

AGE AND GROWTH OF LIZARDFISHES (*SAURIDA* SPP.) FROM THE NORTHWESTERN BAY OF BENGAL*

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ABSTRACT

Length-frequency study shows that *S. tumbil* may grow to 170/190, 270/290, 350/370 and 410/430 mm respectively at the end of 1st, 2nd, 3rd and 4th year. These growth rates are similar to those estimated for fish in the East China and Yellow seas, where it is known to attain a size of 550-560 mm in 5 to 6 years, the maximum size recorded there being 636 mm (fork length). Specimens above 450 mm were, however, not observed in the trawl catches from the Bay of Bengal. Von Bertalanffy equation for growth in length was fitted for length-at-age data of *S. tumbil* and the values of various parameters were estimated as $K = 0.249$; $t_0 = -0.334$; $L_{\infty} = 637$ mm.

S. undosquamis may attain a size of 170/190 and 270/290 mm at the end of 1st and 2nd year, respectively. Specimens above 340 mm were not recorded, and the life span in this species therefore may be 3 years.

INTRODUCTION

The age and growth of *S. tumbil* and *S. undosquamis* were studied by the analysis of length-frequency data (Petersen's method), as the scales, otoliths and other skeletal structures in the species from our waters did not show growth rings or checks on them, though Okada and Kyushin (1955) had observed growth checks on the scales of *S. tumbil* from the East China and Yellow seas.

MATERIAL AND METHODS

Random samples of *S. tumbil* and *S. undosquamis*, each consisting of 50 to 100 fish, were collected once a week from each of the Government of India trawlers, *M. T. Ashok*, *M. F. V. Champa* and *M. V. Sea Horse*, stationed at Visakhapatnam during the period 1964-1967, and the total lengths (distance from the tip of the snout to the tip of the longest ray in the upper caudal lobe) were taken with the help of a fish-measuring board having divisions up to 0.1

* Formed part of the author's thesis for Ph.D. of the Benares Hindu University.

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cm. The length measurements were pooled for each month and analysed, keeping the size interval as 20 mm. The number of fish in each size group was expressed in terms of percentage. The monthly percentage-frequency distributions in respect of *S. tumbil* for the three vessels are shown separately in Figs. 1 to 3, as they used different sizes of trawl nets. M. T. Ashok, M. F. V. Champa and M. V. Sea Horse used 15 m, 14 m and 12 m trawls with cod end mesh sizes of 35-40, 30 and 30 mm, respectively. In all, length measurements 8560 specimens of *S. tumbil* and 2827 specimens of *S. undosquamis* were used in this study. Juveniles and small fish 30-100 mm in length were collected from the catches of shore seines at Lawson's Bay, Waltair, during November-March period.

The protracted spawning period in these fishes (Rao, M.S.) results in a number of broods which enter the fishery over a long period. The mixing of the different broods and the selection by the sampling gear introduce difficulties in tracing the progression of different modes. Nevertheless, a careful study of the modal progressions has yielded a good estimate of the growth rate of these fishes.

RESULTS

Growth of *Saurida tumbil*

M. F. V. Champa: This vessel fished only in zone 17°40', in the period 1964-1968. The monthly length-frequency distributions for the years 1964-65, 1965-66, 1966-67 and 1967-68 are presented in Fig. 1 (the period March to April is reckoned as the year).

