regarding maturity, spawning and morphometric analysis of the stock of this species in the Kanara coast have been given separately elsewhere.

## LENGTH-WEIGHT RELATIONSHIP

For the study of the length-weight relationship of *O. tardoore*, the equation of the form of general parabola $W=al^n$ was used, where "W" and "l" represent the weight and length of the fish respectively, "a" a constant and "n" an exponent to which "n" can be raised The value of the exponent "n" has generally been found by earlier workers to vary between 2·5 to 4 (Hile 1936) and for an individual fish which maintains the same shape n=3 (Allen 1938). The present analysis showed a close agreement between the observed and calculated sets of values. The weight-length relationship formula was found to be $W=0\cdot004508\ L^{2.29997}$.

## LENGTH-FREQUENCY STUDIES

For the purpose of this study, total length was taken into account. A sample of 50 fishes was measured at a time and arranged in 10 mm groups. 9304 specimens from 107 samples were measured during the period of investigation. As the total differed from month to months the numbers of each size group were converted into percentages to facilitate comparison in different months.

**1956 :**

This season lasted only for three months, i.e. June to August. The size range recorded for June, July and August were 51-186 mm, 61-146 mm and 61-146 mm respectively. 2106 specimens from 24 samples were analysed for length frequency studies. The frequency polygon

for June has three modes at 60-69 mm, 80-89 mm, and 120-149 mm size groups. It is further noticed that a slight increase in length has occured during July and August. It seems reasonable to believe that the mode "a" seen at 80-89 mm group in Text figure 1, from June to August represents individuals that have spawned sometime towards the end of the previous season and that the mode "a" seems to belong to the 1955 year class and the specimens ranging from 50-69 mm and 130-149 mm seen in June belong to the 1956 and 1954 year classes respectively.

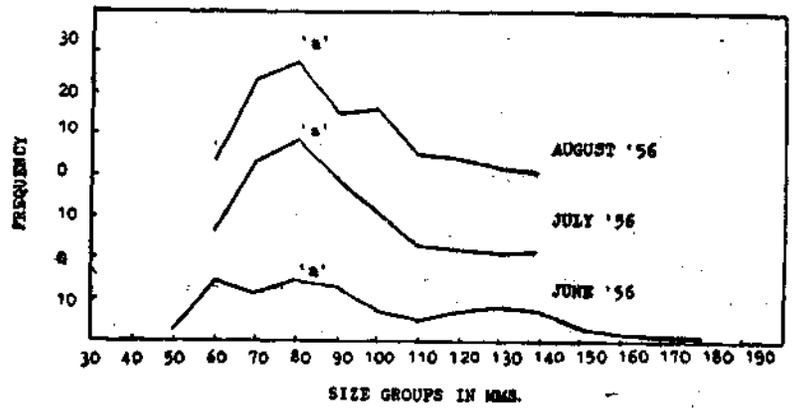


Fig. 1. Length graph of the samples of *O. tardoore* collected from the inshore regions at Karwar during 1956.

**1957 :**

The season commenced in June and extended upto September. Individuals ranging from 37-199 mm in length were netted. The range of size for June, July, August and September were 37-199 mm, 45-126 mm, 50-136 mm and 50-126 mm respectively. 2952 specimen from 29 samples were examined. The 90-99 mm size group "b" predominated during the whole

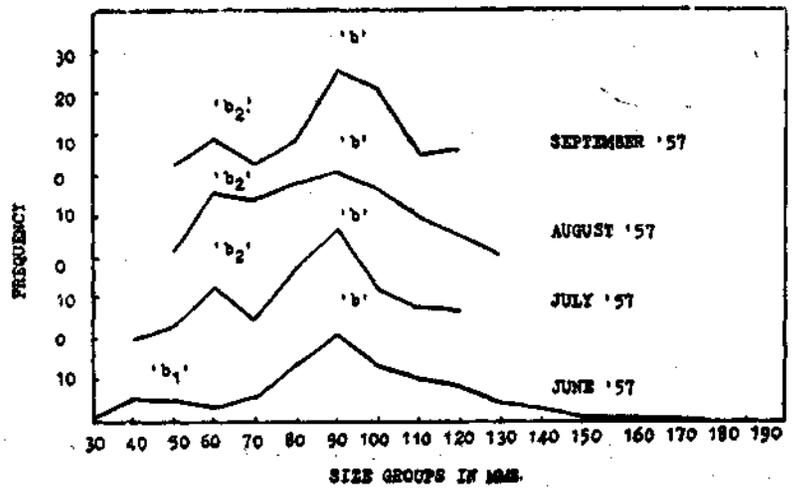


Fig. 2. Length frequency graph of the samples of *O. tardoore* collected from the inshore regions of Karwar during 1957.

