

# Purse Seine Fishery in the Gulf of Suez with Special Reference to Sardine Fishery

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## Abstract

Fishery statistics (catch, effort and catch per unit of fishing effort) of the total purse-seine catch as well as sardine catch from the Gulf of Suez during the fishing seasons from 1987/1988 to 1998/1999 were investigated. The maximum sustainable yield "MSY" and the corresponding level of fishing effort " $f_{MSY}$ " for total purse-seine catch and sardine catch were estimated using the surplus production models of Schaefer (1954) and Fox (1970). The obtained results from the two models indicated that, the fish species exploited by purse-seine fishery are in a situation of overfishing and the maximum sustainable yield of the total purse-seine catch as well as sardine catch can be obtained through the reduction of fishing effort.

## Introduction

The Gulf of Suez extends about 250 km from Suez in the north (Lat. 29° 56' N) to Shadwan Island in the south (Lat. 27° 36' N). Its width varies between 20 and 40 km, and its depth throughout its axis is fairly constant with a mean depth of 45 m (El-Sabh and Beltagy 1983).

The Gulf of Suez is considered as the most productive area along the Egyptian sector of Red Sea. Its importance as a fish resource can be attributed to the fact that its bottom is suitable for trawling and the presence of a large variety of fish species with important economical values. Three main fishing methods are operated in the Gulf of Suez namely; trawling, purse-seining and coral reef artisanal fishery specially long and hand lines.

Purse-seine fishery is the most productive fishing method in the Gulf of Suez where it represents about 77% of the total annual fish production from the Gulf. Despite the economical importance of purse-seine fishery, few studies concerning the evaluation of the status of the exploited stocks by purse-seine were published (Latif 1974, Shaheen et al. 1983 Sanders and Kedidi 1984, El-Gammal et al. 1994, Azab et al. 1998 and Mehanna 1999).

The present study offers an analysis of the data concerning catch, effort and catch per unit of fishing effort of purse-seine fishery in the Gulf of Suez as well as the estimation of the maximum sustainable yield (MSY) and the

corresponding level of fishing effort ( $f_{MSY}$ ) for the total purse-seine catch and sardine catch.

## Materials and Methods

Data concerning the total catch by species caught by the purse seine fisheries in the Gulf of Suez during the fishing seasons from 1987/1988 to 1998/1999 were obtained from the fisheries office of the General Authority for Fish Resources Development.

The surplus production models of Schaefer (1954) and Fox (1970) were applied to calculate the MSY and the corresponding level of fishing effort  $f_{MSY}$ .

The Schaefer model expresses the yield per unit of fishing effort as a function of effort as follows:

$$Y/f = a + bf$$

where

$Y$  = catch

$f$  = effort

and  $a$  and  $b$  are constants whose values can be estimated by least square method. and the corresponding yield curve can be given by the following equation:

$$Y = af + bf^2$$

The curve has a maximum sustainable yield  $MSY = -a^2/4b$  at an effort  $f_{MSY} = -a/2b$ .

The model of Fox (1970) expresses the yield per unit of fishing effort as a function of effort as follows:

$$\ln Y/f = a + bf$$

where  $a$  and  $b$  are constants whose values can be estimated by regression analysis of  $\ln Y/f$  and  $f$ . The yield curve can be expressed by:

$$Y = f \exp(a + bf)$$

The yield curve has a maximum sustainable yield  $MSY = -1/b \exp(a - 1)$  at an effort  $f_{MSY} = -1/b$ .

## Results and Discussion

### *Description of the fishery*

About 84 purse-seiners are operated inside the Gulf of Suez. The vessel's length ranged between 12.5 to 30 m. They are powered by engines of 100 to 800 hp. The purse-seiners are operated at night using lighted dinghies. Each dinghy is equipped by about nine kerosene lamps each of about 100 watt

candle power. This illumination leads to concentrate the fish before setting the net. All fishing ceases for about approximately ten days during each month when the moon is full. The net's length varied between 200 to 300 m and its depth ranged from 50 to 80 m. The nets are hauled manually. The crew ranged between 25 to 40 persons.

The purse-seine fishery is seasonal, generally from October to May. In last three fishing seasons (96-99), fishing paused from May to the end of September. At the beginning of each season, the fishing trip takes about 3 to 5 days because the fishing operation is undertaken relatively close to the landing site at Ataka. Later in the season, fishing trip takes about 10 days.

Catch composition

The important fish species caught by the purse-seiners were grouped in table 1. The dominant species groups are, horse mackerel and scads (family Carangidae) principally *Trachurus indicus*, *Decapterus macrosoma* and *D.*

*maruadsi*. This group is considered as the most abundant group in the catch (32.9%), followed by the round herring (family Clupeidae), principally *Etreumus teres* (23.6%). Sardines (family Clupeidae) principally *Sardinella gibbosa* (13.5%) come in third followed by Indian mackerel *Rastrelliger kanagurta* and slimy mackerel *Scomber japonicus* (family Scombridae). In addition, the species of lesser importance or unsorted species were grouped in the “others” category.

