AVAILABILITY OF SARDINELLA AURITA EGGS AND LARVAE OFF TEMA DURING THE PERIOD 1969 - 1992

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Abstract :

Zooplankton samples collected with the ICITA net off Tema from 1969 to 1992 have been used to determine cyclical changes in the counts of *S. aurita* eggs and larvae. The highest counts of *S. aurita* eggs and larvae were made during the major upwelling (July - September). Though the egg counts fluctuated to a general decline, the larval counts fluctuated to an increase during the last five years (1988 - 1992). The spawning of the *S. aurita* is synchronised with the occurrence of the major upwelling and maximum production of plankton.

From the point of view of the *S. aurita* egg and larval occurrence, the *S. aurita* fishery has still a bright future.

Résumé :

Les échantillons de zooplancton collectés avec un filet ICITA au large de Tema de 1969 à 1992 ont été utilisés pour déterminer les variations cycliques dans les comptages d'oeufs et larves de S.aurita. Les plus fortes valeurs d' oeufs et larves sont observées pendant l'upwelling majeur (Juillet-Septembre). Bien que le décompte d'oeufs fluctue autour d'une tendance déclinante, les décomptes de larves montrent un accroissement lors des cinq dernières années (1988-1992). La ponte de S.aurita est synchronisée avec l'occurence de l'upwelling majeur et la production maximale de plancton.

Selon ces considérations sur l'occurence des oeufs et larves de S.aurita, la pêcherie de sardinelle aurait encore un bel avenir.

1. Introduction :

The most important pelagic fishery resource exploited by both the artisanal and the inshore or semi-industrial fleets is the Sardinella of which there are two species, namely S. aurita and S. maderensis. The S. aurita is heavily exploited during the major upwelling (July - September) and less so during the minor upwelling (January/February or March). The S. maderensis is commonly exploited outside the upwelling periods. The earliest authors who made this observation were: Howat(1946); Johnson (1951 and 1955).

The need was, therefore, felt to study the biology of the S. aurita as part of the attempt at assessing its stock size. The study of occurrence of S. aurita eggs and larvae in the plankton was, therefore, mounted by the Fishery Research Unit of the Fisheries Department aimed at throwing light on the reproductive cycle of the S. aurita and assisting to determine recruitment and year class strength of the S. aurita.

The cyclical occurrence of the eggs and larvae of S. aurita for periods of few years has been reported on by Mensah and Jones (1972), Mensah (1975, 1977, 1983), Houghton and Mensah (1978) and Mensah and Koranteng (1988).

The present paper examines the cyclical changes in the biomass of the S. aurita eggs and larvae over the entire period of 24 years (1969 - 1992) in order to determine if the cyclical changes indicated any prospects for the S. aurita fishery.

2. Materials :

The materials used were the same zooplankton samples collected and analysed for the paper on «The occurrence of zooplankton off Tema during the period 1969 - 1992» given by the author in this workshop ; *included herewith.*

3. Method of Analysis in the Laboratory:

The zooplankton samples collected as explained above were used to estimate the abundance and cyclical changes in the biomass of the S. aurita eggs and larvae.

S. aurita eggs and larvae present in aliquot portions of all the samples were identified and counted in a counting-tray under a binocular microscope.

Depending upon the size of the sample, one-quarter or one-eighth or one-sixteenth or one-thirty-second portion of the sample was analysed. Identification of the eggs and larvae was based on the description by Marchal (1967). Numbers of eggs and larvae of S. aurita obtained were standardised to what would have been present in 1,000 litres of sea water filtered.

4. Results :

(i) In figure 1, mean counts of eggs per 1,000 litres of sea water filtered per year have been plotted. It shows clearly that underlying the variations in abundance of S. aurita eggs, there is a general decline in the biomass from 1969 to 1992.

(ii) In figure 2, monthly means of numbers of S. aurita eggs per 1,000 litres of sea water filtered have been plotted for each year and for the 24-year period. Despite the gaps in sampling, cyclical changes in occurrence of the eggs are discernible. The eggs are most abundant during the major upwelling season (July-September); minimal quantities occur sporadically during the rest of the year. There appears to be a decline in the biomass of the eggs during the period 1972 - 1976; 1979 - 1984; 1986 - 1987 and 1990 - 1992. For the 1972 - 76 period, table 1 shows that except for August 1972, when a high biomass of the eggs was obtained, values obtained for the rest of the period were quite small. During the 1979 - 84, 1986 - 87 and 1990 - 1992 periods, fewer samplings were made and in several of these samples, quantities of eggs obtained were small.