season. (Text figure 2). This category presumably represents the 1956 year class and has more or less completed one year. The minor modes on the left side of "b" seen in June, "$b_1$" at 40-69 mm and "$b_2$" seen in July to September at 60-69 mm belong to the 1957 year classes.

**1958 :**

The season commenced in May and ended in August. 1922 individuals from 23 samples were examined. In May, three modes at 90-99 mm, 140-149 mm and 170-179 mm were noted which represent the 1957, 1956 and 1955 year classes respectively. (Text figure 3). The "b" mode (1956 year class) which contributed to the fishery of 1957 at 90-99 mm, is seen again during the 1958 season at 140-149 mm. This mode remained consistent throughout the season and therefore can be taken as the one, which belonged to I year class. It is also noticed that the fishery is mainly constituted by individuals in the 90-99 mm size group (mode "c" -1957 year class). In August, the mode "c" has registered a 10 mm increase in growth. Thus, the 1958 *Opisthopterus tardoore* season appears to be mainly supported by individuals in the I and I+year classes, in contrast to the 1956 and 1957 seasons where the fishery was constituted only by a single age group.

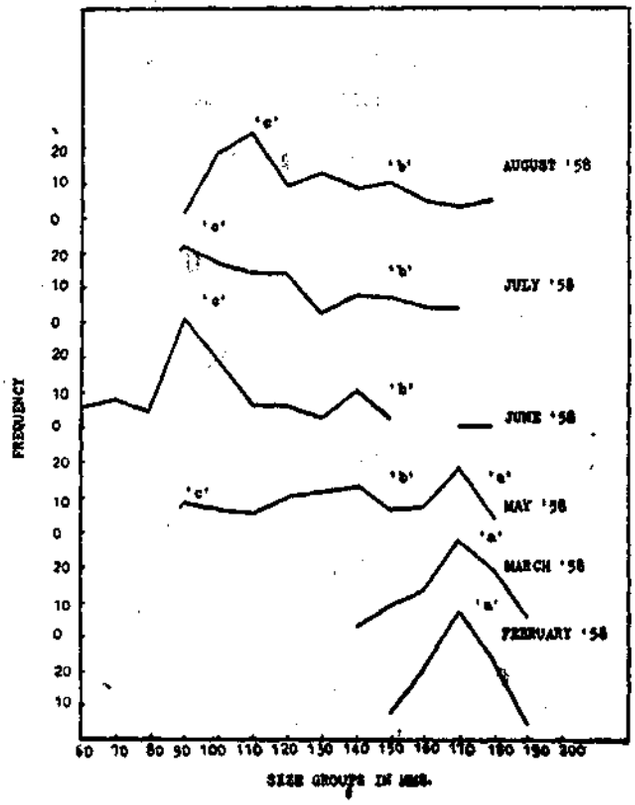


Fig. 3. Length frequency graph of the samples of *Opisthopterus tardoore* collected from the inshore regions at Karwar during 1958.

From February to May, large sized individuals were also netted in the shore seines. During these months, fishes measuring 170-179 mm in length dominated the catches. This

mode is not seen representing the inshore catches commencing from June, though slight indications of its presence is seen during August. This group is the continuation of the mode "a" seen from June to August 1956, which seems to be the progeny of the fish that has spawned in 1955. During 1957, this mode was not represented at all in the commercial catches. The size range recorded for different months of the year are as follows : February 150-190 mm, March 140-190 mm, May 91-186 mm, June 61-182 mm, July 91-175 mm and August 90-175 mm.

