

**STUDIES ON THE AGE DETERMINATION OF 'GHOL',  
*PSEUDOSCIÆNA DIACANTHUS* (LACEPEDE)  
BY MEANS OF SCALES AND OTOLITHS\***

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THE fact that tropical fishes also show periodical growth checks (rings) on their discrete hard parts has been demonstrated in a few Indian species (Nair, 1949; Seshappa and Bhimachar, 1951, 1954, 1955; Pillai, 1954; Radhakrishnan, 1954, 1957; Sarojini, 1957; Jhingran, 1957; Seshappa, 1958 and Balan, 1959). Work on the biology and fishery of *Pseudosciana diacanthus* occurring in the waters off Maharashtra and Gujarat coasts was started by the present author in March, 1958 and during the course of two years study, it has been found that the scales and otoliths of this species show growth checks (rings) which can be utilised for the determination of age and growth as was indicated by Seshappa (1953).

Scale samples from 769 fishes (5-115 cm.) and otolith samples from 350 fishes (5-100 cm.) have been studied from the landings of the trawlers of the New India Fisheries Limited and from the local 'dol' net landings. The Bull-trawlers fished mainly on the grounds off Cutch, Dwaraka, Porbunder and Veraval (Saurashtra coast) while the local 'dol' nets were operated off Bombay in 20-40 metres depths. Scales from the region immediately posterior to the tip of the pectoral fin were always selected.

The growth checks (rings) of the scales are of the nature of breaks or interruptions of the pattern of the circuli, more clear at the antero-lateral corners of the scale. Closer approximation of a few circuli, apparently not forming bands, has also been observed in the scales of younger fish. Another characteristic feature is the increase in the number of radii outward of the ring, the new radii commencing just near the ring and the portion of the radii inside and outside the ring being often not in a line. In the scales of older specimens with five or more rings, the rings (1 or more) near the periphery were observed to be more clear and conspicuous than the inner 3 or 4 rings. The frequency distribution of these rings observed on the scales of 769 fishes is given in Table I.

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TABLE I

Table showing the frequency distribution of rings in the scales of  
*Ghol, Pseudosciaena diacanthus (Lacépède)*

| Size group in cm.*                | Number of fish examined | Number of rings in the scales |      |      |      |       |      |       |       |       |  |
|-----------------------------------|-------------------------|-------------------------------|------|------|------|-------|------|-------|-------|-------|--|
|                                   |                         | 0                             | I    | II   | III  | IV    | V    | VI    | VII   | VIII  |  |
| 5- 9                              | 1                       | 1                             |      |      |      |       |      |       |       |       |  |
| 10- 14                            | 20                      | 20                            |      |      |      |       |      |       |       |       |  |
| 15- 19                            | 62                      | 62                            |      |      |      |       |      |       |       |       |  |
| 20- 24                            | 55                      | 55                            |      |      |      |       |      |       |       |       |  |
| 25- 29                            | 27                      | 23                            | 4    |      |      |       |      |       |       |       |  |
| 30- 34                            | 26                      | 21                            | 5    |      |      |       |      |       |       |       |  |
| 35- 39                            | 25                      | 6                             | 19   |      |      |       |      |       |       |       |  |
| 40- 44                            | 23                      | ..                            | 23   |      |      |       |      |       |       |       |  |
| 45- 49                            | 20                      | ..                            | 20   |      |      |       |      |       |       |       |  |
| 50- 54                            | 23                      | ..                            | 22   | 1    |      |       |      |       |       |       |  |
| 55- 59                            | 14                      | ..                            | 7    | 7    |      |       |      |       |       |       |  |
| 60- 64                            | 16                      | ..                            | 2    | 14   |      |       |      |       |       |       |  |
| 65- 69                            | 21                      | ..                            | ..   | 21   |      |       |      |       |       |       |  |
| 70- 74                            | 28                      | ..                            | ..   | 26   | 2    |       |      |       |       |       |  |
| 75- 79                            | 29                      | ..                            | ..   | 7    | 22   |       |      |       |       |       |  |
| 80- 84                            | 39                      | ..                            | ..   | 1    | 29   | 9     |      |       |       |       |  |
| 85- 89                            | 68                      | ..                            | ..   | ..   | 7    | 61    |      |       |       |       |  |
| 90- 94                            | 89                      | ..                            | ..   | ..   | ..   | 67    | 22   |       |       |       |  |
| 95- 99                            | 88                      | ..                            | ..   | ..   | ..   | 10    | 78   |       |       |       |  |
| 100-104                           | 66                      | ..                            | ..   | ..   | ..   | ..    | 43   | 22    | 1     |       |  |
| 105-109                           | 23                      | ..                            | ..   | ..   | ..   | ..    | 3    | 11    | 9     |       |  |
| 110-114                           | 6                       | ..                            | ..   | ..   | ..   | ..    | ..   | 3     | 2     | 1     |  |
| Total ..                          | 769                     | 188                           | 102  | 77   | 60   | 147   | 146  | 36    | 12    | 1     |  |
| Average length of fish with rings |                         | ..                            | 44.6 | 68.3 | 80.9 | 89.97 | 99.5 | 104.3 | 107.6 | 113.5 |  |