(iii) Figure 3 shows the pooled results for the 24-year period plotted monthly. It demonstrates the monthly variations in abundance of the S. aurita eggs and that the most abundant eggs occur during the major upwelling (July - August).

(iv) Figure 4 shows the mean counts of the larvae per 1,000 litres of sea water filtered per one year. The graph demonstrates that cyclical changes in larval quantities occur yearly and that two main declines occurred during the period. From the high levels in 1969 - 71 period, there was a decline to 1974 after which modest increases occurred till 1981. Another decline occurred, with fluctuations till 1986 after which substantial increases with fluctuations occurred till 1992.

(v) Figure 5 shows a graph of monthly mean values of S. aurita larvae per 1,000 litres of sea water filtered, plotted monthly for each year and for the 24-year period of 1969 - 1992. Again, despite the gaps in sampling, monthly variations in abundance of the larvae are observable, and that the most abundant larvae occur during the major upwelling (July-September); little quantities occur sporadically during the rest of the year.

However, contrary to the pattern of occurrence of the eggs, the cyclical changes in the larval abundance do not show a continuous decline. Rather, the abundance appears to be increasing during the last five years (1988 - 1992). The least values occurred during the periods 1974 - 1978; 1982 - 1984 and 1986 - 1987.

(vi) In figure 6, the period of 24 years has been pooled together to one year and the mean values of the larvae have been plotted monthly. Again, the monthly variations are observed and the highest value of the larvae occur during the major upwelling.

5. Discussion and Conclusion :

(i) Comparing figures 1, 2, 4 and 5, one finds that the general continuous decline observed in the egg biomass abundance does not occur in the case of the larvae. One explanation could be that this situation arose as a result of higher egg mortality than that of the larvae during the period under review. Another explanation could be that at the real time of sampling many more eggs had hatched into larvae. Further, both reasons could have operated jointly to produce this effect.

(ii) Furthermore, in absolute terms there were more eggs than larvae per 1,000 litres of sea water filtered. The maximum monthly pooled means were 311 eggs and 138 larvae per 1,000 litres of sea water filtered (Table 1). In addition, for a total of 16 years during the period under review, there were more than 50 eggs per 1,000 litres of sea water while only 8 years had more than 50 larvae per 1,000 litres of sea water (Figures 1 and 4).

This is what one would expect, namely, that considering that the percentage mortality may be higher in eggs than in larvae, there were high quantities of eggs spawned so that despite the high mortality, significant numbers would remain to hatch into the larvae.

(iii) It is reassuring (figures 4 and 5) that increases in larval abundance were observed during the last five years (1988 -1992). This indicates that the spawning activity of the *S. aurita* is encouraging with increasing rate of larval survival and that the stock situation of the *S. aurita* is improving.

(iv) It is reasonable to expect that the numbers of eggs and larvae should be proportional to the level of abundance of the S. aurita . This is not so with the situation observed in 1972. Figures 1 and 4 show quite low values of the *S. aurita* eggs and larvae while Mensah (this workshop paper on Zooplankton Occurrence) has demonstrated that the *S.aurita* catch in 1972 was very high and therefore, in disproportion to the egg and larval counts. These low levels of egg and larval counts may be due to the fact that most of the adult *S. aurita* were caught in the first two months of the upwelling season (July -August; FRU/ORSTOM, 1976), and so the spawning activity was quite low. In addition, an unfavourable environmental condition for spawning might have occurred during the upwelling season which might have contributed to the apparent low spawning activity.

(v) It is evident from the results obtained that the *S. aurita* carries out major spawning during the major upwelling (July - September) and minor sporadic spawning during the minor upwelling and the rest of the year. This confirms previous findings (Mensah and Jones, 1970; Mensah, 1975, 1977, 1983; Houghton and Mensah, 1978 and Mensah and Koranteng, 1988).