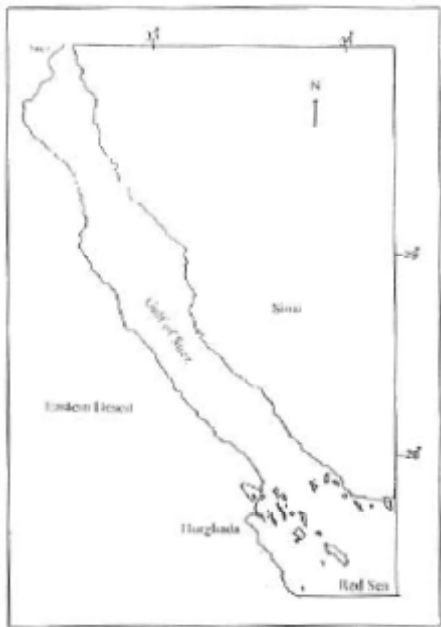


Fig. 1. Map of the Gulf of Suez.

Catch statistics

The annual total catch of the purse-seine fishery and the sardine catch are shown in figure 1. The total catch shows a great fluctuation from the season to another with a maximum value of

Table 1. Species composition of the purse-seine fishery in the Gulf of Suez.

| Common name              | Scientific name               | Local name | %*   |
|--------------------------|-------------------------------|------------|------|
| Horse mackerel and scads | <i>Trachurus indicus</i>      | Bagha      | 32.9 |
|                          | <i>Decapterus maruadsi</i>    | Bagha      |      |
|                          | <i>Decapterus macrosoma</i>   | Bagha      |      |
| Sardine                  | <i>Sardinella gibbosa</i>     | Sardina    | 13.5 |
| Round herring            | <i>Etreumus teres</i>         | Moza       | 23.6 |
| Indian mackerel          | <i>Rastrelliger kanagurta</i> | Kaskomry   | 2.8  |
| Slimy mackerel           | <i>Scomber jabonicus</i>      | Shak elzor | 10.1 |
| Others                   |                               |            | 17.1 |

\*The percent represents the mean annual catch during the last twelve years

26,153.7 ton during the 1992/93 fishing season and a minimum value of 8531 ton during the 1998/99 fishing season with a mean of 16359.5 ton. On the other hand, sardine catch varied between 5,573.8 ton during the 1987/88 fishing season and only 330.2 ton during the 1990/91 fishing season with a mean of 2215.5 ton

**Fishing effort**

The fishing effort represented by the number of landings is given in figure 2. The number of landings varied between 2,228 during the 1987/88 fishing season and 3,271 during the 1995/96 fishing season with a mean of 2,861 landings.

**Catch per unit of fishing effort**

The catch per unit of fishing effort for total purse-seine catch and sardine catch expressed as catch/landing are given in figure 3.

The values of total catch per unit of fishing effort varied between a maximum of 10.3 ton per landing during the 1989/90 fishing season and a minimum of 2.7 ton per landing during the 1998/99 fishing season. In respect to sardine catch per unit of fishing effort, it ranged between a maximum of 2.5 ton per landing during the 1987/88 fishing season and a minimum of 0.12 ton per landing during the fishing season 1990/91.

**Surplus production models**

To evaluate the effect of fishing effort expressed as the number of landings on the fish stocks exploited by purse-seining in the Gulf of Suez, the surplus production models as described by Schaefer (1954) and Fox (1970) were applied to estimate MSY and  $f_{MSY}$  of the

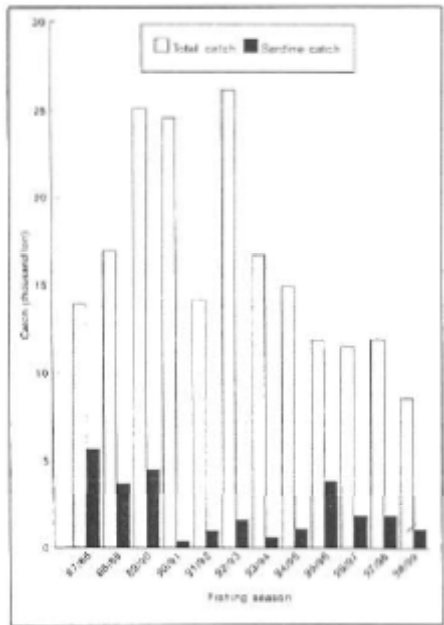


Fig. 2. Total purse-seine catch (ton) and sardine catch from the Gulf of Suez during the fishing seasons from 1987/1988 to 1998/1999.

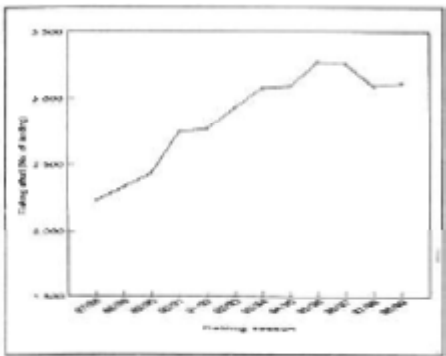


Fig. 3. Fishing effort (No. of landing) of the purse-seine fishery in the Gulf of Suez during the fishing seasons from 1987/88 to 1998/99.

total purse-seine catch as well as sardine catch. The obtained results are presented in table 2 and figures 4, 5, 6, 7 and 8.

