

**FISHERIES INVESTIGATION OF THE SARDINE GILL NET
AT EL-MAX REGION, NEAR ALEXANDRIA.**

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ABSTRACT

Statistical data on the Sardine gill net fishery during the period 1963-1976 was discussed. Also, the monthly fluctuation in the landings of Sardine gill net from El-Max region was analysed during the same period (1963-1976), before and after Asswan High Dam construction.

The catch-per-trip as index of fish abundance at El-Max region was estimated for the different months during 1977, that showed increased fish abundance in the Summer months. The species composition, as well as the length frequency and age composition of the gill net catch was studied.

The survival and mortality rates are deduced for both *Sardinella aurita* and *S. maderensis*.

INTRODUCTION

As a result of the regulation of the Nile flood, after the construction of the Aswan High Dam in 1966, remarkable changes in the hydrographic and ecological conditions in the S.E. Mediterranean have been observed (El-Hehiawy, 1974; Al-Kholy and El-Wakeel, 1975 and Gerges, 1976). These changes greatly affected the sardine fishery along the Egyptian Mediterranean coast. The sardine catch drastically decreased from 18 thousand tons in 1962 to less than one thousand ton in 1972 (El-Zarka and Koura, 1965; Hashem, 1972; Year Book of Fishery Statistics, 1962-1972).

The present study deals with sardine gill net fisheries at El-Max region, near Alexandria, where the sardine landing is not affected by the High Dam construction. The aim of this study is to gain necessary information needed for the management and development of this fishery resource.

MATERIAL AND METHODS

The sardine gill net engaged in the commercial sardine fishery is a kind of gill net, comprised 20-25 parts of a single wall webbing of synthetic

fiber, attached to each other, the length of the net ranges between 200 and 400 meters, its height ranges between 15 to 17 meters and mesh size of 1.2-1.4 cm (bar length). The upper edge is sustained at water surface by floats. The sinkers are fixed to the lower edge of the net. The fishing operation is carried out at night, the net is set in inshore water of 1-3 km. from the shore by one rowing boat, rarely motorized boats are used.

The sardine gill net, commonly known as "Ghazl El Sardine", is extensively used to catch the sardine from El-Max region, near Alexandria. The commercial landings of that fishing gear from that area were monthly examined during the period from December 1976 to November 1977. The total catches of the fishing boats were recorded at each visit to estimate the total landing. Representative random samples were taken for analyses to get information about species composition, length frequency, age structure, and other data necessary for such study.

Commercial Fishery of Sardine Gill Net

General trends of Sardine Gill Net fishery (1963-1976):

Statistical data of sardine gill net catches from the Egyptian Mediterranean waters, were available for the years 1963-1976 (Table 1). Although the annual production had varied widely, almost four intervals (1963-1965, 1966-1967, 1968-1971 and 1972-1976) can be distinguished, within which these variations showed no definite trend. The first period (1963-1965) was characterized with high production (the average annual production was 6,486 tons). This annual catch was greatly decreased to 724.5 tons in the next period (1966-1967), after which the catch was progressively reduced to 68 tons in the third period (1968-1971). During the fourth period (1972-1976), an upward trend in the annual production (300.3 tons) was observed (Table 2).

According to the regulation of the Nile flood, the catch of sardine gill net during the period from 1963 to 1976, may be divided into two periods: from 1963 to 1965 (before High Dam construction) and from 1966 to 1976 (after High Dam construction). The first period had an average catch of about 6 thousand tons per year, while the second period had an average annual catch of about 290 tons.

Gill Net fishery according to location:

Data of Sardine Gill Net landings from different centres along Egyptian Mediterranean coast, were grouped into three zones, (Table 3) (El-Zarka and Koura, 1965). The data indicated certain variation in the three zones. Before High Dam construction (1963-1965), fish landing from the second zone (between Rosetta and Damietta Branches of the Nile) contributed the largest percentage of Ghazl el-Sardine landing (67.4%), while the first zone (west of Rosetta Nile Branch) and the third zone (east of Damietta Nile Branch) contributed 12.1% and 20.5% of the sardine catch respectively.

Table (1)

Annual landing of Sardine Gill Net in comparison to the total landing in the Egyptian Mediterranean waters (1963-1976).

Year	Total Fish landing (ton)	Landing of Ghazl El-Sardine (ton)	% of landing of Ghazl El-Sardine to total (ton)
1963	32 909.2	8 692.8	26.4
1964	25 975.0	3 700.6	14.2
1965	24 686.4	7 064.7	28.6
1966	15 045.4	696.2	4.6
1967	12 212.7	752.8	4.7
1968	13 586.3	139.5	1.0
1969	8 520.6	39.5	0.5
1970	8 118.7	36.4	0.4
1971	9 874.4	56.4	0.6
1972	10 300.6	503.5	4.9
1973	6 695.0	212.1	3.2
1974	6 848.9	269.1	3.9
1975	5 407.2	240.1	4.4
1976	7 142.2	249.6	3.5

Table (2)

Mean periodic fluctuation of landing of Sardine Gill Net in the Egyptian Mediterranean waters.