\* Total length in cm. from the tip of the snout to tip of the longest ray of caudal fin.

The highest number of rings observed in the scales so far is 8 from a specimen measuring 113.5 cm. in length. The average length of fish having different number of rings is also given in Table I.

*Time of formation of the rings.*—Scales with 'Open' margins were observed during all the months and those with exactly closed margins have been rarely found. The time of formation of these checks was found out by the method employed by Perlmutter and Clarke (1949). There was not much difference in the width of the space between circuli within a zone enclosed by a ring. The width of the space between circuli differed in various zones, the circuli being much closer to each other in the inner zones and the width between them increasing in the outer zones. So also, the width (*i.e.*, number of circuli) of the zones enclosed by the different rings varied. The inner two zones enclosed by the first and second ring were wider than those

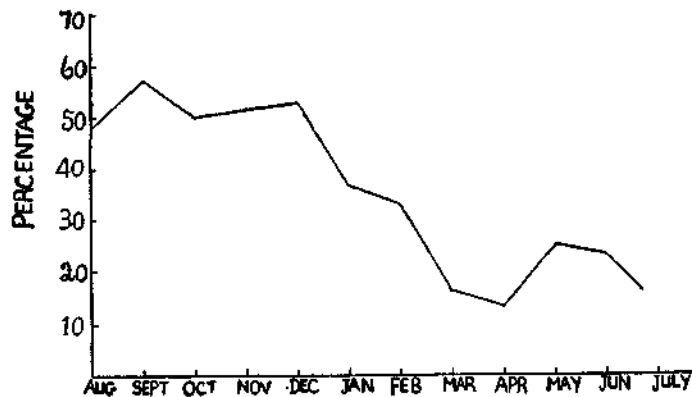


FIG. 1. Percentage of scales with minimum circuli count (width) in the terminal zone in different months.

towards the periphery which were narrower. Keeping in view this difference in the width of the zones between different rings, different circuli counts have been considered for finding the percentage of scales with minimum width (circuli count) of the terminal zone (zone between the last ring and the scale edge). For scales with 1-3 rings those with less than 25 circuli in the terminal zone have been taken as having minimum width. Similarly in the case of scales with 4 rings and 5 or more rings those with less than 10 and 5 circuli respectively in the terminal zone have been considered as having minimum width. The percentage of scales with minimum width and circuli count in terminal zone were observed to be high during the period August to January (Text-Fig. 1) which period appears to be the time of formation of rings.

There seems to be good agreement between the size of the age groups observed in the length frequency distributions and the average size of the fish having 1-5 rings on their scales. The modes at 42.5-47.5 cm., 67.5-72.5 cm., 77.5-82.5 cm., 87.5-92.5 cm. and 97.5-102.5 cm. observed in the length frequency distributions of samples from the trawlers can be taken as representing the age groups I, II, III, IV and V respectively. The first ring seems to be formed after completion of one year. The spawning season for this species is protracted extending from June to September.

The growth checks in the otoliths are of the nature of translucent (hyaline) rings. Though the material studied is limited, the results are encouraging and are in close agreement with those observed in scales. The distribution of the translucent rings in different size groups is more or less similar to those of scales. The otoliths examined were from the same specimens used for scale studies.

