J. Exp. Zool. India Vol. 19, No. 2, pp. 757-762, 2016 | www.connectjournals.com/jez | *ISSN 0972-0030*

BREEDING BIOLOGY OF *OTOLITHES RUBER* (BLOCH & SCHNEIDER, 1801) FROM MANGALORE COAST

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(Accepted 25 May 2016)

ABSTRACT : The tiger toothed croaker, *Otolithes ruber* is one of the important demersal fish landed by commercial trawlers and found up to the depth of 50 m. Maturation studies carried out on *Otolithes ruber* samples collected from commercial landings from March-2009 to February-2010 showed the dominance of male with male to female ratio of 1:0.81. The Gonado Somatic Index values ranged between 0.3472 to 1.2876 in male and in case of female, it fluctuated between 1.0958 to 3.5973. The fecundity ranged from 48,625 to 2, 31,396 eggs with an average of 1, 16,118 eggs. The ova diameter ranged from 0.04 mm to 0.99 mm. From the maturity stage study it is clear that *Otolithes ruber* spawns only once a year from September to November. The minimum size at sexual maturity was at 190 mm and 200 mm (TL) for male and female respectively. The logarithm relationship between fecundity, total length, body weight and ovary weight were also calculated.

Key words : *Otolithes ruber*, breeding biology , Mangalore coast.

INTRODUCTION

Sciaenids are among the important groups of demersal fishes landed by commercial trawlers in Indian waters and are commonly called as croakers. Sciaenids captured off Dakshina Kannada coast are locally called as "Kallur" (in tulu). In India the estimated landing of croakers in the year 2014 was 1,61,864 tons (Anon, 14).

The fishes of the family Sciaenidae are represented by the 17 genera and 34 species in the Indian waters (Ayyappan, 2006). Fourteen species of sciaenids contributed to the fishery along Dakshina Kannada coast (Baragi and James, 1984) among these *Otolithes ruber*, *O.cuvieri* and *Johnieops osseus* are prominent ones. The common name of *Otolithes ruber* is "Tiger toothed croaker".

MATERIALS AND METHODS

The present study on *Otolithes ruber* from Mangalore is based on a random sample of 290 specimens, in the size range from 13 to 273 mm (TL), consisting of 160 males and 130 females. Fortnightly samples were collected from the Mangalore main fish landing center (Bunder jetty) and fish market from March 2009 to February 2010. The length, weight, sex and stage of maturity of individual fish in each sample were noted. The gonad were then carefully removed and preserved in 5% formalin for further analyses.

In the laboratory, the total length (mm), weight (g), sex and maturity stage of individual fish were noted. The ovaries of matured females were preserved in 5% formalin for further studies. Six stages of maturity (immature, maturing, early mature, late mature, gravid and spent) were recognized on the macroscopic appearance of the ovary and microscopic characteristics of ova. Eggs were measured by an ocular micrometer. Frequency polygons were drawn for all the stages of maturity to find out the frequency of spawning. Gonado Somatic Index (GSI) was calculated by using the formula, gonad weight x 100/ fish weight. Size at first maturity was determined by cumulative percentage frequency method and the relative condition factor (Kn) values at various size groups. Fecundity was estimated by using ovaries of stages IV and V. Sex-ratio was calculated for different months and different size groups of fish.

RESULTS AND DISCUSSION

Ovaries belonging to six stages of maturity were selected and the ova diameter frequency polygons of these ovaries were drawn. The data are presented in (Fig. 1).

In stage I, the size of ova ranged from 0.04 mm to 0.23 mm with majority of them in the size range of 0.05 mm. The size of ova in stage II varied from 0.21 mm – 0.56 mm. The frequency polygon for this stage indicated the withdrawn of a batch of ova with a modal size of 0.3 mm from the general egg stock to undergo maturation. The maturing group had a modal value at 0.3 mm, while the largest ova measured was at 0.56 mm. In stage III, this progresses to 0.25 mm, the maximum size being 0.66

mm. The mode of the largest group being at 0.4 mm. The mode in the stage III at 0.4 mm moved to 0.5 mm in stage IV with a maximum size at 0.89 mm.

In stage V, maximum size of ova was 0.99 mm and the mode shifted from 0.45 mm to 0.75 mm from the previous stage. In the stage VI the maximum size of the ova was found to be 0.20 mm with the mode at 0.07 mm.