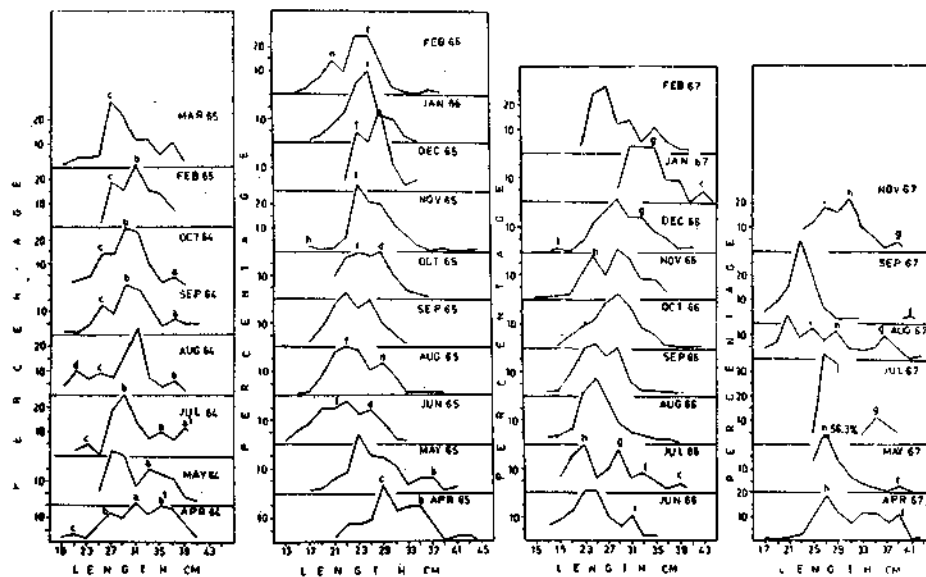


FIG. 1. Monthly length-frequency distributions of *S. tumbil* in the landings of the Govt. of India trawler, M.F.V. Champa during April 1964-November 1967.

Four modes a_1 , a , b and c at 35, 31, 27 and 21 cm, respectively, were observed in the length-frequency distribution for April 1964. Mode b at 27 cm in April 1964 can be traced to the mode (b) at 35 cm in April 1965 and this progression shows a growth of 8 cm in one year. Mode c at 21 cm in April 1964 can be traced to the mode at 29 cm in April 1965. This progression also shows a growth of 8 cm in one year. It can be seen that the fish under the mode c (21 cm) grow to a size of those under the mode b (27 cm) in about one year. Similarly fish under mode b (27 cm) grow to a size of those under mode a_1 (35 cm) in one year. From this it is clear that the time interval between the modes c and b and that between b and a_1 is one year. The interval between the modes b and a is not one year.

The mode a at 31 cm in April 1964 shifts to 37 cm in October 1964 and this shift shows a growth of 6 cm in 6 months. Mode a_1 at 35 cm in April 1964 progresses to 39 cm in July 1964 and this progression indicates a growth of 4 cm in 3 months. The mode c at 29 cm in April 1965 can be traced to the mode at 37 cm in February 1966, indicating a growth of 8 cm in 10 months. The mode c at 37 cm in February 1966 can further be traced to the mode at 43 cm in January 1967, with an increase in length of 6 cm in one year. The progression of the mode c in the period 1964-1967 indicates a growth of 8, 8 and 6 cm in the first, second and third years, respectively.

The mode d at 21 cm in August 1964 shifts to 29 cm in August 1965. Similarly, the mode e at 19 cm in September 1964 can be traced to the mode at 27 cm in September 1965. Both these progressions show a growth of 8 cm in one year. The mode f at 23 cm in June 1965 can be traced to the mode at 31 cm in June 1966 and this can be traced further to the mode at 39 cm in May 1967. These progressions indicate a growth of 8 cm in one year. The mode g at 29 cm in July 1966 progresses to 35 cm in July 1967 thereby indicating a growth of 6 cm in one year. The mode g can be traced further to the mode at 39 cm in November 1967. The mode h at 17 cm in November 1965 progresses to 25 cm in November 1966 and can be traced further to the mode at 31 cm in November 1967. These progressions show a growth of 8 cm and 6 cm in one year. The mode i at 19 cm in December 1966 shifts to 27 cm in November 1967 and this shift indicates a growth of 8 cm in one year.

The first mode in the length-frequency distributions during the spawning time, October to March (period of birth), was observed at 17 or 19 cm. It can be seen from the progressions of modes traced above, that a growth of 8 to 10, 8 and 6 cm in one year is attained by fish with modal sizes of 17/19, 27/29 and 35/37 cm respectively. It has been shown above that the time interval between these modes is one year.