Otoliths from specimens 30-60 cm. in length show 1, 65-75 cm. 2, 75-85 cm. 3, 85-95 cm. 4, and 95-100 cm. 5 rings respectively.

In the otoliths examined from specimens 38-46 cm. in October-November, the first translucent ring had been formed and the edges were still translucent. It is most likely that the translucent ring is formed during this period or just before as is the case in scales.

Low feeding may be responsible for the formation of these rings, particularly among the juveniles. A study of the food and feeding habits of the juveniles (below 25 cm.) in the inshore waters around Bombay has shown that the feeding intensity of the juveniles of this size is high during September-December and declines gradually thereafter reaching the minimum by March-April. The scales of this size group do not show first growth ring and the otoliths show only the inner opaque zone. Thus there is circumstantial evidence to show that the formation of opaque zone in the otolith is connected with high feeding intensity. 40-50 cm. specimens showing one growth ring in their scales and otoliths are not found in the inshore catches during September-January and it is probable that they live in deeper waters. Among the adults it is possible that the strain of spawning activity would also induce the formation of the rings and that is probably the reason why the fifth and subsequent rings appear clearer and more conspicuous than the earlier ones.

The sudden change in the hydrological conditions of the waters in the region between Latitude 20° N. and 22° N. due to the commencement of N.-E. monsoon characterised by abrupt change from high surface temperature

and low salinity of October-November period to low temperature and high salinity from November end to February observed by Jayaraman and Gogate (1957) and the low bottom temperature especially in the Dwaraka region (22° N.) from December-February (Jayaraman *et al.*, 1959) may also have a bearing on the formation of growth rings.

#### ACKNOWLEDGEMENTS

I am grateful to Dr. S. Jones, Director, for kindly suggesting this problem and for his guidance and encouragement in this work. My thanks are due to Dr. G. Seshappa and Shri K. H. Mohamed for kindly going through the manuscript of this paper and for offering valuable criticism and suggestions for its improvement.

#### REFERENCES

- Balan, V. 1959 .. Age determination of the Indian Oil Sardine, *Sardinella longiceps* (Val.) by means of scales. *Curr. Sci.*, **28**, 122-23.
- Jayaraman, R. and Gogate, S. S. 1957 .. Salinity and temperature variations in the surface waters of the Arabian Sea off the Bombay and Saurashtra coasts. *Proc. Ind. Acad. Sci.*, **45**, 151-164.
- , Seshappa, G. Observations on the trawl fisheries of the Bombay and Saurashtra waters, 1949-50 to 1954-55. *Indian J. Fish.*, **6**(1), 58-144.
- Mohamed, K. H. and Bapat, S. V. 1959
- Jhingran, V. G. 1957 .. Age determination of the Indian major carp *Cirrhina mrigala* (Ham.) by means of scales. *Nature*, **179**, 468-69.
- Nair, R. V. 1949 .. The growth rings on the otoliths of the Oil Sardine *Sardinella longiceps* (Cuv. and Val.). *Curr. Sci.*, **18**, 9-11.
- Perlmutter, A. and Clarke, .. Age and growth of immature Rose fish (*Sabastes marinus*) M. George. 1949 in the Gulf of Maine and off Western Nova Scotia. *Fish. Bull.*, No. 45, U.S. Fish and Wild Life Service, **51**, Washington, D.C.
- Pillai, T. V. R. 1954 .. The biology of the grey mullet *Mugil tade* (Forsk.) with notes on its fishery in Bengal. *Proc. Nat. Inst. Sci. India*, **20**(2), 187-217.
- Radhakrishnan, N. 1954 .. Occurrence of growth rings on the otoliths of the Indian Whiting, *Sillago sihama* (Forsk.). *Curr. Sci.*, **23**(6), 196-97.
- , 1957 .. A contribution to the biology of Indian Sand Whiting, *Sillago sihama* (Forsk.). *Indian J. Fish.*, **4**(2), 254-83.
- Sarojini, K. K. 1957 .. Biology and fisheries of the grey mullets of Bengal. I. Biology of *Mugil parsia* (Hamilton) with notes on its fishery in Bengal. *Ibid.*, **4**(1), 160-207.