Spawning habits

Otolithes ruber may be considered as spawning once in a season for a prolonged period as evidenced from the ova diameter studies.

Spawning season

The spawning season was determined on the basis of occurrence of individuals in maturing, mature, and spent stages of maturity in each month. The data are presented in Figs. 2a and 2b. The results of the gonadal maturity of females the data revealed that in March the stages from I to IV were seen among which stages I, II and III were predominant. In April and May also stages I to IV were seen with stages II and III being predominant. In September the stages II to V were seen among which stages III and IV were dominant. In October, except stage I, all the other stages were recorded, stage IV and V being predominant. In November, except stage I and II, all stages were present, among them the stage IV was predominant followed by the stage V and VI. In the month December also except stage I and II, all stages were recorded with the stage V being dominant. In January, stages II to VI were noticed with stage II and IV dominating. In February, all the stages were seen except stage I, with dominance of stage III followed by IV and VI.

For males, the data revealed that in March and April stages I to IV, were present with dominance of stages I and II. In the month of May stages I and IV were seen among which stage II and IV were dominant. During the month of September stages II to IV were present, among that stage III was dominant. In October except, stage VI all the other stages were recorded, stage III prominent followed by IV. In November among all the stages stage II was dominant. In December, all the stages were recorded, stage VI being predominant. In January II, III and VI were present, among this stage VI was dominant. In February the stages II, III, IV and VI were recorded and stage VI was dominant.

Rao (1985) made intra-ovarian studies and reported that spawning period of *Otolithes cuveiri* extended from November to April along Veraval coast.

Relation between the size of fish and maturity stage

Fishes were sorted sex-wise into 2 cm size groups to calculate percentage occurrence of fish in various stages of maturity. Fish from the stage III onwards were considered mature. The data is presented in Fig. 3a and 3b.

In case of male, the data revealed that immature and maturing stages were found up to size range 13 – 15 cm (Stage I, II). From 15 cm onwards maturity stages appeared. The percentage of mature fish crossed 50% at the size group 18 - 20 cm. Hence, it is clear that the size at first maturity for male lie between 18 and 20 cm with an average length 19 cm.

In case of female, all were in immature stage up to 13-15cm (Fig. 4). From size group 13-15cm, the maturing stages appeared and the percentage occurrence increased with increase in size. The occurrence of 50% mature fish crossed in the size group 19 - 21 cm (TL). From the above data the size at first maturity for female was found to be 19-21 cm. with an average of 20 cm (TL). Earlier studies revealed that the size at first maturity of *O. ruber* was found to be within the range of 220 mm-240 mm (Vaidya, 1960). Wallace (1975) reported that the size at first maturity in *O. ruber* from East Coast of South Africa was in the size range of 220 mm- 250 mm.

In order to determine the size at first maturity cumulative percentage of III to V were considered. Cumulative percentage frequencies of fish belonging to the above stages were plotted against size group. The size at 50% cumulative percentage frequency was considered to indicate the overall reproductive maturity of the population as a whole. From Fig.4 it is clear that male and female mature at 19.0 cm (TL) and 20.0 cm (TL), respectively.

Gonado-Somatic Index

Gonado-Somatic Index (GSI) was calculated for each individual fish with male and female were taken into consideration separately. The average GSI values were plotted against each month and the results are presented in (Fig. 5). The G.S.I. values ranged between 0.3472 to 1.2876 in male fish. The lowest G.S.I. value was recorded in January, while the highest was in September.

In case of female, the G.S.I. values fluctuated between 1.0958 to 3.5973. The lowest value of G.S.I. was in the month of March and it gradually increased in February and then slightly decreased in March. From March onwards increased up to November. Maximum value of G.S.I. was in October indicating the occurrence of maximum number of mature fish during post-monsoon months.