Aanang (1976 and 1979) and Hougton and Mensah (1978) have shown that the highest concentrations of phytoplankton, zooplankton and *S. aurita* occur during the major upwelling (July - September). Further, the *S. aurita* larvae and the general zooplankton feed on the phytoplankton while the juveniles and adult *S. aurita* feed on the zooplankton (Kwei,1964; Houghton and Mensah,1978 ; Mensah,1974). Thus, the ideal situation is produced whereby during the major upwelling high concentrations of phytoplankton are produced as food for the *S.*

aurita larvae and the general zooplankton which also constitutes food for the S. aurita juveniles and adult. Hence, the timing of the major upwelling synchronises with the production of food for the larvae, juveniles and adult of the S. aurita and hence the occurrence of the major spawning of the S. aurita during the major upwelling .

Despite the decline in the zooplankton biomass over the 24-year period, the biomass of S. aurita larvae has been showing an increase for the past five years. This is an indication that despite its decline, the minimum or threshold level of zooplankton necessary for optimum S. aurita survival has been available. One would, therefore, conjecture that other factors being the same, the S. aurita fishery still has a bright future.

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CAPTION OF TABLES AND FIGURES

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B 1981 -1992

Table 2 : Monthy men counts of Sardinella aurita larvae per 1000 litres of sea wates off Tema
A - 1969 - 1980
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Figure 1 : Yearly mean counts of Sardinella aurita eggs per 1000 litres of sea water, 1969-1992.

Figure 2 : Monthly mean counts of Sardinella aurita eggs per 1000 litres of sea water, 1969-1992.

Figure 3 : Monthly mean counts of Sardinella aurita eggs per 1000 litres of sea water.

Figure 4 :Yearly mean counts of Sardinella aurita larvae per 1000 litres of sea water, 1969-1992.

Figure 5 : Monthly mean counts of Sardinella aurita larvae per 1000 litres of sea water, 1969-1992.

Figure 6 : Monthly mean counts of Sardinella aurita larvae per 1000 litres of sea water.

Table 1 A : Monthly mean counts of *Sardinella aurita* eggs and larvae per 1000 litres of sea water off Tema.
A 1962 - 1980

TABLE 1. MONTHLY MEAN COUNTS OF SARDINELLA AURITA EGGS AND LARVAE PER 1000 LITRES OF SEA WATER OFF TEMA. 1969-1992

SARDINELLA AURITA EGGS.

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
J	371.3	0	0	23.4	48.3	7.4	0	23.9	583.3	627.5	39.8	17.3
F		14.4	0	0	6.8	20.9		0		190	40.8	12.7
M	938	0	0	1	0				0	21.8	10.5	0
A	253.2	106.1	0	0	110.8	1.3	0		99.8	0		0
M	105.9	511	0	0	0	0	0	8.6	70			0
J	85.7	50.5	0	0	69.6	23.3	26.1	0	126.8			30.6
J	87.6	592.1	134.4	0	311.4	0	0	51.3	1305.4			310.6
A	1220.7	307.7	747.1	453.3	0	0	0		211.8			112.3
S	779.7	52.6	768.4	3	74.3	79.2	0	10.3	6			437.4
O	0	128.9	111.7	288	96.9	3.9	367.6	137.5			87.4	17.4
N	3	1.8	101.6	86	0	0	0			6	3.7	
D	2.2	0	0	12.4	39.6	0	0	8.2	295.8	25.5	1.9	
MEAN	349.8	147.1	155.3	72.3	63.1	12.4	39.4	30.0	299.9	145.1	30.7	93.8

Table 1 B : Monthly mean counts of Sardinella aurita eggs and larvae per 1000 litres of sea water off Tema.
B 1981 -1992

1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	MEAN
	28.6	0	0	0	0		15.3	0		7.7	341.1	101.
185	0	5.6			0			0	38.8	0		32.2
114.9	46.4	93.8	0	12.3	0		0	0		66.4	13	69.4
4.5	0		0	20.6	0		2.8	0		0	0	31.5
2.7	0		0	47	0		2.7	0	0	0	0	37.4
6.4	3	0		0	0		0	0	0	0	0	21.1
409.6	269.2	394.1	0	1311.8	302.7	26.5	384.8	3.3	459.8		85.3	306.7
242.1	0		0	1014.8		0	95.2	819.4	64.6		316.5	311.4
24.5	5.6	0	325.2	115.4	221.3		68.9	274.9	53.2		260	178.0
18.8	1.7	0	0.7	8		4.3		315.7	178.4	0	41.1	90.4
0	46.7	0		0		0	19.5	0	0	0	1.7	14.2
0	0	148.5	0			0	773.8	209.3	0	77.6		79.7
91.7	33.4	71.3	36.2	253.0	65.5	6.2	136.3	135.2	88.3	16.9	105.9	

