ON THE MATURITY OF *SARDINELLA DAYI* REGAN IN KARWAR REGION (WEST COAST OF INDIA)

G.G. ANNIGERI

Central Marine Fisheries Research Institute, Cochin - 682 031, India

ABSTRACT

Study on spawning biology of *Sardinella dayi* Regan for 1979-83 period shows that the size at first maturity is attained around 140 mm. For determining maturity and nature of spawning, condition factor (K) and gonadosomatic index (GSI) were utilized. The spawning in this species is protracted and lasts from October - December, and from January - May on a reduced scale. Relation of fecundity to length and fecundity to weight when tested statistically showed better correlation in 1979 and 1980, than in the rest of the years and the analysis of variance showed different rates of egg production during different years. Studies on fecundity showed that generally 66,000 eggs are released by each individual in the spawning act.

INTRODUCTION

Sardinella dayi which belongs to the family clupeidae is represented fairly well in the catches of purse seiners at Karwar. As there is no detailed account on the spawning biology of this species except a description of its occurrence in Karwar (Antony Raja and Lazarus, 1975) it was felt necessary to take up investigations on the same.

MATERIALS AND METHODS

The present account relates to the material collected from 1979 to 1983 at Karwar. Length, weight and maturity stages of fish sample were recorded and the ovaries were preserved in 5% formaldehyde for gonad studies. The scale adopted by the International Council for Exploration of Sea, was followed for maturity studies. Study on ovadiameter of preserved ovaries was carried out according to the methods recommended by Clark (1934) and then followed by Hickling and Rutenberg (1936) for fishes they

studied. Total number of ovaries analysed during this period was 265. For fecundity study, mature ovaries numbering 95 were studied.

Maturity studies

Size at first maturity: The minimum size at first maturity is given in Fig. 2. The fish beyond 139 mm size group are all mature. Figs. 1 and 2 show seasonal distribution and size-cum-distribution of 'K' values. High values of 'K' were encountered in 140 mm in 1980, in 140-150 mm in 1981 and at 135 mm group in 1982 indicating the mature fish in these groups. The values showed fall after these sizes indicating the spawning condition of this species. 'K' values are in conformity with the observed values of maturity of fish.

Seasonal changes in gonadal condition : Seasonal variation in the condition of gonad for five year period for the pooled data is shown in Table 1.

TABLE 1. *Seasonal changes in stages of maturity for* S. dayi

| Stages	Percentage	Months of occurrence
I & II (Immature)	12.95	January-May, August, September and November (Out of this 11% was in April, May and September)
III & IV (Developing)	10.20	January-May and August - December (Percentage was high from February - September)
V & VI (Mature)	25.30	January - May and August - December (Formed 21% in the latter period)
VII (Spent)	23.50	January -May and August - December (Percentage was high in the latter period)
lib (Resting)	28.05	January - May and August - December (Percentage was high in the latter period)
Total	100.00	
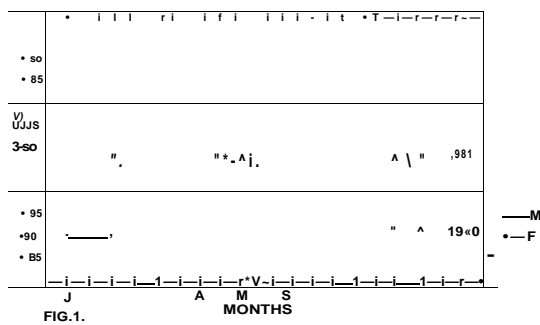
FIG.1.

Fic. 1. Seasoned changes in 'K' values for different years for S. *dayi.*

From the above table, it is observed that mature and spent fish were noticed in the same period simultaneously indicating protracted spawning in this species.