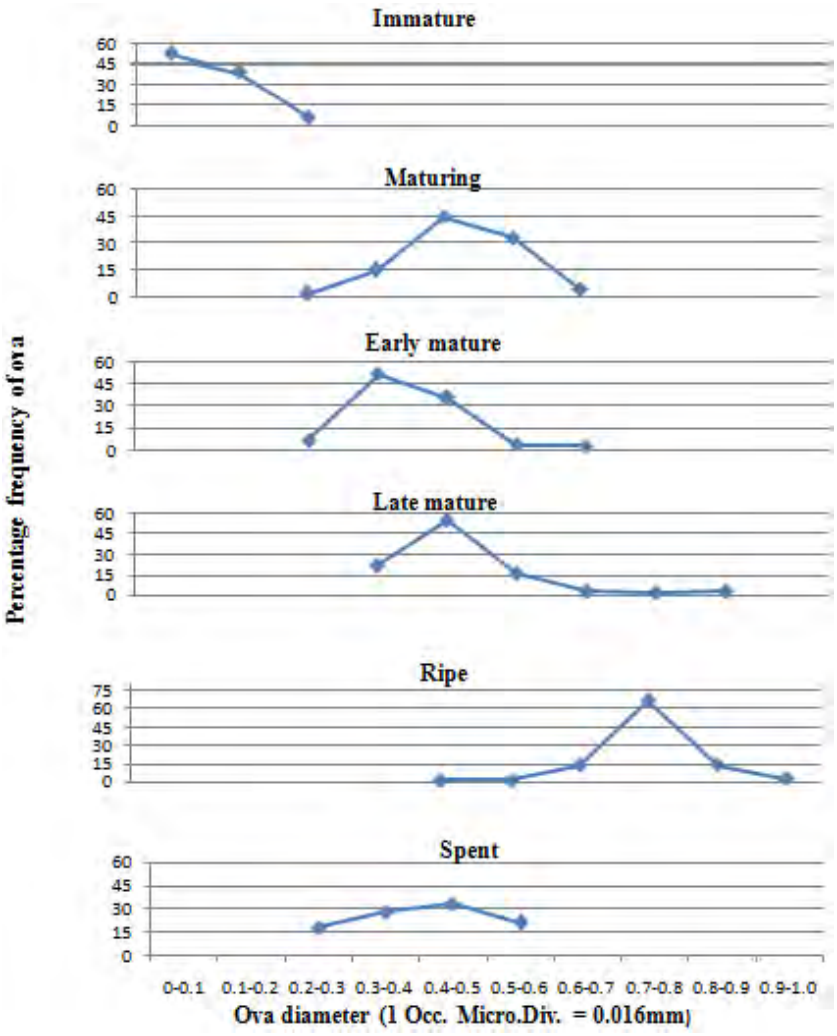

Fig. 1 : Ova diameter frequency polygon of *Otolithes ruber.*

Fecundity

Only the mature ova were considered for the estimation of fecundity. In *Otolithes ruber,* a clear demarcation of mature and immature ova was noticed from stage IV onwards. Hence, for fecundity studies, fishes of IV and V were taken into consideration (Table 1). The fecundity in *Otolithes ruber* ranged from 48,625 to 2, 31,967 eggs with an average of 1, 16,118 eggs. The minimum weight of the mature *Otolithes ruber* was 85.1g and the maximum weight was 213.5 g, with total length varying between 18.2 cm to 27.2 cm. This was quite high when compared to the earlier findings. According to Mahadevan Pillai (1983) the fecundity of *O. ruber* revealed that the number of ova in the mature ovaries varied between 43, 810 and 1, 70,130 with an average of 130,761. Stephen Dadzie (2007) reported that the fecundity of *O. ruber* was 1,90,000 eggs.

The number of ova generally increased with increase in length and weight. However, variations in fecundity with respect to length and weight were also noticed.

Relation between fecundity and length of fish

When the logarithmic values of fecundity (Y) were plotted against logarithmic values of length (X), a linear relationship between the two variables was observed (Fig. 6a). The relationship between length and fecundity was Y=2.0342 +3.0801X

Where, Y=Log Fecundity and X=Log Length of fish

The correlation coefficient (r) calculated from the logarithmic values of these two variable was at 0.79.

Relationship between fecundity and weight of fish

The relationship between the log weight (X) and the log fecundity (Y) of *Otolithes ruber* (Fig. 6b) were linear. The linear form of regression between weight of fish and fecundity was calculated as Y=5.5493 + 1.2292X

Where, Y=Log Fecundity and X=Log Weight

The correlation coefficient (r) between fecundity and weight of fish was 0.80.

Relationship between fecundity and gonad weight

The logarithmic values of the fecundity (Y) when plotted against logarithmic gonad weight (X) of the fish (Fig. 6c) indicate a linear regression equation of the form Y= A+BX. The calculated regression equation was Y=10.1750 +0.6966X

Where, Y= Log Fecundity and X= Log Gonad weight

The correlation coefficient (r) between fecundity and gonad weight of fish was 0.84.