Kuthalingam (1969) had artificially fertilized the eggs of *S. tumbil* and reared the larvae for about 45 days. He observed that the larvae grew to 18.8 mm in

26 days, 22.4 mm in 34 days and 26.7 mm in 42 days. The length-frequency distribution of samples collected by the present author from shore seine catches at Lawson's Bay in February (Fig. 1) showed a size range of 40-140 mm with two modes, one at 50 mm and the other at 90 mm. In the light of the work of Kuthalingam (*op. cit.*), it is reasonable to infer that fish with a modal size of 50 mm are about 2½ to 3 months old and those with a modal size of 90 mm are 5 to 6 months old. A growth of 170 to 190 mm in the first year of life appears quite reasonable in view of the growth rate of 90 mm in about 6 months deduced above. Fish under the first mode at 170 or 190 mm in the length-frequency distributions during the (spawning time) period of birth are therefore one year old.

The modal positions in the length-frequency distributions during the spawning season (October to March) were frequently observed at 170 or 190, 270 or 290, 350 or 370, and 410 or 430 mm and, from the growth rates derived earlier, it is clear that fish with these modal values are 1, 2, 3 and 4 years old respectively.

M. T. Ashok: The monthly length-frequency distributions of *S. tumbil* from this vessel for the period April 1964 to March 1967 are presented in Fig. 2.

The length-frequency distribution for January 1965 shows 3 modes, *f* at 19 cm, *d* at 31 cm and *b* at 39 cm. The mode *f* at 19 cm in January 1965

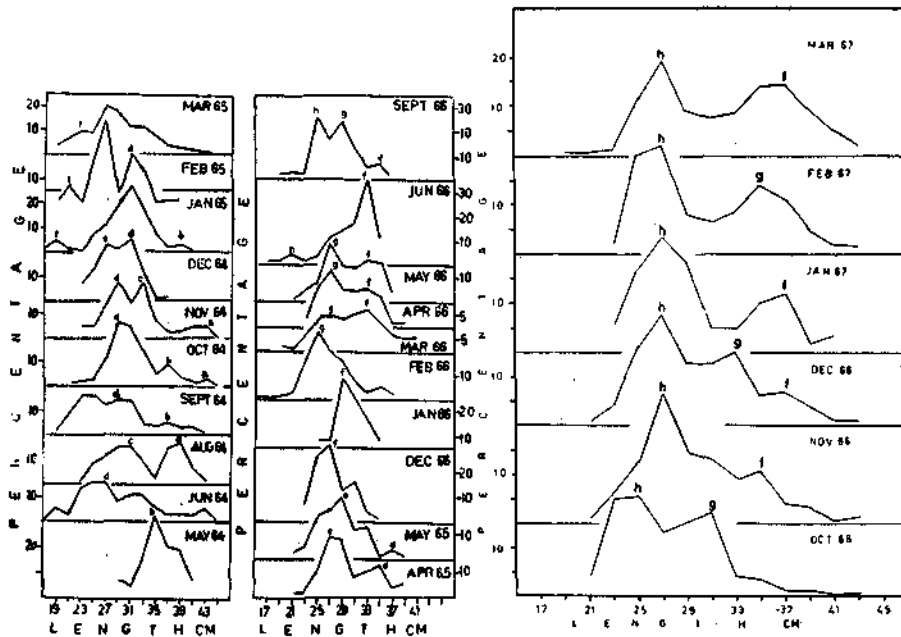


FIG. 2. Monthly length-frequency distributions of *S. tumbil* in the trawler landings of M.T. Ashok during April 1964-March 1967.

progresses to 29 cm in January 1966 and this shift shows a growth of 10 cm in one year. The mode *f* at 29 cm in January 1966 can be traced further to the mode at 37 cm in January 1967. This shift indicates a growth of 8 cm in one year. From this it is clear that fish with a modal value of 19 cm grow to a modal size of 29 cm and those with a modal size of 29 cm grow to a modal size of 37 cm in one year. Therefore, the time interval between the modes *f* (19 cm) and *d* (31 cm), and *b* (39 cm) in the length-frequency distribution for January 1965 is one year. It has already been shown that fish with a modal size of 19 cm are one year old and so the modes *f*, *d* and *b* in January 1965 represent fish 1, 2 and 3 years old.

The growth rates derived from the progression of the following modes substantiate the above view.