Period	Total Fish landing (ton)	Landing of Ghazl El-Sardine (ton)	%
1963-1965	27 856.9	6 486.0	23.3
1966-1967	13 629.1	724.5	5.3
1968-1971	10 025.0	68.0	0.7
1972-1976	7 278.8	300.3	4.1

Table (3)
Annual landing of Sardine Gill Net in the
Egyptian Mediterranean waters according
to different zones.

Year	First Zone		Second Zone		Thrd Zone	
	Landing (tons)	%	Landing (tond)	%	Landing (tons)	%
1963	1538.6	17.7	4305.3	49.5	2848.9	32.8
1964	457.1	12.4	2458.8	66.4	784.7	21.2
1965	355.2	5.0	6360.0	90.0	349.5	4.9

1966	131.1	18.8	565.1	81.2		
1967	211.1	28.0	541.7	72.0		

1968	127.8	91.6	11.7	8.4		
1969	39.0	98.7	0.5	1.3		
1970	36.4	100.0				
1971	56.4	100.0				
1972	503.5	100.0				
1973	212.1	100.0				
1974	258.8	96.2	10.3	3.8		
1975	214.2	89.2	25.9	10.8		
1976	233.1	93.4	16.5	6.6		

During the years 1966 and 1967, there was a transitional period, where the sardine landing were greatly decreased but the second zone still having higher production than the first. Since 1968 till 1976, the landing of sardine gill net from the first zone contributed the largest percentage (96.3%9 while the second zone contributed 3.7% of sardine gill net landings. It has to be mentioned that, in the third zone, the fishermen did not use this fishing method since 1966.

Landing of Sardine Gill Net at El-Max region:

The landing of sardine gill net from El-Max region as compared with the total landing during the period 1963-1976 is shown in Table (4).

The average annual landing of sardine gill net from El-Max region was 11.2 tons in the years 1963-1973. A very large increase (138.6 tons) in the annual landing was observed in 1974-1976 period. This unexpected large increase in the catch during that period 1974-1976 can be explained by the increased fishing efforts exerted during the period.

Table (4)
Annual landing of Sardine Gill Net in comparison to
the total landing in El-Max region.

Year	Total Fish Landing (tons)	Landing of Ghazl El- Sardine (tons)	%
1963	81.6	23.3	28.6
1964	92.6	18.4	19.9
1965	55.1	5.4	9.8
1966	72.5	11.5	15.9
1967	48.1	6.2	12.9
1968	53.4	5.1	9.6
1969	46.2	5.5	11.9
1970	58.0	3.6	6.2
1971	203.9	10.5	5.1
1972	156.9	15.3	9.8
1973	178.0	18.2	10.2
1974	236.4	106.1	44.9
1975	204.4	126.5	61.9
1976	282.8	183.2	64.8

Seasonal fluctuation of the catch at El-Max region

Table (5) represent the monthly fluctuation of landings of the sardine gill net at El-Max region before and after the Aswan High Dam. From these figures, it is evident that the landings of sardine gill net before the High Dam (1963-1965) increase in May-June i.e early summer. Another high peak was found in January (winter). The catch of sardine gill net, on the other hand, after High Dam construction, shows only one high peak in the months of June and July (i.e summer). This variable trend of catch (before and after High Dam construction) may be related to the variation in the pattern of phytoplankton blooms in the South-Eastren Mediterranean.

Monthly Landings of Sardine Gill Net at El-Max Region:

The catch of sardine gill net was monthly estimated in the period from December 1976 to November 1977, at El-Max region by observations carried out by the author's interviews. The estimation of the catch per month was deduced simply according to the following method:

Assuming that N_s denotes number of boat-trips in sample, C_s denotes catch of boat-trips in sample, N_t denotes estimated total number of boat trips which are determined by multiplying actual fishing days by number of fishing boats engaged in this month, and R denotes raising factor to adjust sample catch to the total ($R = N_t/N_s$). Therefore the estimated total catch $C_t = R \times C_s$.

The annual landing of sardine gill net in the period (December 1976 - November 1977) as shown in Table (6) was about 341 tons.

Table (5)
 Mean monthly fluctuation of landing of Sardine Gill Net before and after
 High Dam construction at El-Max region.