Sex-ratio

The data on sex-ratio of *Otolithes ruber* showed that in most of the months male were dominant. The sex-ratio between male and female was 1:081. Chi-square test showed no significant difference from the theoretical ratio of 1:1. It is believed that the following factors might be responsible for the sex composition, Del Zarka and El-sedfy (1970).

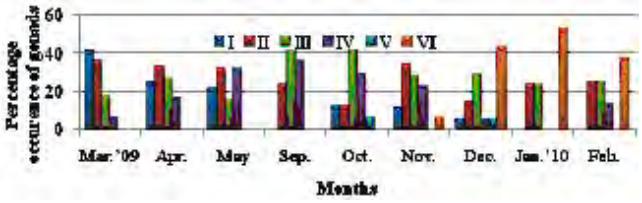

Fig. 2a : Percentage occurrence of different maturity stages in male *Otolithes ruber*.

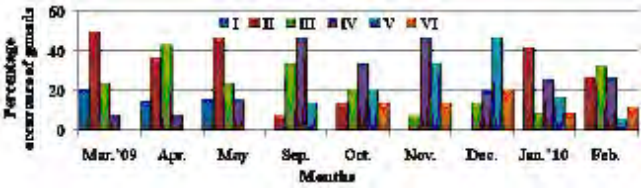

Fig. 2b : Percentage occurrence of different maturity stages in female *Otolithes ruber*.

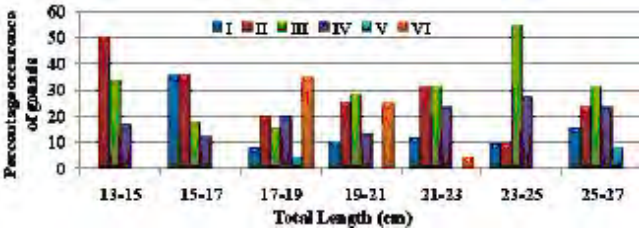

Fig. 3a: Percentage occurrence of different stages of maturity of male in relation to different size groups of *Otolithes ruber*.

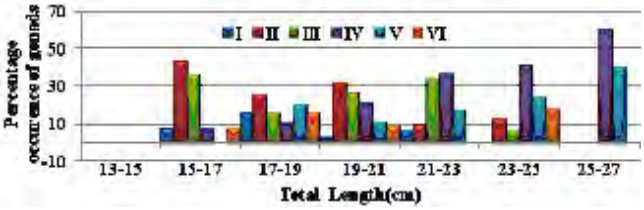

Fig. 3b: Percentage occurrence of different stages of maturity of female in relation to different size groups of *Otolithes ruber*.

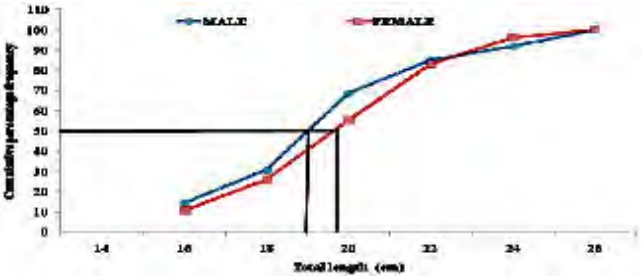

Fig. 4 : Cumulative percentage frequency of mature gonads of both male and female of *Otolithes ruber*.

(a) segregation of the sexes through various periods of the year including segregation resulting from sex difference in age and maturity. (b) Gear selectivity in relation to sex difference in morphology and in physiology activity and (c) difference in natural and fishing mortality between two sexes. Sex ratio may depend upon differential catch.

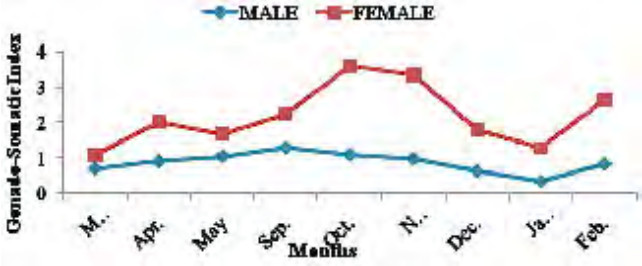

Fig. 5 : Monthly variation in the Gonado-Somatic Index of *Otolithes ruber*.