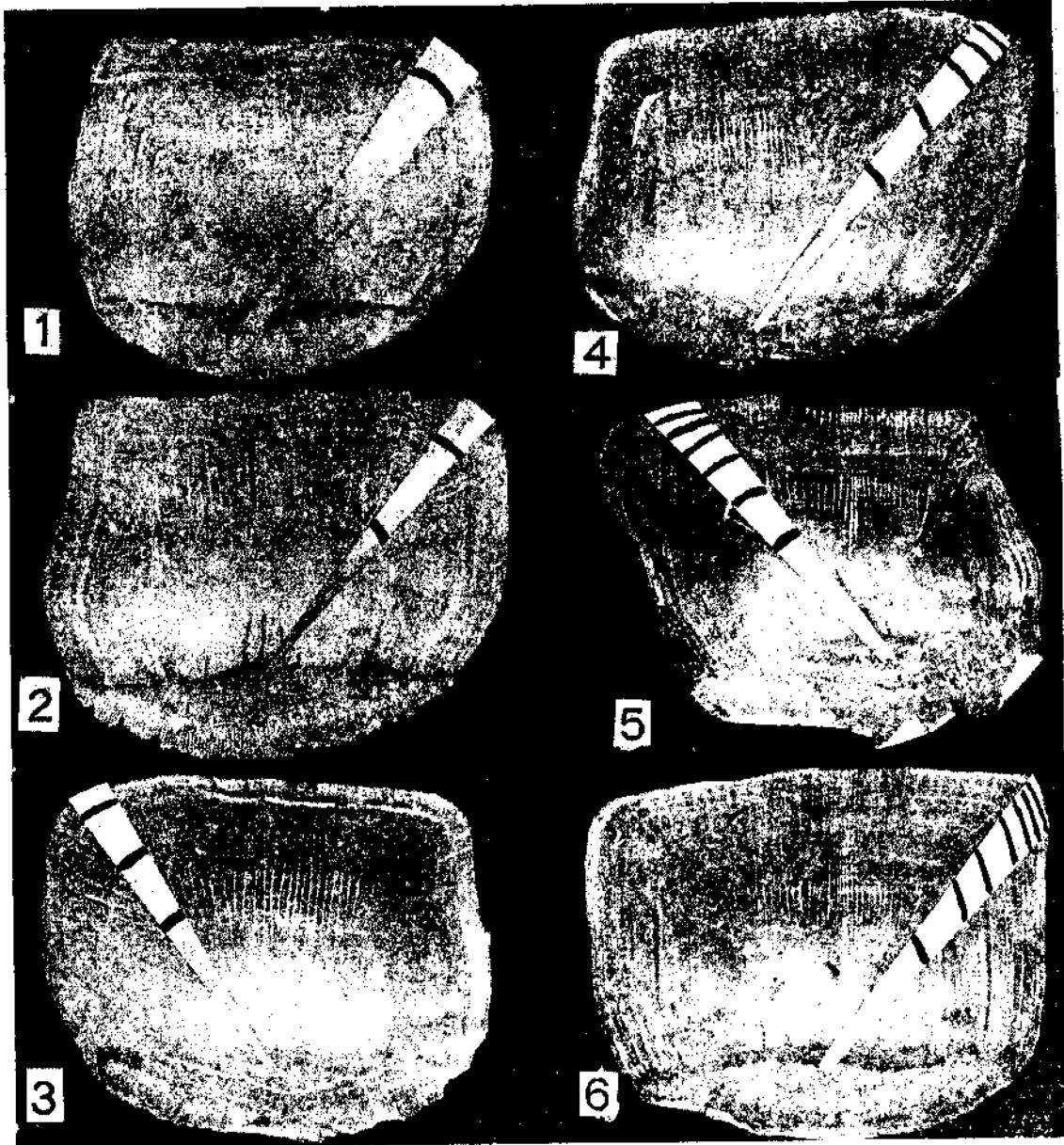
- Seshappa, G. 1958 .. Occurrence of growth checks in the scales of the Indian mackerel, *Rastrelliger canagurta* (Cuv.), *Curr. Sci.*, **27**, 262-63.
- , 1953 .. Report of work done for the quarter ending 31st December 1953 at Central Marine Fisheries Research Substation, Bombay (unpublished).
- and Bhimachar, B. S. 1951 .. Age determination studies in fishes by means of scales with special reference to the Malabar sole. *Curr. Sci.*, **20**, 260-62.
- , 1954 .. Studies on the age and growth of the Malabar sole, *Cynoglossus semifasciatus* (Day.). *Indian J. Fish.*, **1**, 145-62.
- , 1955 .. Studies on the fishery and biology of the Malabar sole, *Cynoglossus semifasciatus* (Day.). *Ibid*, **2**(1), 180-230.