MONTH	Before High Dam (1963-1965)			After High Dam (1974 - 1976)		
	Total landing of fish (kg)	Landing of Ghazl El-Sardine (kg)	%	Total landing of fish (kg)	Landing of Ghazl El-Sardine (kg)	%
January	6367	4233	66.4	5000	233	4.7
February	3000	767	25.6	5600	333	5.9
March	3333	500	15.0	7200	1100	15.2
April	4433	533	12.0	8300	2333	28.1
May	6400	1900	29.7	23167	10867	46.9
June	8933	1600	17.9	57200	40933	71.6
July	12433	1300	10.5	57367	41800	72.9
August	7533	466	6.2	30033	21800	72.6
September	4267	-	0.0	23933	12800	53.5
October	6733	900	13.4	13700	4867	35.3
November	7300	1600	21.9	7800	1333	17.1
December	5700	2233	39.2	4300	667	15.5
Total	76432	16032	21.0	243600	139066	57.1

The largest contribution were confined to the months, May, June, July and August. In these four months, a total of nearly 310 tons (about 91%) were landed. The catch-per-trip as index of fish abundance indicates increased fish abundance in the months May, June and July.

Species Composition of the Gill Net Catch:

Table (6) shows that the landing was mainly composed of sardine (92.6%). The monthly landing of sardine was concentrated from April till September and to a less extent in October and November. Other fish (*Sphyraena sphyraena*, *Eulhynnus alletteratus*, *Boops boops*, *Trachurus mediterraneus* and others) did not constitute more than (7.4%) of the catch. However the *Sphyraena sphyraena* was landed mostly from December till March and to a less extent in October and November, while the *Eulhynnus alletteratus* was landed mostly in March, the *Boops boops* in June, and the *Trachurus mediterraneus* in August.

Species Composition of Sardine at El-Max Region:

Sardinella aurita, *Sardinella maderensis*, *Sardina pilchardus* and *Dussumieria acuta* were found in El-Max region, captured by sardine gill net. The first two species were always present among the catch all the year round (Table 7). The other two species were either absent or insignificantly represented in the catch, especially *S. pilchardus*.

Table (6)
Monthly commercial catch of Sardine G111 Net at El-Max region during the period
December 1976 - November 1977.

DATE	No. of fishing boats	No. of fishing trips	Sardine	Sphyraena sphyraena	Euthymus alletetratus	Boops boops	Trachurus mediterraneus	* Other Fish	Total catch (kg)	Catch/ trip (kg)
Dec., 1976	2	15	14 (13.4)	80(76.2)	11(10.5)	-	-	-	105	7
Jan., 1977	1	6	8(8.3)	38(79.2)	5(10.4)	-	-	1(2.1)	48	8
February	1	8	7(17.5)	9(22.5)	24(60)	-	-	-	40	5
March	1	10	4(13.3)	19(63.3)	7(23.3)	-	-	-	30	3
April	15	300	8730(97.0)	171(1.9)	-	-	99(1.1)	-	9000	30
May	15	375	4245(199.3)	299(0.7)	-	-	-	-	42750	114
June	30	750	6535(87.1)	225(0.3)	-	9422(12.6)	-	-	75000	100
July	55	1375	154236(96.7)	638(0.4)	-	4147(2.6)	160(0.1)	319(0.2)	159500	116
August	25	675	29966(90.6)	628(1.9)	-	66(0.2)	2382(7.2)	33(0.1)	33075	49
September	10	175	8646(91.5)	558(5.9)	-	-	227(2.4)	19(0.2)	9450	54
October	10	150	3804(54.3)	3045(43.5)	77(1.1)	74(1.1)	-	-	7000	47
November	10	100	2632(52.6)	2100(42.0)	100(2.0)	90(1.8)	78(1.6)	-	5000	50
Total		3939	315847(92.6)	7810(2.3)	224(0.1)	13799(4.0)	2946(0.9)	372(0.1)	340998	87

* Lichia - Pelymus - Engraulis.

Table (7)
 Monthly composition of Sardine capture by Sardine Gill Net
 from December 1976 to November 1977.

MONTH	<i>S. aurita</i>		<i>S. maderensis</i>		<i>S. pilchardus</i>		<i>Dussumieria</i>	
	k.g.	%	k.g.	%	k.g.	%	k.g.	%
Dec., 1976	10	71.4	4	27.8	0.1	0.8	-	-
Jan., 1977	3	67.4	1	30.4	-	-	-	-
February	6	85.1	1	14.9	-	-	-	-
March	3	77.2	1	22.8	-	-	-	-
April	8599	98.5	131	1.5	-	-	-	-
May	37569	88.5	4882	11.5	-	-	-	-
June	13986	21.4	51367	78.6	-	-	-	-
July	30230	19.6	123543	80.1	--	-	463	0.3
August	8091	27.0	21783	72.7	-	-	90	0.3
September	7859	90.9	787	9.1	-	-	-	-
October	3405	89.5	399	10.5	-	-	-	-
November	2487	94.5	129	4.9	16	0.6	-	-
Total	112248	35.3	203030	64.3	16	0.0	553	0.2

The percentage composition of *S. aurita* showed a high percentage in the period from September till May and a minimum percentages lasting for three months (June, July and August). Its presence amounted to 35.3% of the total sardine catch.

Sardinella maderensis indicates a reverse trend, a broad minimum percentage lasting from September to May and a narrow maximum percentages lasting from June to August. Throughout the whole year, *S. maderensis* represented 64.3% of the total sardine catch.