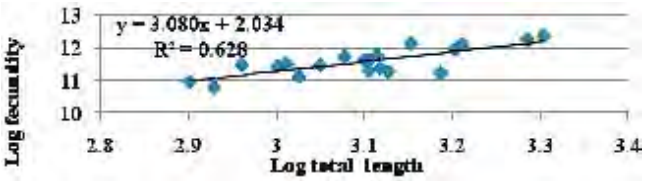

Fig. 6a

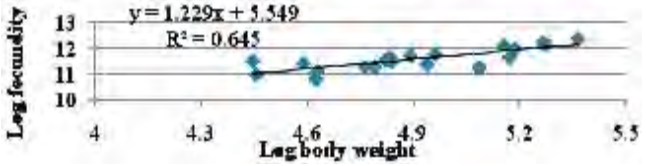

Fig. 6b

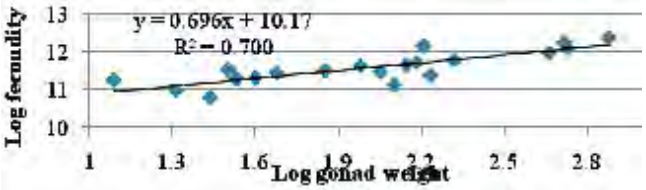

Fig. 6c

Fig.6 a : Logarithmic length of fish and fecundity relationship of *Otolithes ruber*

b: Logarithmic body weight of fish and fecundity relationship of *Otolithes rube*r

c: Logarithmic gonad weight of fish and fecundity relationship of *Otolithes ruber*

The sex ratio in different size groups showed that male *O. ruber* were dominant in the smaller size groups (13- 15 cm), while female were dominant in the larger size groups (23- 25 cm). The dominance in the higher size groups of male and female i.e., after attaining first maturity could be attributed to differential growth pattern. Males dominated over females in the commercial catches (Table 2). The sex- ratio showed no significant deviation in case of the sciaenid *J. osseus* (Baragi, 1976). According to him, length above 17 to 18 cm indicated faster growth of females, while males grew faster only in the initial period.

CONCLUSION

A perusal of the data on the occurrence of males

Table 1 : Number of mature ova in individuals of *Otolithes ruber.*

Sl. No.	Total length(cm)	Body weight(g)	Gonad weight(g)	Fecundity	Stages of maturity
1	20.6	102.21	8.18	67,785	V
2	22.8	120.31	4.64	78,954	IV
3	22.3	116.9	4.95	80,985	V
4	24.2	161.6	2.97	76,249	IV
5	22.2	125.62	8.54	1,12,600	V
6	22.6	139.56	9.36	86,834	V
7	22.5	142.80	10.19	1,30,304	V
8	18.7	102.00	4.20	48,625	IV
9	18.2	86.00	3.72	58,166	IV
10	21.1	126.00	7.80	95,740	IV
11	24.6	179.00	14.30	1,56,766	V
12	24.8	194.80	15.30	1,78,650	V
13	27.2	213.50	17.80	2,31,967	V
14	26.7	194.00	15.16	2,08,407	V
15	21.7	133.00	8.90	1,23,250	V
16	20.1	98.30	5.35	92,422	IV
17	19.3	85.10	6.40	96,764	IV
18	23.4	173.00	9.12	1,84,396	V
19	22.3	176.00	7.24	1,12206	V
20	20.3	124.00	4.50	1,01,287	IV

Table 2 : Sex –ratio in different size groups of *Otolithes ruber.*

Size group (cm)	Total no. of fish	Male		Female		Chi-square values	Male : Female
		No. of fish	%	No. of fish	%		
13-15	6	6	100	0	0	6.00*	01:00.0
15-17	31	17	54.84	14	45.16	0.29	01:00.8
17-19	46	26	56.52	20	43.48	0.78	01:00.8
19-21	99	61	61.62	38	38.38	5.34*	01:00.6
21-23	62	26	41.94	36	58.06	1.61	01:01.4
23-25	28	11	39.29	17	60.71	1.29	01:01.5
25-27	18	13	72.22	5	27.78	3.56*	01:00.4

*Significant at 5% level.

and females of *Otolithes ruber* in different stages of maturity in relation to size of fish indicated that first maturity is attained when females measure about 15-17 cm size range and males about 13-15 cm size range. The size at first maturity was also calculated from the relative condition factor. The peak point on the curve showing the determination of relative condition 'K' with increasing length at which sexual maturity is attained (Hart, 1946).