The mode *d* at 27 cm in June 1964 can be traced to the mode at 37 cm in May 1965 and this shift shows a growth of 10 cm in one year. Similarly, the mode *g* at 25 cm in February 1966, by shifting to 35 cm in February 1967, shows a growth of 10 cm in one year. Mode *e* at 23 cm in September 1964 can be traced to the mode at 29 cm in May 1965 and this shift indicates a growth of 6 cm in 8 months. Mode *h* at 21 cm in June 1966 shifts to 27 cm in November 1966, thereby indicating a growth of 6 cm in 5 months. The mode *b* at 35 cm in May 1964 progresses to 39 cm in January 1965, a growth of 4 cm in 8 months. The mode *c* progresses from 31 cm in August 1964 to 37 cm in May 1965, an increase in length of 6 cm in 9 months.

From the growth rates derived above, it is clear that the modal values of 19, 27 or 29, 35 or 37 and 43 cm observed in the length-frequency distributions during the spawning period (October to March) represent fish 1, 2, 3 and 4 years old, respectively.

M. V. Sea Horse (Fig. 3): Data are available for the year 1964-65 only. Two modes, *a* at 35 cm and *c* at 27 cm are present in the length-frequency distribution for May 1964. The mode *c* at 27 cm in May 1964 progress to 35 cm in April 1965 and this shift indicates a growth of 8 cm in one year. The time interval between the modes *c* and *a* in May 1964 is one year.

The mode *a* at 35 cm in April 1964 can be traced to the mode at 41 cm in November 1964; and the mode *b* at 35 cm in July 1964 progresses to 41 cm in February 1965. These shifts indicate a growth of 6 cm in 6 and 7 months respectively. The mode *d* at 27 cm in October 1964 shifts to 29 cm in January 1965; and the mode *c* at 19 cm in January 1965 progresses to 21 cm in March 1965.

Seasonal growth rate: In Fig. 4 the positions of the modes in the length-frequency distribution of *M. F. V. Champa* for 1964-1967 are replotted against

Hence the von Bertalanffy equation for *S. tumbil* would be

$$L_t = 637 (1 - e^{-0.249 (t+0.334)})$$

The growth curve of *S. tumbil* obtained by fitting the Bertalanffy equation is shown in Fig. 7. Estimates of length-at-age made according to this equation show a high degree of agreement with estimates by the length-frequency studies showing that, in the length ranges studied, the theoretical growth equation adequately describes the actual growth.

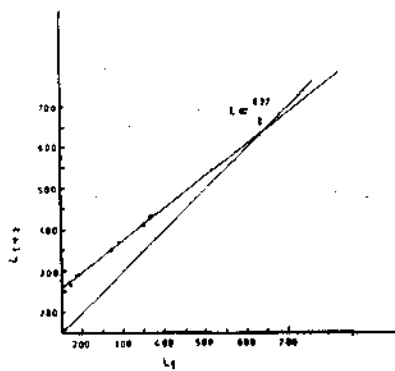


FIG. 5. Ford-Walford plot of growth of *S. tumbil*.

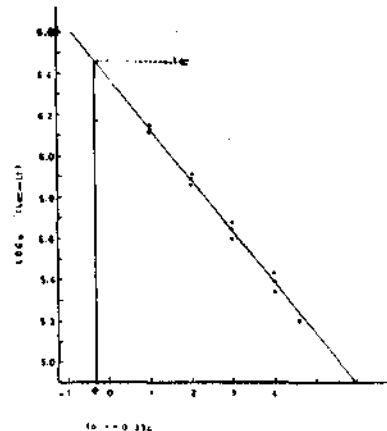


FIG. 6. $\text{Log } e (L_{\infty} - L_t)$ plotted against age 't' for estimation of t_0 in *S. tumbil*.