**1959 :**

The season lasted only for three months, June to August. 1343 specimens from 12 samples were examined for length frequency studies. The size range for June, July and August were 61-164 mm, 61-126 mm and 60-146 mm respectively. From the Text figure 4, it can be seen that the dominant size group in the months of the commercial fishery belonged to the 90-99 mm group. The mode "d" represents the 1958 year class, which has completed about one year. No other age group supported the fishery. The occurrence of larger individuals measuring 140 mm and above was noted only in June.

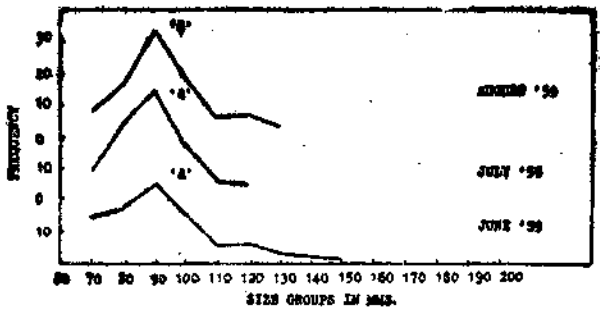


Fig. 4. Length-frequency graphs of the samples of *O. tardoore* collected from the inshore regions at Karwar during 1959.

**1960 :**

May to July were the main fishery months for the year. The size range for May, June and July were 51-179 mm, 61-157 mm and 61-157 mm respectively. 981 specimens form 19 samples were analysed during the course of the year. The 90-99 mm group (mode "e"—1959 year class) dominated the catches throughout the season. (Text figure 5). The result of the recruitment of the new generation with a size 60-69mm is also seen in May in addition to the 90-99 mm group. Individuals ranging from 120-149 mm (mode "d" also contributed to some extent towards the 1960 fishery, although this mode "d" (1959 year class) was the main stay of the fishery during the 1959 season. Individuals with the size range 130-190 mm and 113-189 mm were netted during February and April respectively. The mode "c" (1957 year class) which formed the fishery of 1958 is seen at 170-179 mm in February. A notable feature in the frequency curve for the month of April is that the mode has moved downward instead of upward, which may probably be due to sampling error.

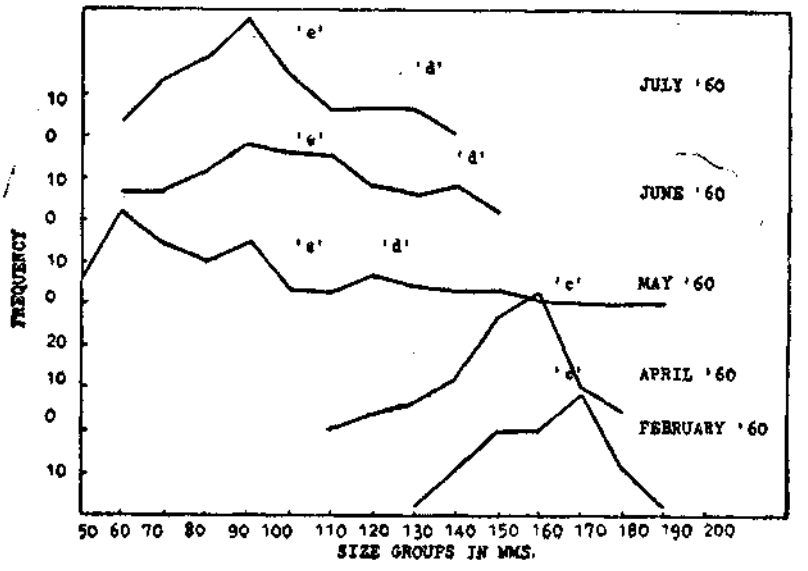


Fig. 5. Length-frequency graphs of the samples of *O. tardoore* collected from the inshore regions at Karwar during 1960.

## DISCUSSION

This investigation covers a period of five years commencing from 1955 to 1960. The total number of fish measured during the period was 9304 consisting of adults and immature taken from 107 samples from the inshore regions at Karwar.