Table 2 A : Monthy mean counts of Sardinella aurita larvae per 1000 litres of sea wates off Tema 1969 - 1980

SARDINELLA AURITA LARVAE.												
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
J	0	0		2.1	19.7	15.5	13.5	2.8	6	13	0	19.8
F		3.7	0	7.1	0	3.8		0		0	0	2.7
M	186.5	13.8	8.3	2.1	0				6	29.8	129	0
A	22.8	23.9	14.5	3.6	6.6	3.7	0		0	18.7		1.3
M	61.5	159.7	0	0	0	3.5	7.3	12.9	10	3.8		0
J	160.9	111.5	32	0	0	0	33.4	1.3	5.4			92.1
J	589.9	72.3	1017	0	233.9	1.6	0	6.3	35.8			40.1
A	102.3	140.1	17.4	229.1	33.1	4.6	12.6		0			43.6
S	50.8	15.6	164.4	7.8	0	0	0	30.9	0			2
O	0	113.7	17.7	127	0	28	6.5	0			50.2	83.1
N	8.1	0	9.5	0	0	0	4.9			19.3	21.1	
D	2.3	0	2.9	0	85.8	0	0	108.4	4.9	0	3.6	
MEAN	107.7	54.5	116.7	31.6	31.6	5.5	7.8	20.3	7.6	12.1	34.0	

Table 2 B : Monthy men counts of Sardinella aurita larvae per 1000 litres of sea wates off Tema 1981 -1992

1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	MEAN
	11.5	0	45.1	14.8	0		11.3	116.6		4.4	19	15.8
116.	5	0	9.5			0		24.8	33	0		12.6
16	25.1	58.3	0	133.2	0		43.4	4.9		0	208.8	45.5
6.2	4.1		6	43.3	5.5		18.6	7.1		14.8	28.7	12.1
1.7	10			0	0		40.8	17.6	5.5	30.7	0	18.3
7.8	1.4	6		73.6	19.6		0	0	0	5	94.2	32.2
93.4	17.2	34.3	27.9	10	10.1	42.6	108.3	149.4	104.9		300	137.9
450.4	44.5		3.6	7		18.7	33.4	159.4	186.4		3.4	82.8
61.4	55.2	19.8	0	19.6	43.8		157.7	222.6	318.5		276.3	72.3
18.6	10.9	21.8	29.2	97		0		441.2	62.8	21.2	49.5	58.9
0	10.9	3.5		0		5.6	3.6	11.4	0	28.8	50.1	9.3
9.3	6	73.1	4			14.3	32.2	0	27.2	708		54.1
71.0	16.4	25.1	14.5	39.9	9.9	16.2	44.9	96.3	82.0	90.3	103.0	