Growth of S. undosquamis

S. undosquamis occurred in small numbers in the catches of the trawlers and in some months this species was practically absent in the catches. Only in some months could sufficient number be measured. The monthly length-frequency distributions showed only one mode in many months which remained

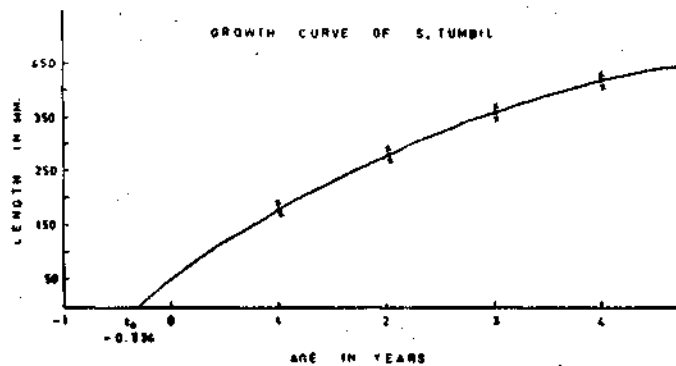


FIG. 7. Growth curve of *S. tumbil* obtained by fitting von Bertalanffy equation.

at the same place almost throughout the year without showing any progression. Hence the monthly length-frequency data of each trawler were pooled into quarterly length-frequency distributions to see if a clear picture could be made out. The quarterly length-frequency (percentage) distributions of *S. undosquamis* from the trawlers are presented in Figs. 8 to 10.

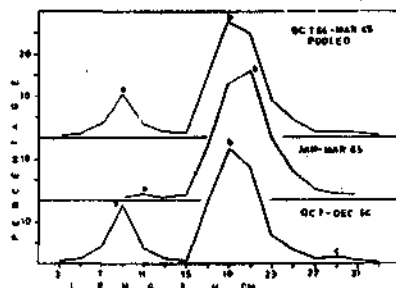


FIG. 8. Quarterly length-frequency distributions of *S. undosquamis* from M.V. Sea Horse landings in 1964.65.

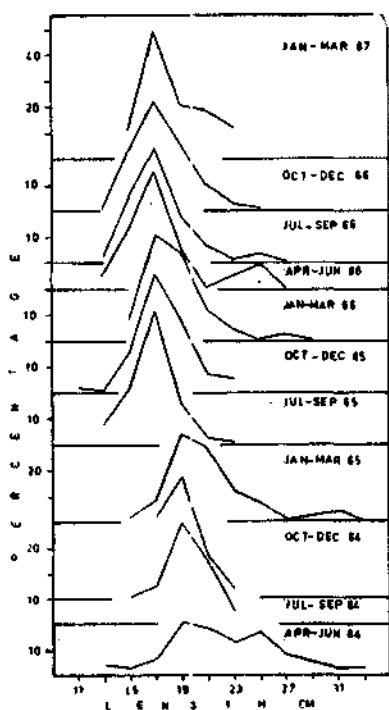


FIG. 9. Quarterly length-frequency distributions of *S. undosquamis* in M.F. V. Champa landings in 1964-67.

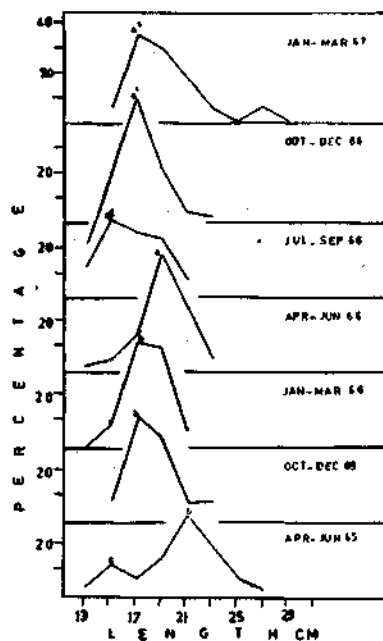


FIG. 10. Quarterly length-frequency distributions of *S. undosquamis* in M. T. Ashok landings in 1965-67.

M. F. V. Champa: The quarterly length-frequency distributions for the period 1964-1967 are shown in Fig. 9. Except in two quarters, the length-frequency distributions show only one mode either at 17 or 19 cm. A second mode at 25 cm was observed in the quarter April-June 1964 and July-September 1966. As the modes do not show progression, it is not possible to estimate the growth rates. It is possible that the annual growth rates in this species are similar to those observed in *S. tumbil* and in that case fish with a modal value of 17 or 19 cm and 25 cm are one and two year old, respectively.

M. T. Ashok (Fig. 10): The length-frequency distribution, as in the case of *M. F. V. Champa*, show only one mode at 15 or 17 or 19 cm in all the quarters except April-June 1965 and January-March 1967 when a second mode at 21 cm and 27 cm respectively was observed. It is not possible to trace the progression of the modes. Fish with a modal value of 15 to 19 cm may be one year old and those with a value of 27 cm may be two years.