The range of size of specimens varied from 30 to 216 mm. A study of the various size groups related to various years and their progression in successive months gave an indication that the *O. tardoore* fishery at Karwar is dependent mainly upon two age groups. The modes "a", "b", "c", "d" and "e" representing the year classes of 1955, 1956, 1957, 1958 and 1959 formed the mainstay of the seasons during 1956, 1957, 1958, 1959 and 1960 respectively. The size and month of the first appearance of these year classes for various fishery seasons have been shown below :

| Mode and corresponding year class | Season of abundance of the year class | Month of appearance of the mode (year class) | Size of mode at the time of first appearance (mm) |
|---|---|---|---|
| "a"—1955 | June-August, '56 . . . | June 1956 . . | 80—89 |
| "b"—1956 | June-August, '57 . . . | June 1957 . . | 90—99 |
| "c"—1957 | May-August, '58 . . . | May 1958 . . | 90—99 |
| "d"—1958 | June-August, '59 . . | June 1959 . . | 90—99 |
| "e"—1959 | May-July, '60 . . . | May 1960 . . | 90—99 |

Length frequency studies of different seasons have shown that 80-89 mm size group had the highest frequency during 1956. During succeeding fishery seasons the 90-99 mm group was dominant. The 1958 and 1960 seasons were contributed by 140-149 mm group in addition to the 90-99 mm group. It is clear from Text figure 2 and 4 that the modes "b" obtained during 1957 and "d" obtained during 1959 include the same size groups of *O. tardoore* fishery. Thus, the fishery of 1957 and 1959 was mainly supported by one year old fishes. In 1957 and 1959 seasons the fishery was mainly based on modes "b" and "d" which were preceding year's broods. Their size in these years were 90-99 mm. During succeeding years *i.e.* 1958 and 1960 these groups appeared in the frequency polygons at 140-149 m/m. Thus, one could see that during the 1958 and 1960 seasons the *O. tardoore* fishery was mostly supported by I and I year old individuals. In 1956, the seasonal catch included 0-year group fishes also.

From the length frequency data, the growth rate of the fish appears to be slow, hence the monthly progression of various modes could not reveal any increase in size. However, the normal modal size of one year old specimen appears to be 90-99 mm and at the end of the second year of their life, the fish probably attains 140-149 mm in length. It has been already indicated that the size of *O. tardoore* at first maturity is 150-169 mm (Radhakrishnan MSS). Keeping this in view, it appears that the fish probably matures after it has completed two years of its life. Assigning the age of the earliest observed mode which is governed by the "Petersen's method" and conclusions in this regard can be only tentative, and the final confirmation of the issue will be got when either the "known age method" (Van Oosten, 1923; Applegate, 1947) or marking experiments are tried.

The otoliths and scales of *O. tardoore* were studied. The opaque zones usually seen on the otoliths of fishes in temperate waters are the regions where excessive calcification has taken place during the season. This occurs when growth of the fish is rapid. The translucent zones on the other hand are formed when growth is slow or has practically stopped. Even by employing the methods of clearing suggested by Nair (1949) and Radhakrishnan (1954) no successful results were obtained as the zones on the otoliths remained indistinct. Hence the age of *O. tardoore* at different sizes could not be confirmed from otoliths or scale studies.

## FOOD ANALYSIS

The material was mostly collected from the inshore commercial catches at Karwar during 1960. The stomach of each fish was carefully removed and preserved in 5% formaldehyde. At the time of examination, it was split open and the contents washed with water in a petridish. The volume of gut content was measured by displacement method. Enumeration method was followed in determining the composition of the stomach content *i.e.*, one c.c. of the made up gut content which was well strirred was taken by means of a graduated pipette and spread over a counting chamber. The number of organisms belonging to each species was counted under a binacular microscope and recorded.

A cursory examination of the stomach contents of specimens taken from the inshore regions, showed that *O. tardoore* is a carnivorous fish. To see if there were any differences in the composition of the diet in fishes of different sizes, the stomachs of about 410 specimens of size 30-200 mm were examined. The food of *O. tardoore* was found to be composed mainly of mysids, *Pseudodiaptomus*, and copepod eggs, their percentage in the total volume of food being 56·93, 18·52 and 10·28 respectively. The other items were *Acetes*, *Acrocalanus*, *Lucifer*, broken

fragments of crustacean appendages, prawns, bivalve eggs and larvae, *Cypris* larvae *Coscinodiscus* and amphidpods. Fish larvae and packets of fish scales were also noticed. The larval fishes noted in the stomachs were species of *Thrissocles* and *Ambassis*. Sand grains were also seen in the stomachs.