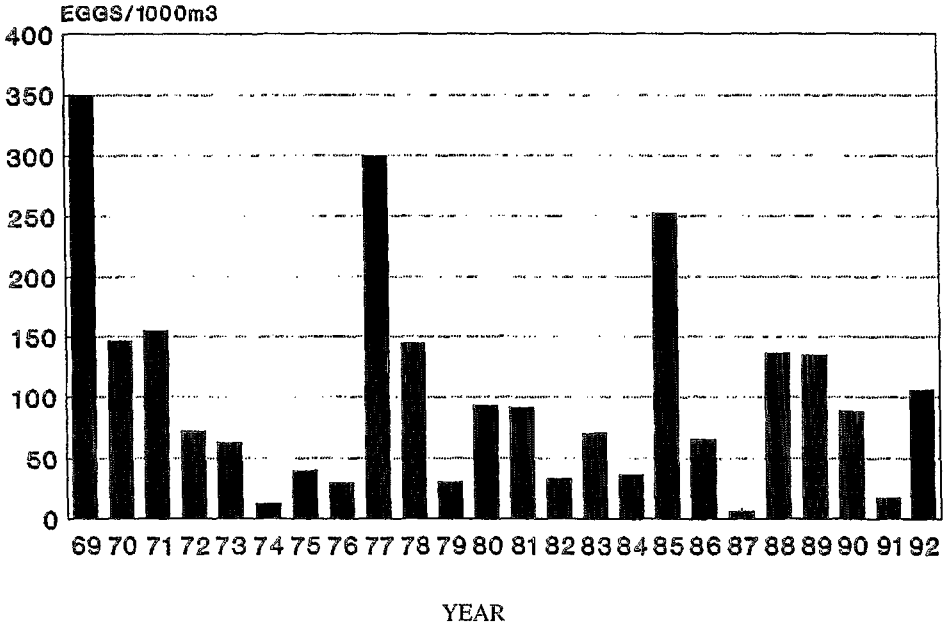

Figure 1 : Yearly mean counts of Sardinella aurita eggs per 1000 litres of sea water, 1969-1992.

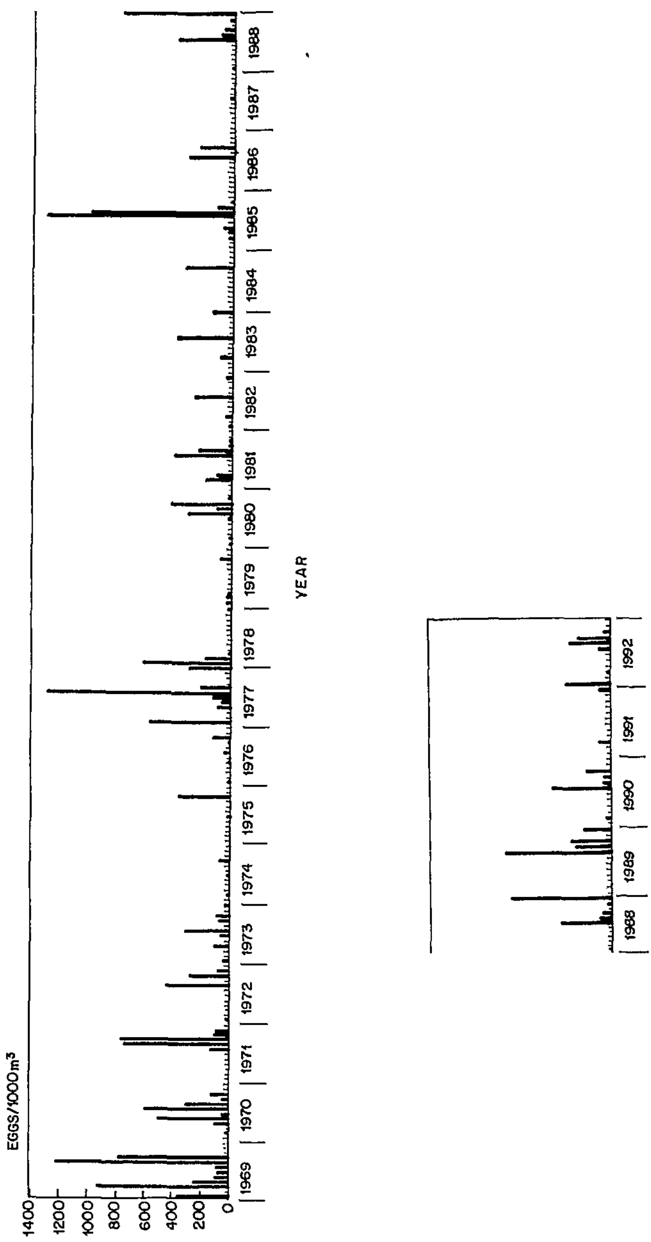

Figure 2 : Monthly mean counts of Sardinella aurita eggs per 1000 litres of sea water, 1969-1992.