The size at first maturity was determined by cumulative frequency method. The cumulative percentage of fishes belonging to stage III, IV and V were taken into consideration to calculate the size at first maturity. The study indicated that the male attained the maturity in the size range of 18- 20 cm with an average of 19 cm. and females attain the maturity in the size range of 19-21 cm with an average of 20 cm. Earlier studies revealed that the size at first maturity of *O. ruber* was found to be within the range of 220 mm-240 mm (Vaidya, 1960).

In the present study, the data on the Gonado-Somatic Index (GSI) revealed that it remained relatively high in both sexes during the months of September, October and November indicating the spawning period of *O. ruber* in Dakshina Kannada coast. Males always recorded lesser gonado-somatic index values than females.

In the present study, stages IV and V ovaries were taken into consideration for the fecundity estimation studies because only these ovaries are concerned with spawning. The absolute fecundity of *Otolithes ruber* was found to vary from 48,625 to 2, 31, 967 eggs depending upon the size of the fish and the average being 1, 16,118 eggs per female. These estimates of fecundity of *Otolithes ruber* is in agreement with the observation of

(Mahadevan Pillai, 1983).

In present study, the logarithmic relations between fecundity and length of fish, fecundity and weight of fish and fecundity and gonad weight of *Otolithes ruber* were found to be linear indicating that the fecundity varied irrespective of length and weight of fish, but increased with the weight of ovary. These observation are in agreement with the observation of (Muthiah, 1981; Rao, 1985). In the present study it was observed that the relationship between fecundity and fish length, fish weight and gonadal weight were log F =2.0342 +3.0801 log L (r =0.79), log F= 5.5493 + 1.2292 log FW (r =0.80), log F= 10.1750 +0.6966 log GW (r= 0.84), respectively.

REFERENCES

Anon (2015) CMFRI Annual Report, 2014-15.

Ayyappan S (2006) Demersal Fisheries of India. Hand Book of Fisheries and Aquaculture, 56-78.

Baragi V M (1976) Biology of *Jhonieops osseus* (Day) with notes on the sciaenid fishery of the South Kanara coast. *M.F.Sc. thesis,* Univ. Agril. Sci, Bangalore, pp.216

Baragi V M and James P S B R (1984) Fisheries and bionomics of Sciaenids of South Canara coast. *Matsya* **9-10**, 8-14.

Del-Zarka S E and El-Sedfy H M (1970) the biology and fishery *of Mugil salinens* (Risso) in lake Quarun. *Bull. Inst. Oceanogr. Fish.* **1**, 3-26.

Druzhinin A D (1972) The Distribution of Lutjanidae and Sciaenidae (Pisces) in the Indian Ocean. *Indian J. Fish.* **18**(1&2), 52-66.

Fennessy S T (2000) Aspects of the Biology of Four Species of Sciaenidae from the East Coast of South Africa. *Estuarine, Coastal and Shelf Sci*. **50**, 259-269.

Hart T J (1946) Report on trawling survey on the Petagonian continental shelf. *Discovery Res.* **23,** 223-408.

Mahadevan Pillai P K (1983) On the biometry, food and feeding and spawning habits of *Otolithes ruber* (Schneider) from Porto Novo. *Indian J. Fish.* **30**(1), 69-72.

Muthah C (1981) Study on the biology of *Johnieops vogleri* (Bleekar) of Bombay waters. *Indian J. Fish.* **29** (1&2), 118-133.

Rao T Aappa (1985) Observations on some aspects of biology of *Otolithes cuvieri* (Trewavas) from Veraval coast. *J. Mar. boil. Ass. India* **27**(1&2), 186-188.

Stephen Dadzie (2007) Vitellogenesis, oocyte maturation pattern, spawning rhythm and spawning frequency in *Otolithes ruber* (Schneider, 1801) (Sciaenidae) in the Kuwaiti waters of the Arabian Gulf. *Scientia Marina* **71**(2), 239-248.

Vaidya V M (1960) A study on the biology of *Otolithus ruber* (Bl. and Schn.). *M. Sc. Thesis*, University of Bombay. 126pp.

WALLACE, J. H. and Van der Klst R P (1975) The estuarine fishes of the East coast of South Africa. IV Occurrence of juveniles in estuaries. V Biology, estuarine dependence and status. *Investigational Report, Oceanographic Research Institute No.* **42**, 1–63.