An interesting fact noticed was that the specimen with 130 mm and above in total length showed preference towards mysids. Smaller individuals (70-100 mm) on the other hand were found to contain mostly *Pseudodiaptomus*, copepod eggs and *Acrocalanus* in their stomachs.

The main constituents in the stomachs of this species noted by Venkataraman (1960) were penaeid prawns, *Acetes*, post larval fish and polychaetes. According to him, copepods (*Pseudodiaptomus*, *Acartia*, *Temora*, *Eucalanus* and *Labidocera*) occurred in the stomachs of this species throughout the year at Calicut (Malabar coast). Basheeruddin and Nagappan Nayar (1961) have also indicated that the food components in the stomachs of *O. tardoore* on the coastal waters off Madras were stomatopods, prawns, amphipods and mysids.

## SUMMARY

The length frequency distribution of *O. tardoore* at Karwar from 1956 to 1960 is presented and discussed. The size group with the highest frequency was 80-89 mm in 1956, whereas for subsequent fishery seasons it was 90-99 mm. The fishery was mostly supported by I year old fishes during 1957 and 1959 and I and I+year groups during 1958 and 1960. But during 1956 the fishery included 0-year group also. The normal modal size of one year old fish appe ars to be 90-99 mm. At the end of the second year it approximately reaches 140-149 mm. Analyses of food reveal that *O. tardoore* is a carnivorous fish. Its main food item is composed of mysids, *Pseudodiaptomus* and copepod eggs. Items of minor importance are *Acetes*, *Acrocalanus*, *Lucifer*, prawns, bivale eggs and larvae, *Cypris* larvae, *Coscinodiscus* and amphipods. Fish larvae and fish scales are also found in the guts. The weight-length relationship formula was found to be $W = 0{\cdot}00458 - 0{\cdot}004508\ L^{2{\cdot}2997 \cdot 2997}$.

## ACKNOWLEDGEMENTS

The author wishes to thank Dr. S. Jones, Director, Dr. G. Seshappa and Dr.M. S. Prabhu of the Central Marine Fisheries Research Institute, and Dr. S. Z. Qasim, Scientist Director, Indian Ocean Expedition, Biological Centre, Ernakulam, for their help and for in windemere *F. Anim E. col*, critical reading of the manuscript. My thanks are also due to Sarvashri A. Noble and P. V. Rao for the help rendered in the food analysis.

## REFERENCES

Allen, K. R. 1938. Some observation on the biology of the trout (*Salmo trutta*) 333-49.

Applegate, V. C. 1947. Growth of some lake trout, *Cristivomer namayoush* of known age in inland Michigan lakes. *ibid*, **4**: 237-241.

Basheeruddin, S. & Nagappan Nayar, K. 1961. A preliminary study of the juvenile fishes of coastal waters off Madras city. *Indian J. Fish*, 8(1) : 169-188.

Day, F. 1899. *The Fauna of British India. Fishes* I. Taylor and Francois, London 548 p.

Hile, R. 1936. Age and growth of the Cisco, *Leucichthys artedi* (Le seur) in the lakes of the northern highlands, Winconsin. *Bull. U.S. Bur. Fish.* **48**: 211-316.

Nair, R. V. 1949. The growth rings on the otoliths of the Oil sardine, *Sardinella longicesps* (Cuv & Val) *Curr. Sci.*, **18** (1): 9-11.

Radhakrishnan, N. 1954. Occurrence of growth rings on the otoliths of the Indian whiting, *Sillago sihama* (Forskal) *Curr. Sci.* **23**(6) : 196-197.

—— (Mss). Notes on the maturity and spawning of *Opisthopterus tardoore* (Cuvier).

—— (Mss). A preliminary report on a comparison of the stocks of *Opisthopterus tardoore* (Cuvier) in the Kanara coast.

Venkataraman, G. 1960. Studies on the food and feeding relationship of the inshore fishes off Calcicut on the Malabar coast. *Indian J. Fish* **7**(2) : 275-306.

Van Oosten, J. 1923. The white fishes (*Coregonus clupeaformus*) A study of the scales of white fishes of known ages *Zoologica* (N.Y.) **2** : 381-412.