The high percentag of *Sardinella maderensis* in summer months (June-August), be explained by salinity decrease as shown by Gerges (1979) who pointed that salinity values reach minimum (38 p.p.t) at El-Max region in the summer.

The *Sardine pilchardus* were absent in all months except November and December, when it was very rarely found in insignificant percentage. Also *Dussumieria acuta* was insignificantly available in July and August.

Size Frequency of The catch

i- *S. aurita*

The percentage length frequency of *S. aurita* in the catch of sardine gill net is recorded in Table (8). The fish length ranges between 8 and 23 cm, but the majority lie between 11 and 19 cm. Larger fish (above 20 cm) were recorded in the winter seasons, while the small size (less than 11 cm) were recorded in the period from August to November. This means that new recruits enter the fishery during that short period.

ii- *S. maderensis*

The percentage length composition of *S. maderensis* is given in Table (9). The fish length varies between 9 and 22 cm. The majority of fish length lie between 10 and 20 cm. The winter catch exhibits an increase in the percentage of large fish. The small fish (less than 11 cm) dominate the catch from May to November. This means that new recruits enter the fishery during that long period.

iii- *Sphyraena sphyraena*

From Table (10), it is obvious that fish length ranges between 14 and 32 cm. In February and March, the highest percentage of the lengths lies between 26 and 30 cm. On the other hand, the small length (18 cm) represents 68.3% of the catch in November.

Age Composition of Sardines

Studying the age composition of a species gives a picture of the age structure of the population. In addition, it is used to compute the mortality and survival rates.

Age-length keys of both *S. aurita* and *S. maderensis* were constructed from scale investigation of specimens of different age groups in different seasons of the year, by which we are able to convert the size composition into age composition.

i- *S. aurita*

The monthly age composition of *S. aurita* is shown in Table (11). It is clear that, as far as number of fish is concerned, age group I was more dominant from May to January. In March and April, age group II dominated the catch. Age group III appeared significantly from December to June. Age group IV was insignificantly represented in the period December-March. The appearance of age group 0 in the catch (i.e. recruitment) was noticed significantly from August to November.

ii-*S. maderensis*

The age composition of *S. maderensis* is shown in Table (12). It is obvious that, as far as number of fish is concerned. Age group I was highly represented in the catch particularly from May to November. Fish of age group II were also present in appreciable amounts especially in the months

Table (8)
Size Composition of *Sardinella aurata* in El-Max Region.

Length (cm)	76 Jan.		77 Febr.		77 March		77 April		77 May		77 June		77 July		77 Aug.		77 Sept.		77 Oct.		77 Nov.		77	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11	-	-	1	1.5	-	-	-	-	-	2	0.9	-	-	-	-	6	3.4	6	1.3	2	1.2	4	1.4	
12	4	4.0	9	13.8	3	4.2	1	4.0	-	45	22.1	4	20.0	24	32.4	37	21.0	55	12.1	3	1.9	33	11.2	
13	8	8.0	25	38.5	8	11.3	0	0.0	4	2.4	97	47.5	2	10.0	41	55.4	63	35.8	226	49.8	29	18.0	33	31.6
14	23	23.0	6	6.2	8	11.3	4	16.0	36	21.7	48	23.5	2	10.0	5	6.8	12	6.8	40	8.8	42	26.1	40	13.6
15	28	28.0	6	9.2	8	11.3	6	24.0	35	21.1	4	2.0	3	15.0	2	2.7	2	1.1	7	1.5	30	18.6	22	7.5
16	13	13.0	3	4.6	15	21.1	3	12.0	44	26.5	7	3.4	4	20.0	0	0.0	0	0.0	1	0.2	10	6.2	7	2.4
17	10	10.0	7	10.8	10	14.1	2	8.0	34	20.5	1	0.5	3	15.0	1	1.4	1	0.6	0	0.0	-	-	1	0.3
18	6	6.0	3	4.6	5	7.0	3	12.0	11	6.6	-	0	0.0	-	-	-	-	1	0.2	-	-	-	-	
19	5	5.0	2	3.1	3	4.2	4	16.0	-	-	-	1	5.0	-	-	-	-	-	-	-	-	-	-	
20	0	0.0	1	1.5	6	8.4	1	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
21	1	1.0	1	1.5	4	5.6	1	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
22	1	1.0	1	1.5	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
23	-	-	-	-	1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	100		65		71		25		166		204		20		74		176		454		161		294	
Mean	15.1		14.5		16.3		16.4		15.7		13.2		15.0		12.8		12.2		12.3		13.6		12.8	

Table (9)
Size composition of *Sardinella maderensis* in El-Max Region.