Ova-diameter studies: Out of 265 ovaries studied for this purpose, 30 belonged to stage II, 22 stage III, 48 stage IV, 162 stage V and 3 stage VI. In Fig. 3, pooled average for differ-
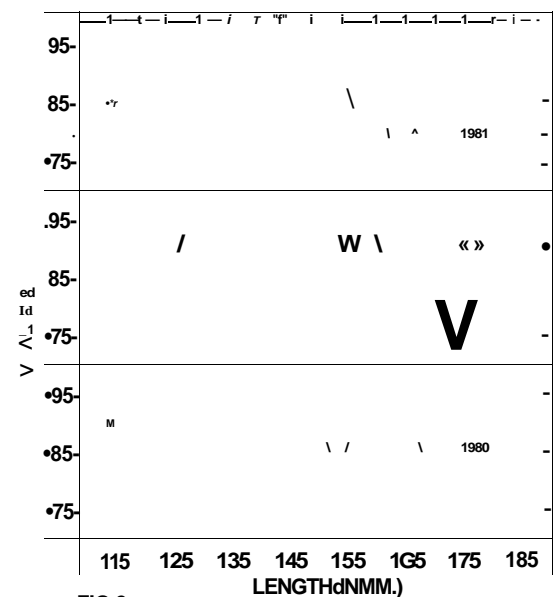

FIG.2.

FIG. 2. Size cum distribution of 'K' values of S. *dayi* during different years.

ent stages for this period is shown. In stage II, ova were transparent with visible nuclei and showed ova-diameter range upto 20-25 m.d. The ova-diameter range in stage III was upto 30-35 m.d. and ova were semi-transparent. In stage IV, ova were opaque due to yolk accumulation and range extended upto 65-70 m.d. In stage V fishes, ova were opaque and periphery transparent. Ova in stage VI were transparent without oil globule and ova-diameter range extended upto 100 m.d.

From Fig. 3, it is observed that stages II and III do not show differentiation of mode of mature eggs from the immature stock. In stage IV, the mode is observed at 50 m.d. which is sharply separated from the immature stock. Ovaries in stages V and VI show four distinct modes at 30,40,55 & 80 m.d. and 30,40,50 and 80 m.d. respectively separated
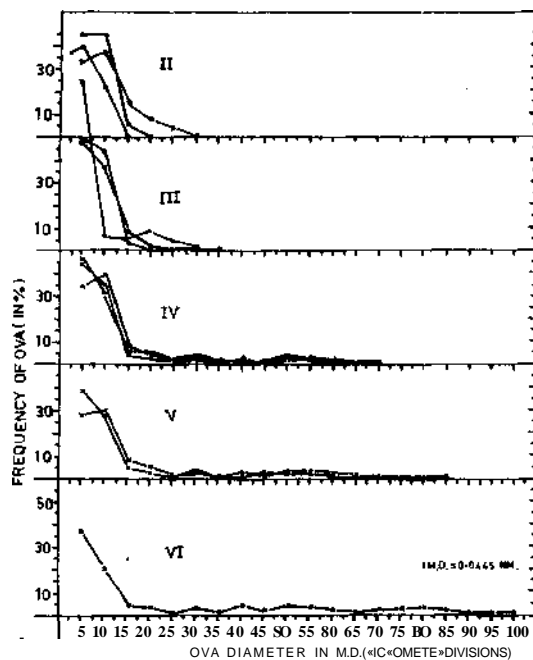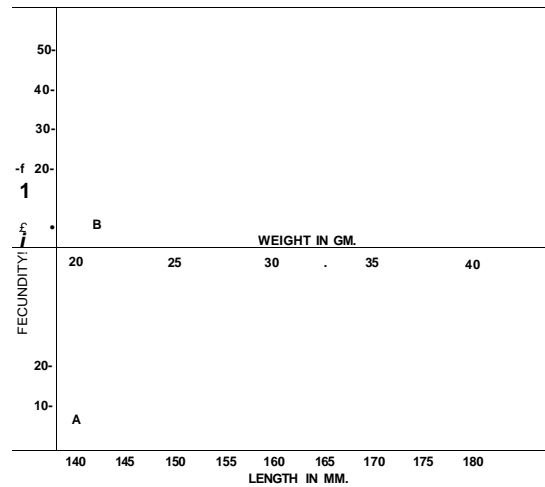