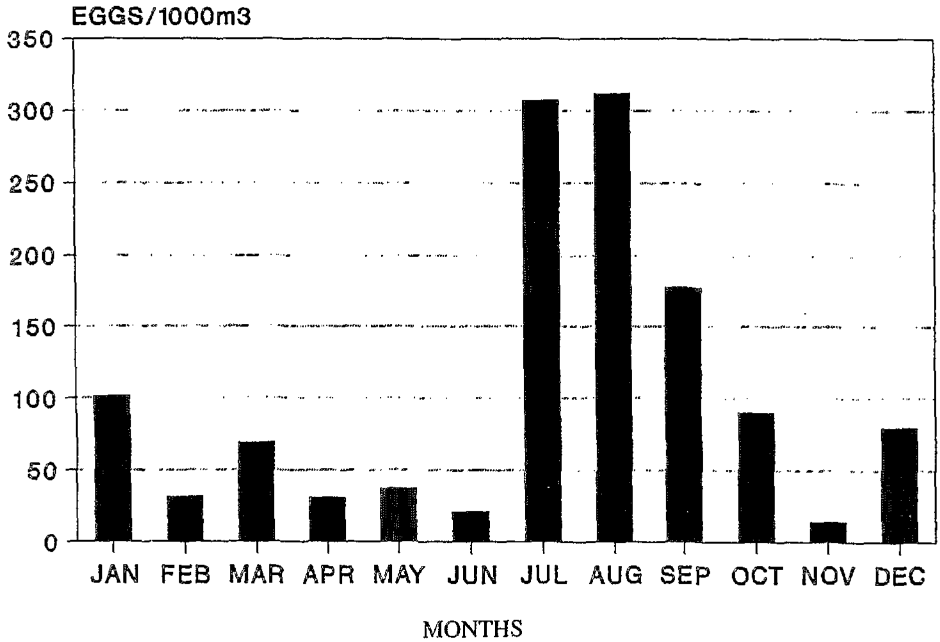

Figure 3 : Monthly mean counts of Sardinella aurita eggs per 1000 litres of sea water.

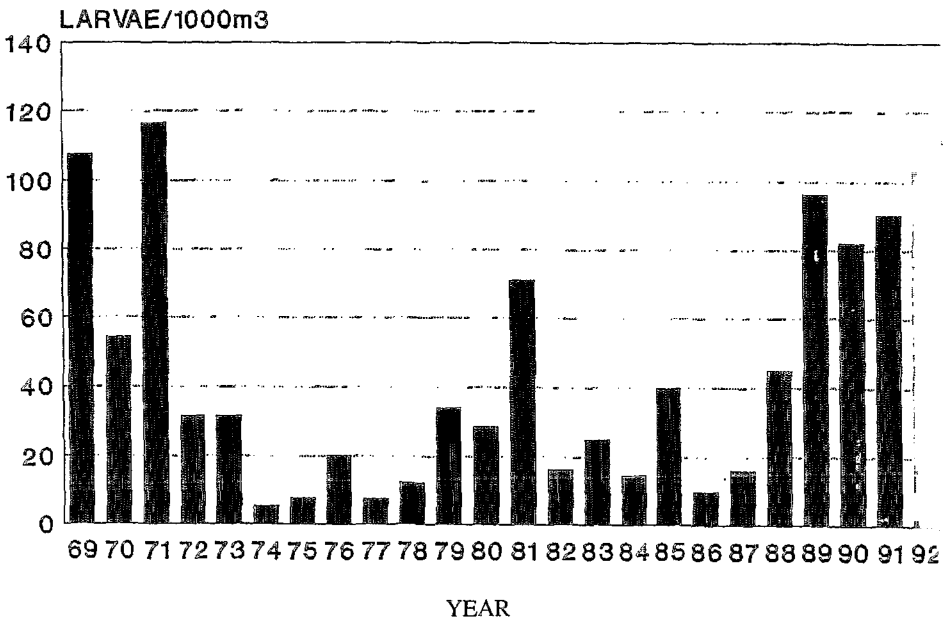

Figure 4 :Yearly mean counts of Sardinella aurita larvae per 1000 litres of sea water, 1969-1992