(cm) No.	Dec. 76		Jan. 77		February		March		April		May		June		July		August		September		October		November		
	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	
9	1	2.2	-	-	-	-	-	-	-	-	1	2.9	-	-	-	-	-	-	-	-	-	-	-	-	
10	1	2.2	-	-	-	-	-	-	-	-	3	8.6	2	1.4	5	1.3	-	2	0.4	12	25.0	3	9.4	4	19.8
11	5	10.9	-	-	1	11.1	-	-	-	-	10	31.4	28	19.9	216	57.4	153	32.6	9	18.8	4	12.5	11	52.4	
12	5	10.9	1	4.8	0	0.0	-	-	-	-	15	42.8	79	56.0	127	33.8	275	58.6	17	35.4	7	21.9	3	14.3	
13	7	15.2	0	0.0	0	0.0	-	-	-	-	5	14.3	30	21.3	21	5.6	29	6.2	4	8.3	7	21.9	1	4.8	
14	13	28.3	3	14.3	0	0.0	-	-	-	-	0	0.0	2	1.4	6	1.6	6	1.3	3	6.3	6	18.8	1	4.8	
15	3	6.5	7	33.3	1	11.1	-	-	-	-	1	2.9	-	-	1	0.3	4	0.9	2	4.2	4	12.5	-	-	
16	7	15.2	2	9.5	0	0.0	-	-	-	1	50.0	-	-	-	-	-	-	-	0	0.0	1	3.1	-	-	
17	1	2.2	4	19.0	0	0.0	-	-	-	1	50.0	-	-	-	-	-	-	-	0	0.0	-	-	-	-	
18	2	4.4	1	4.8	3	33.3	-	-	-	-	-	-	-	-	-	-	-	-	1	2.1	-	-	-	-	
19	0	0.0	1	4.8	2	22.2	2	50.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
20	1	2.2	1	4.8	1	11.1	1	25.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
21	-	-	1	4.8	0	0.0	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
22	-	-	-	-	1	11.1	1	25.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

TOTAL	46	21	21	9	9	17.8	4	4	2	35	141	376	489	48	32	21	11.7	11.7	11.7	11.8	12.8	11.1	11.1	11.1	

MEAN	13.8	16.0	16.0	17.8	16.4	16.5	11.7	12.0	11.5	11.5	11.7	11.5	11.7	11.7	11.8	12.8	11.7	11.7	11.8	12.8	11.1	11.1	11.1	11.1	

Table (10)
Size composition of *Sphyraena sphyraena*
in El-Max region.

Length (cm)	February		March		Sept.		October		November	
	No.	%	No.	%	No.	%	No.	%	No.	%
14	-	-	-	-	-	-	1	1.7	-	-
16	-	-	-	-	-	-	7	12.1	17	12.2
18	2	6.0	-	-	1	10.0	2	3.4	95	68.3
20	0	0.0	-	-	2	20.0	0	0.0	9	6.5
22	1	3.0	-	-	2	20.0	0	0.0	4	2.9
24	1	3.0	1	5.3	1	10.0	6	1.3	3	2.2
26	11	33.4	2	10.5	3	30.0	32	55.2	5	3.6
28	12	36.4	8	42.1	1	10.0	8	13.8	4	2.9
30	6	18.2	6	31.6	-	-	1	1.7	1	0.7
32	-	-	2	10.6	-	-	1	1.7	1	0.7
Total	33		19		10		58		139	
Mean	26.0		28.2		22.4		25.0		18.7	

October, December and January. Age groups III and IV were significantly represented from December to March, while age group V was either scarce or lacking in all months. Age group 0 was represented from May to December.

Survival and Mortality Rates

The survival and mortality rates have its importance as population parameters, used in estimation of the stock. The mortality rate or instantaneous total mortality (Z) is deduced mathematically from the decline of the log frequency of different age groups of the catch curve, (Ricker,1975) and the survival rate (S) is computed from the equation ($S=e^{-Z}$).

A- Survival and mortality rates of *S. aurita*:

Table (13) and Figure (1) show a decreasing trend from age group I to larger ages, the slope of this decline was estimated by least square method, to be -0.59795, i.e.

$$Z = -0.59795 \times -2.303 = 1.3771$$

$$\text{and } S = e^{-1.3771} = 0.2523$$

Thus, survival rate is equivalent to about 25%, per year after one year old.

Table (11)
Monthly age composition of *S. aurita* in
Sardine Gill Net catch at El-Max region.

Month	AGE GROUPS									
	0		I		II		III		IV	
	No.	%	No.	%	No.	%	No.	%	No.	%
Dec. 1976	-	-	58	58.6	30	30.3	10	10.1	1	1.0
Jan., 1977	1	1.5	45	68.2	13	19.7	6	9.1	1	1.5
February	-	-	27	38.0	25	35.2	16	22.5	3	4.2
March	-	-	3	12.0	11	44.0	9	36.0	2	8.0
April	-	-	26	15.7	105	63.3	35	21.1	-	-
May	2	1.0	168	82.4	33	16.1	1	0.5	-	-
June	-	-	8	40.0	8	40.0	4	20.0	-	-
July	1	1.4	68	91.8	4	5.4	1	1.4	-	-
August	43	24.4	124	70.5	8	4.5	1	0.6	-	-
September	62	13.7	365	80.4	26	5.7	1	0.2	-	-
October	5	3.1	103	64.0	53	32.9	-	-	-	-
November	37	12.6	213	72.4	43	14.6	1	0.3	-	-

B- Survival and mortality rates of *S. maderensis*:

Table (14) shows log frequency of different age groups of *S. maderensis* and Fig. (2) is the catch curve. From Age I-III, the catch curve takes the form of straight line.