FIG. 4. Relation between fecundity and length(A) and fecundity and weight (B) for *S. dayi.*

from the immature eggs. In some cases ovaries indicated more than 4 modes but pooled data of number of ovaries resulted into four modes in the higher stages. The study revealed that the fish is having a protracted nature of spawning as is evidenced by the presence of multiple modes. The October-December period appears to be active spawning in this species followed by a lesser degree during January - May.

Sex ratio

Pooled data on sex ratio for the five year period is given in Table 2. It could be observed that the females during March, April and October-December generally outnumbered the males although the total for the whole period showed equal proporation of 1:1 ratio in their population structure.

Fecundity

A total of 95 ovaries were considered for fecundity studies. As there was no difference

FIG. 3. Ova diameter frequency polygons or different stages of maturity for *S.dayi.*

195

TABLE 2. *Distribution of sex ratio in* S. Dayi

Years	Jan.	Feb.	Mar.	Apr.	May	Aug.	Sep.	Oct.	Nov.	Dec.	Total
	M : F	M : F	M : F	M : F	M : F	M : F	M : F	M : F	M : F	M : F	M : F
1979				1:1.12	1:0.85	1:0.72	1:0.88	1:1.14	1:1.38	1:0.77	1:0.99
1980	1:0.93	1:1	1:2.25	1:0.92	1:1		1:0.63	1:0.99	1:1.10	1:1.05	1:0.93
1981	- -	1:2		1:0.87	1:1.11	- -	1:1.06	1:1.57	1:0.92	1:1.50	1:1.12
1982	1:4.67	1:0.74	1:1.35	1:1.17	1:0.94	- -	1:0.39	- -	1:3.00	1:1.76	1:0.89
1983	1:0.73	1:1.09	1:0.79	- -			1:1	- -	1:1.31	- -	1:0.97
Total	1:1.04	1:0.86	1:1.12	1:1.02	1:0.97	1:0.72	1:0.80	1:1.14	1:1.23	1:1.23	1:0.98

in the size of eggs from anterior, middle and the posterior regions of an ovary, a small sample was weighed and total number of mature ova present in the ovary was estimated. The number of eggs within a size range of 141 -173 mm ranged from 14,000 to 66,280.

Fig.4 (A,B) show relation of fecundity and length and fecundity and weight which show linear relationship and their values are given in Table 3.

Calculated lengths and weights are plotted in figures. The correlation coefficients (r) between fecundity & length and fecundity & weight for first two years showed better correlation and showed significant difference at 5% level with 24 and 23 degrees of freedom, the 't' table value being 1.71. Rest of the 3 years when tested with 11,12 and 15 d.f. showed that r values were not significant at 5% level. The pooled values for 5 years with 93 d.f. indicated that r values were significant at 5% level as seen from Table 2.

To test the relationship between fecun-

dity & length and fecundity & weight further, from year to year, analysis of variance was made and the values are given in Table 4.

Variance ratio of 10.20 is significant at 5% level. F values at 5% for 4 and 100 degrees of freedom is 2.46. This shows that egg production during different years differ at 5% level.
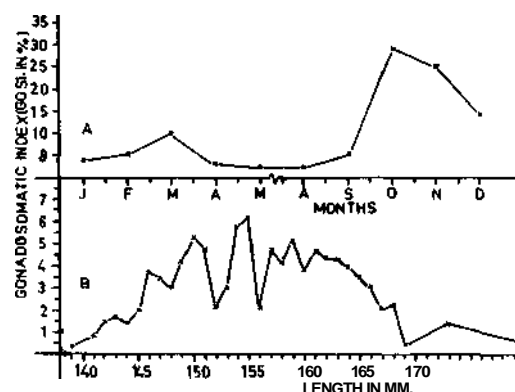