## PLATE I

- Photograph 1. A scale of 'Ghol' showing one growth ring,  $\times 5$ . Total length of fish: 48.0 cm. Date of collection: 25-1-1960.
- Photograph 2. A scale of 'Ghol' showing two growth rings,  $\times 4.2$ . Total length of fish: 72.5 cm. Date of collection: 6-3-1959.
- Photograph 3. A scale of 'Ghol' showing three growth rings,  $\times 3.3$ . Total length of fish: 77.5 cm. Date of collection: 13-3-1959.
- Photograph 4. A scale of 'Ghol' showing five growth rings,  $\times 3$ . Total length of fish: 96.8 cm. Date of collection: 6-3-1959.
- Photograph 5. A scale of 'Ghol' showing six growth rings,  $\times 2.3$ . Total length of fish: 106.0 cm. Date of collection: 19-3-1960.
- Photograph 6. A scale of 'Ghol' showing seven growth rings,  $\times 2$ . Total length of fish: 108.0 cm. Date of collection: 5-3-1959.

## PLATE II

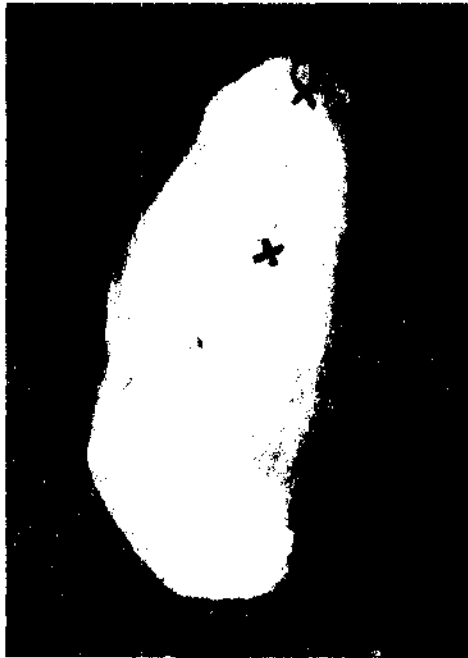
- Photograph 1. Otolith of 'Ghol' showing one translucent growth ring near the margin,  $\times 3$ . Total length of fish: 42.1 cm. Date of collection: 18-11-1958.
- Photograph 2. Otolith of 'Ghol' showing two translucent growth rings,  $\times 3.8$ . Total length of fish: 64.5 cm. Date of collection: 27-2-1959.
- Photograph 3. Otolith of 'Ghol' showing four growth rings and opaque zone,  $\times 2.5$ . Total length of fish: 96.0 cm. Date of collection: 28-12-1960



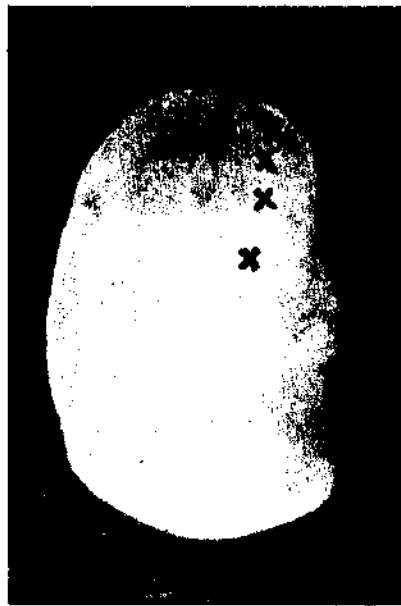
PHOTOGRAPHS 1-6



1



2



3

PHOTOGRAPHS 1-3