The slope of this straight line = $1.9593 - 0.177 / 1 - 2 = -1.0416$.

Thus, Instantaneous total mortality = 2.3988

and the survival rate = 0.0908 i.e 9% of fishes survive per year after one year old.

DISCUSSION

Before the regulation of the Nile flood, the sardine fishery was mainly operated with gill net during Autumn. This was due to the arrival of Nile flood, rich in nutrients, that flourish the phytoplankton (Halim, 1960). El-Zarka and Koura (1965) showed a significant positive correlation between the monthly sardine catch and the monthly out flow one month earlier. The variable trend in the sardine gill net catch (before and after Aswan High Dam Construction) may be related to the variation in the pattern of phytoplankton production.

The present study shows that the landing of sardine gill net was mainly composed of *Sardinella aurita* and *S. maderensis*. The monthly landing of

Table (12)
 Monthly age composition of *S. maderensis* in Sardine Gill Net
 at El-Max region.

MONTH	AGE GROUPS											
	0		I		II		III		IV		V	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Dec., 76	2	4.3	12	26.1	21	45.7	9	19.6	2	4.3	-	-
Jan., 77	-	-	1	4.8	10	47.6	7	33.3	2	9.5	1	4.8
February	-	-	1	11.1	1	11.1	2	22.2	4	44.4	1	11.1
March	-	-	-	-	-	-	-	-	3	75.0	1	25.0
April	-	-	-	-	-	-	2	100.0	-	-	-	-
May	3	8.6	28	80.0	4	11.4	-	-	-	-	-	-
June	1	0.7	118	83.7	22	15.6	-	-	-	-	-	-
July	3	0.8	352	93.6	21	5.6	-	-	-	-	-	-
August	1	0.2	438	93.4	30	6.4	-	-	-	-	-	-
September	8	16.7	31	64.5	8	16.7	1	2.1	-	-	-	-
October	2	6.2	15	46.9	14	43.8	1	3.1	-	-	-	-
November	4	20.0	14	70.0	2	10.0	-	-	-	-	-	-

Table (13)
 The \log_{10} frequency of the different age groups
 of *S. aurita*.

Age Group	0	I	II	III
Percentage	6.167	69.079	20.353	4.400
\log_{10} percent	0.79007	1.83935	1.30863	0.64345

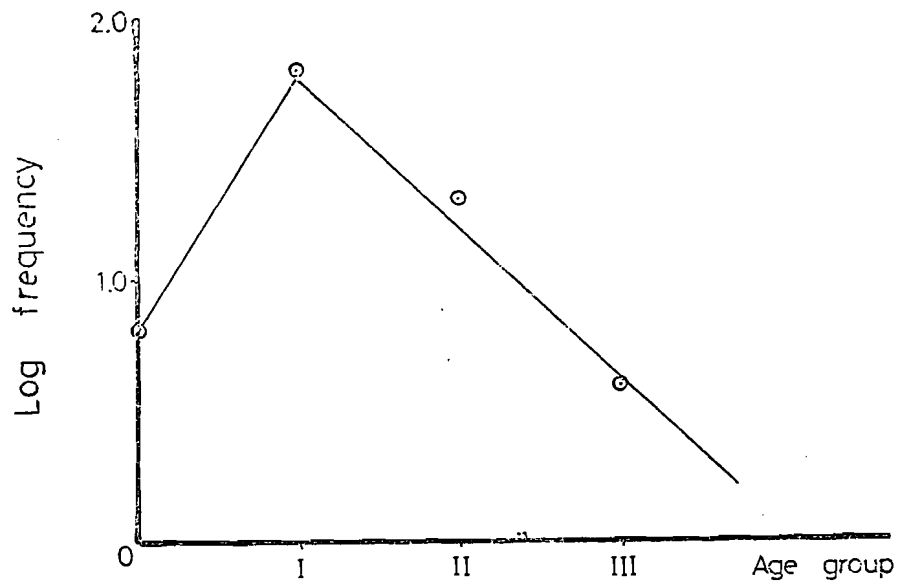


Fig. 1. Catch curve of *S. aurita*.

Table (14)
The log₁₀ frequency of the different age groups
of *S. maderensis*.