FIG. 5. Seasonal distribution (A)andsize-cumdistribution of GOSI values for *S. dayi.*

196

TABLE 3. *Relation between fecundity and length and fecundity and weight for* S. dayi

Years	Fecundity and length (F/L)	Corre- lation co- efficient (r)	't' distri- bution	Fecundity and weight (F/L)	Corre- lation co- efficient (r)	't' distri- bution
1979	F=823.9854x-94568.62	0.58	3.53 S	F = 1246.02Y-11166.4	0.65	4.19 S
1980	F=615.20x-69470.54	0.35	1.79 S	F = 1214.11Y-18369.82	0.51	2.84 S
1981	F=10986.99 +81.06 x	0.08	0.27 NS	F=43446.4-=504Y	0.18	0.61 NS
1982	F = 635.08x-74991.2	0.29	1.05 NS	F=26957-74.41Y	0.02	0.07 NS
1983	F = 12041.53 +106.23 x	0.09	0.35 NS	F=884.01Y-3062.64	0.34	1.40 NS
For 5 year period	F=397.9189x-34320.27	0.26	2.60 S	F=836.0296Y-2582.14	0.34	3.49 S

F = Fecundity: x = Length (mm): Y = weight (g)
S = significant at 5% level: NS = Not significant at 5% level.

TABLE 4. *Analysis of variance of S.* dayi *for fecundity and length*

Source of variation	degrees of freedom	Sum of square	mean square	
Deviation from individual regressions within years	85	12312264074.4	144850165.58	
Difference among regressions within the years	4	5908769575.7	1477192393.92	10.20
Deviation from average regression	89	18221033650.1	204730713.50	

When fecundity and weight were tested, F value for 4 and 85 degrees of freedom gave 196.64, showing significant difference between years indicating that egg production was not uniform from year to year.

Gonadosomatic index (GSI)

Like condition factor (K), gonadosomatic index is also taken as a measure of determining the spawning season. This is expressed as relative percentage of gonad weight to the

body weight.

Fig. 5 A, shows seasonal distribution of GSI values. High values were encountered in February - March and again in September - October indicating the ripe gonad condition, and fall in their values after March and October show the spawning activity in this species. Fig. 5 B shows size-cum-distribution of GSI values. There are a number of modes ranging from 140-180 mm within the size group of 135-180 mm followed by sharp decline. It is apparent that the spawning takes place when the fish are in the size range of 135 to 180 mm.

GENERAL OBSERVATIONS

Study on spawning biology of *S.dayi* shows that the size at first maturity is around 140 mm. For determining the size at first maturity and spawning, condition factor (K) and gonadosomatic index (GSI) were used. These methods were equally efficient and gave reliable estimate of spawning season as observed from collection of gonads in different months. The spawning season is protracted and extends from October-December and from January - May on a smaller scale. The distribution of sex-ratio indicated the dominance of females over the males. Relation of fecundity to length and fecundity to weight showed better correlation in 1979 and 1980, than other years. This difference when tested by analysis of variance indicated different rates of egg production during different years. Fecundity study showed that about 66,000 eggs are released by an individual during the spawning act.

REFERENCES

ANTONY RAJA, B.T. AND S. LAZARUS 1975. A descriptionof *Sardinella dayi,* Regan, (Pisces: Clupeidae) of Indian Seas with remarks on its close similarity with *S. maderensis* (Lowe) and *S. jussieui* (Val). *Indian J.Fish .,* 22 (1&2): 113-125.

CLARK, F.N. 1934. Maturity of California sardinc,Sardma *caeruka)* determined by ova-diameter measurements. *Fish. Bull., Sacramento,* 42: 1-49.

HICKUNG, C.F. AND E. RUTENBERG 1936. The ovary as an indicator of spawning period of fishes. *].mar. hid. Ass. U.K.,* 21: 311-317.