M. V. Sea Horse: Data from this vessel are available for two quarters only (Fig. 8). The graph for October-December 1964 shows three modes, i.e., at 9, 19 and 29 cm, while in the next quarter only one mode at 21 cm is observed. The pooled data for the two quarters show two modes, one at 9 cm and the other at 19 cm. As mentioned above, fish under the mode at 19 cm may be one year old while those under the mode at 9 cm may be about six months old.

DISCUSSION

Studies on the length-frequency distributions of *S. tumbil* indicate a number of broods for a year class. This is supported by the results of studies on spawning in this species, where it has been shown that 5 or 6 broods may be spawned during the spawning season.

The growth rates deduced from the progressions of the modes in the length-frequency distributions of *S. tumbil* from the trawlers and the modal positions during the spawning season (October to March) clearly show that *S. tumbil* grows to 170-190, 270-290, 350-370 and 410-430 mm at the end of 1, 2, 3 and 4 years, respectively.

Fish above 450 mm were not observed in the catches of the trawl nets during the period of this investigation. The value of the parameter L_{∞} (637 mm) in the von Bertalanffy equation calculated from the above growth rates appears to be high compared to the maximum size recorded by the present author. It is quite possible that specimens longer than 450 mm may be available in deeper waters in the Bay of Bengal not fished by the trawlers during the period of this study. Moreover, it is also known that the trawls may not catch the large individuals of a population of fish and that such large individuals may be caught on hook and line or by other gear. Sekharan (1973) has reported that, in the

northwestern part of the Bay of Bengal, catfishes (*Tachysurus* spp.) of more than 60 cm are not caught in the trawls, but are common in the catches of the hook and line. The present author (Rao, 1968) has observed that in Bombay and Saurashtra waters large individuals of *Pseudosciaena diacanthus* more than 110 cm in total length are not caught in the trawls but specimens 120 to 125 cm in length are caught by the *dol* nets and bottom-set gill nets. From length-frequency studies Longhurst (1965) has estimated L_{∞} for *Galeoides decadactylus* from Nigerian waters to be 54.5 cm while the maximum size he recorded in the trawl catches was 39.0 cm. It may be mentioned in this connection that specimens as long as 636 mm in fork length have been recorded in Japanese waters by Okada and Kyushin (1955).

Okada and Kyushin (*op. cit.*) have estimated the life span of *S. tumbil* in the East China and Yellow seas to be 5-6 years and from scale studies these authors have calculated the lengths (fork length) at ages 1, 2, 3, 4, 5 and 6 years to be 175.5-184.8, 283.2-292.8, 380.2-377.9, 464.8-462.4, 537.7-560.6 and 553.3-558.5 mm, respectively. The lengths at the end of 1, 2, 3 and 4 years, deduced from the length-frequency studies in the present investigation, are in close agreement with those calculated for fish in the East China and Yellow seas by Okada and Kyushin (*op. cit.*) but differ from those estimated by Tiews et al (1972) for *S. tumbil* in the Philippine waters. Using the Petersen's method, these authors have found that *S. tumbil* grows to 8, 16, 24 and 32 cm in 1, 2, 3 and 4 years, respectively.

In the case of *S. undosquamis*, the modes in the length-frequency distributions remain stationary almost throughout the year without showing any progression and this may indicate that spawning in *S. undosquamis* may be continuous resulting in continuous recruitment to the stocks. The spawning period and the number of broods spawned in this species could not be fixed for lack of specimens beyond stage IV of maturity as mentioned earlier.

During the period of this investigation specimens of *S. undosquamis* above 340 mm were not recorded. It appears that the life span in this species may be 3 years. The fishery is mainly supported by one-year-old fish and to some extent by two-year-old fish.

ACKNOWLEDGEMENTS

I am grateful to the late Dr. K. V. Sekharan, then Head of Fishery Biology division, Central Marine Fisheries Research Institute, Cochin and Dr. J. P. Thapliyal, Professor of Zoology, Banaras Hindu University, for guidance and help.

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