Age Group	0	I	II	III
Percentage	0.6384	91.0534	8.2730	0.0349
Log ₁₀ percent	- 0.1949	1.9593	0.9177	- 1.4572

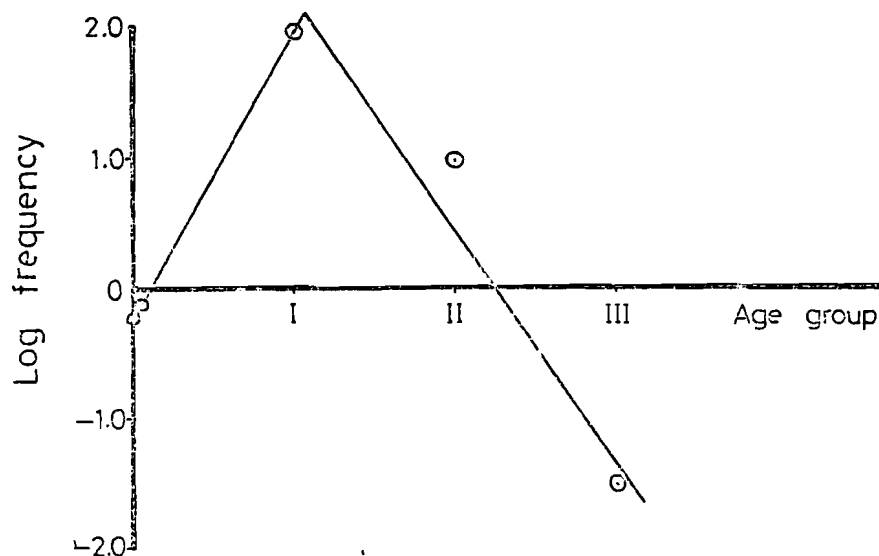


Fig. 2. Catch curve of *S. maderensis*.

these sardines was concentrated from April to September, and to a less extent in October and November. Many workers showed that temperature could affect the Sradine abundance (Nakai, et al., 1960). Postel (1960) added that the temperature (20°C) plays a Principal role in the definition of sardine fishing season.

The present work also shows that although *S. maderensis* appeared from April to November, its maximum abundance is from May to August. Ben-Tuvia (1960) demonstrated that the *S. maderensis* lives in warm waters where the yearly surface isotherm is not much lower than 20°C. He also mentioned that this fish species prefers living in shallow and less saline water. In Algeria the *S. maderensis* was found to concentrate at the mouths of small rivers, which cause a decrease in water salinities (Dieuzeide, 1950-Ben-Tuvia, 1960 a). The same observation was noticed at El-Max region, where it was characterized by decreased salinity in summer months (Gerges, 1979) and high nutrients (Emara, 1979).

In the present study, the length range of *S. aurita* was 8-23 cm. and the majority lie between 11 and 19 cm.. The length range of *S. aurita* caught with purse seine near Alexandria was recorded by Hashem et al, (1979) to be 6-27 cm. Ben Tuvia (1960 b) gave a length range (9-11 cm.) for *S. aurita* caught by purse-seine in Israeli waters. Al-Sayes et al. (1979) recorded a length range of (4-17 cm.) for *S. aurita* caught by beach seine from Alexandria Mediterranean waters.

For *S. maderensis*, the length range was 9-22 cm. Hashem et al. (1979) gave a size-range 6-17 cm for that species caught by purse-seine, while Al-Sayes et al. (1979) recorded a length range of 4.5-22 cm for the same species caught by beach seine, both working in Alexandria waters. Ben-Tuvia (1957) reported that *S. maderensis* common near the Israeli shores, have a size range of 9-12 cm.

As regarding the age composition of the *Sardinella* species, Hashem et al (1979) showed that the most abundant age group in the catch of purse seine was age group I. The present results also show that the catch of gill net was dominated by fish of one year old. Therefore, the presence of recruits of both *Sardinella* species at El-Max region might mean that the spawning grounds of these fishes lies near to that area.

The survival rate of *S. aurita* at El-Max region was found to be 25%, which is greater than that found by Ben-Tuvia (1960 b) in Israeli waters. On the other hand, the survival rate of *S. maderensis* at El-Max region was found to be low (9%). This low value may be due to gear selectivity and or offshore migration of older fish.

SUMMARY

As a result of the regulation of the Nile flood, after the construction of Aswan High Dam in 1966, remarkable changes in the hydrographic and ecological conditions in the S.E. Mediterranean, have been observed. This greatly affected the sardine fishery along the Egyptian Mediterranean coast. The sardine catch drastically decreased from 18 thousand tons in 1962 to less than one thousand ton in 1972.

At El-Max region, an increase in the sardine landing (186.6 tons) was noticed in the last few years (1974-1976) as compared with 11.2 tons during the period 1963-1973. This large fluctuation of the catch can be explained by the increasing fishing efforts.

The landing of sardine gill net before the construction of Aswan High Dam showed two maxima, the first in late spring (may) and the second in winter (January). This pattern was changed after the construction of the Dam, and only one maximum is observed in summer. This pattern variation is related to phytoplankton abundance in the Mediterranean Sea before and after the construction of Aswan High Dam.