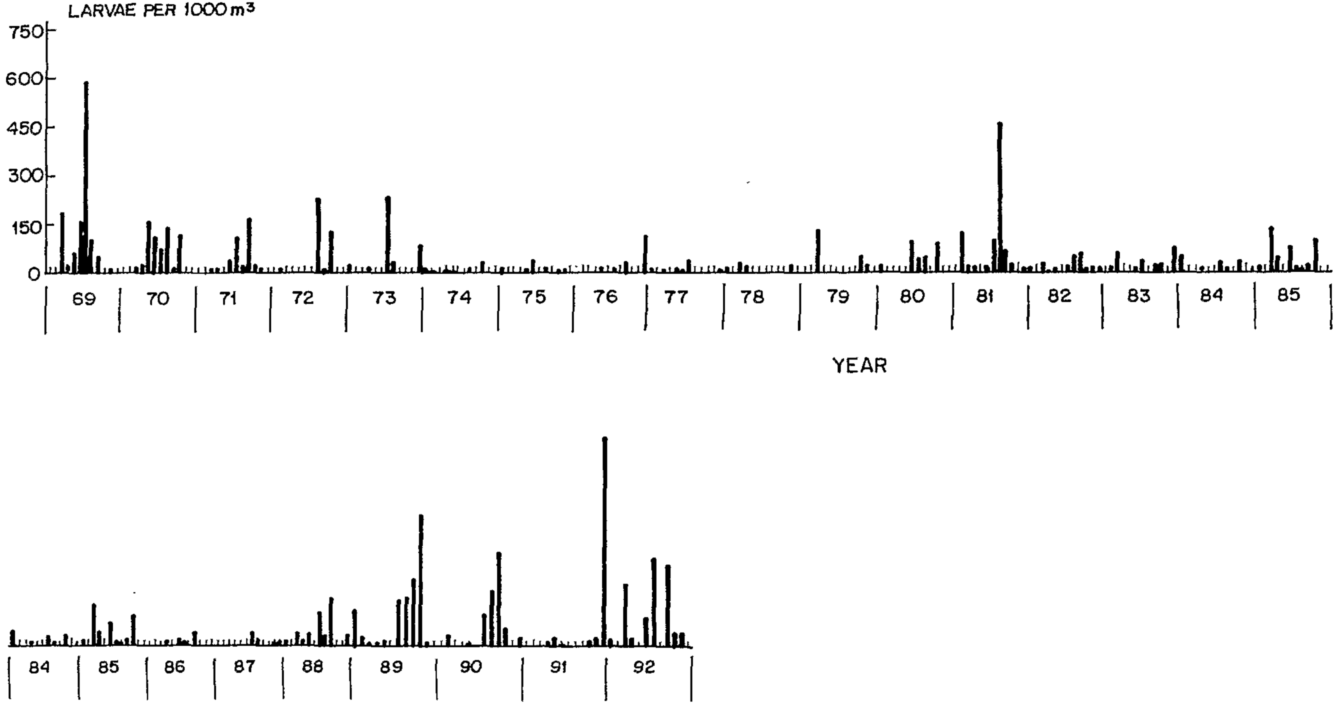

Figure 5 : Monthly mean counts of Sardinella aurita larvae per 1000 litres of sea water, 1969-1992.

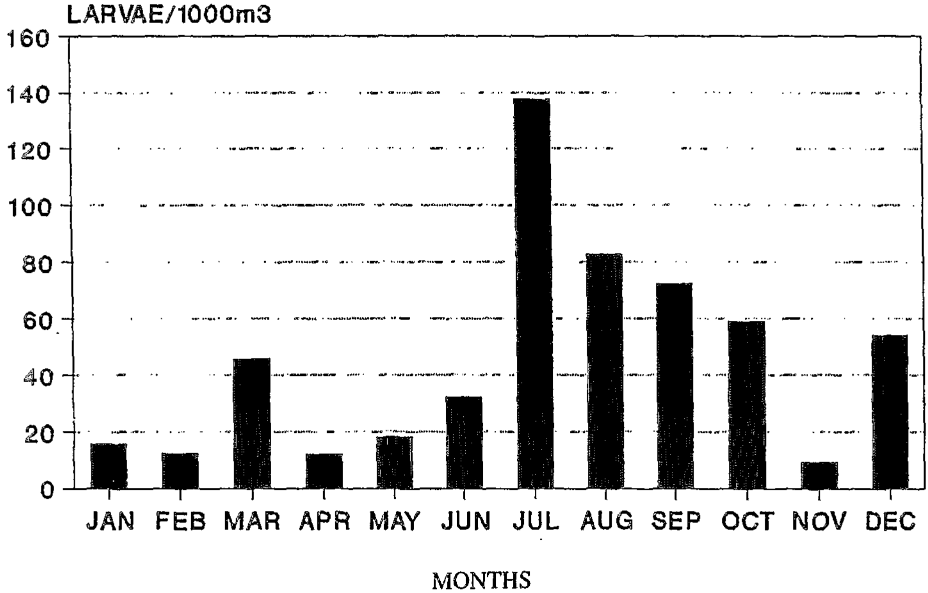

Figure 6 : Monthly mean counts of Sardinella aurita larvae per 1000 litres of sea water.