The total catch of sardine gill net in El-Max region was estimated to be about 340 tons during the period from December 1976 to November 1977. The largest contribution was confined to the summer season and the catch was mainly composed of sardine (92.6%). Other fishes (*Sphyraena sphyraena*, *Euthynnus allet*, *Boops boops*, *Trachurus mediterraneus* and others) do not constitute more than 7.4% of the catch.

Sardines are mainly composed of *S. aurita* and *S. maderensis*. The percentage composition of *S. aurita* showed a high percentage from September to May. On the other hand, *S. maderensis* show abundance from June to August.

The length of *S. aurita* ranges between 8 and 23 cm, and the new recruits enter the fishery ground from August to November. On the other hand, the size of *S. maderensis* varies between 9 and 22 cm and the new recruits enter the fishery ground from may to November or December.

The majority of both *S. aurita* and *S. maderensis* is composed mainly of age group I. However, *S. aurita* attain age group IV and *S. maderensis* attain age group V, but these older ages were insignificantly represented in the catch.

The survival and mortality rates are deduced for both *S. aurita* and *S. maderensis*. the survival rate of *S. aurita* is 25% i.e. 25% of fish survive per year after one year old. On the other hand, *S. maderensis* showed a very low rate of survival (9%) i.e. 9 % of fish survive per year after one year old. This low value was explained as may be due to gear selectivity and or migration of older fish to offshore waters.

REFERENCES

- Ben-Tuvia, A. 1957. Pelagic Fisheries in Israel. *Gen. Fish. Coun. For the Med.*, 45: 383-391.
- Ben-Tuvia, A. 1960 (a). Synopsis of the systematics and biology of *Sardinella maderensis* Lowe. In: *Proc. World Sci. Meet. Biol. Sardine and related Sp., FAO Species Synopsis*, 14.
- Ben-Tuvia, A. 1960 (b). Synopsis of biological data on *Sardinella aurita* of the Mediterranean Sea and other waters. In: *Proc. World Sci. Meet. Biol. Sardines and related Sp., FAO Species Synopsis*, 9.
- El-Hehiawi, M.E. 1974. Changes in salinity and landing of six fish species in the shelf, north to the Nile Delta. *Bull. Inst. Ocean. Fish.*, IV.
- El-Zarka, S. and R. Koura, 1965. Seasonal fluctuation in the production of important food fishes of the U.A.R. waters of the Mediterranean Sea. *Alex. Inst. Ocean. Fish., Notes and Memoires*, 74.
- Emara, H.I., 1979. Hydrochemical studies in the area Rosetta-Matrouh. *Inst. Oceanogr. Fish., Medit. Branch, Alex., Techn. Rep.* (2/1): 40-56.
- Gerges, M.A. 1976. The damming of the Nile River and its effects on the hydrographic conditions and circulation pattern in the South-eastern Mediterranean and the Suez Canal. *Proceedings of the Symposium in the Eastern Mediterranean, Malta, 1973. Acta Adriatica*, XVIII, 11: 177-191.
- Gergis, M.A. 1979. Hydrography and circulation. *Inst. Ocean. Fish. (Medit. Branch), Techn. Rep.*, (2/1), I: 3-39.
- Hashem, M.T. 1972. Bottom trawling surveys for Abu-Kir / Rosetta Region during 1969-1970. *Bull. Inst. Ocean. Fish.*, II.

- Hashem, M.T. et al, 1979. Fisheries investigations of the sardine and other pelagic fish. *Inst. Ocean. Fish. (Medit. Br.), Tech. Rep.*, (2/3).
- Halim, Y. 1960. Observations on the Nile bloom of phytoplankton in the Mediterranean. *J. Cons. Int. pour l'Explor. de la Mer.*, 26(1): 57-67.
- Nakai, Z., G.I. Murphy and J. Radovich 1960. Fluctuations and Abiotic factors. *Proceedings of World Scientific Meeting on the Biology of Sardine and related. Rep. of sect. II: 7-10.*
- Postel, E. 1960. Rapport sur la Sardinella (*S. aurita*, Valenciennes) Atlantique Africain. In: *Proc. World Sci. Meet. Biol. Sardines and related Sp., FAO Sp. Synopses 1.*
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of Fish populations. *Bull. Fish. Res. Bd. Canada*, 191: 382 pp.
- Al-Kholy, A.A. and S.K. El-Wakeel 1975. Fisheries of the South-Eastern Mediterranean Sea along the Egyptian coast. Soviet-Egyptian Expedition 1970-1971. *Bull. Inst. Ocean. Fish.*, V.
- Al-Sayes, A.A., M.T. Hashem and I.A. Soliman 1979. The Beach Seine Fishery of the Eastern Harbour, Alexandria. *Bull. Inst. Oceanogr. Fish.*, 7, (3).