As can be seen from the figures, the obtained results from the Schaefer model suggested that, a maximum sustainable yield of 19,609.3 ton for total catch (the catch during the 1998/99 fishing season is 8,531 ton) can be obtained by reducing the fishing effort by about 27%. Also, the MSY of 4,408.5 ton sardine (the sardine catch during the 1998/99 fishing season is 1,051 ton) can be obtained by reducing the fishing effort by about 43%.

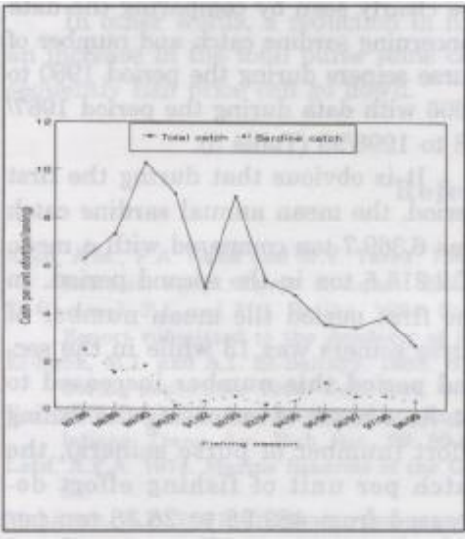


Fig. 4. Catch per unit of fishing effort (ton/landing) of total catch and sardine catch from the Gulf of Suez during the fishing seasons from 1987/88 to 1998/99.

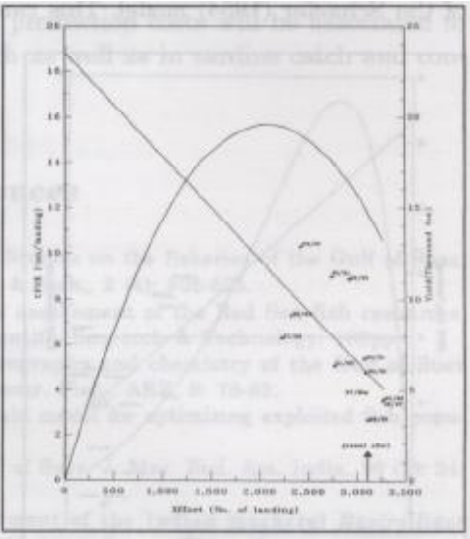


Fig. 5. Maximum sustainable yield (MSY) and the corresponding level of fishing effort (fMSY) of the purse-seine catch in the Gulf of Suez using the model of Schaefer (1954).

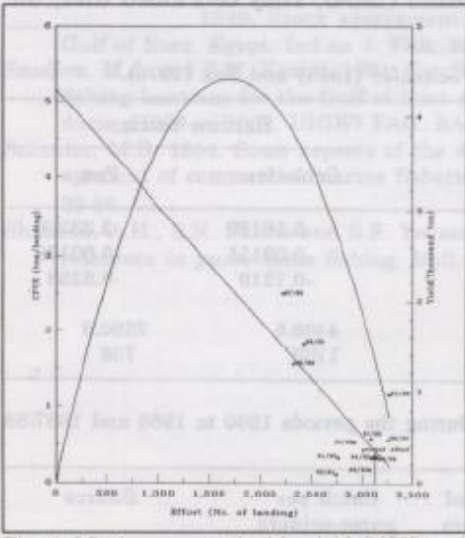


Fig. 6. Maximum sustainable yield (MSY) and the corresponding level of fishing effort (fMSY) of the sardine catch in the Gulf of Suez using the model of Schaefer (1954).

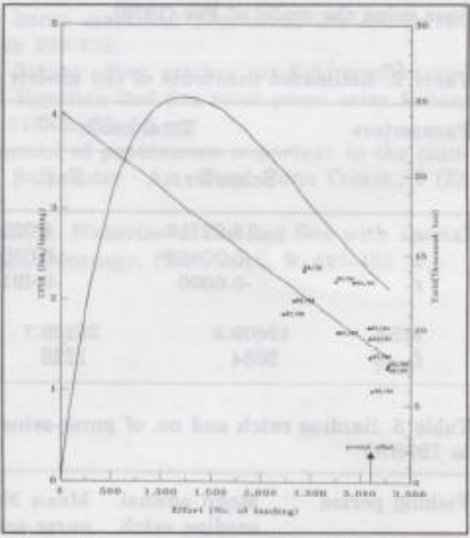


Fig. 7. Maximum sustainable yield (MSY) and the corresponding level of fishing effort (fMSY) of the purse-seine catch in the Gulf of Suez using the model of Fox (1970).

In respect to Fox's model, a total MSY of 25,229.7 ton can be obtained by reducing the fishing effort by about 60% and a MSY of 7,580.8 ton sardine by reducing the fishing effort by about 76%. These results clearly indicated that, the fish stocks exploited by purse-seine fishery are in a situation of overfishing and the rational exploitation of these stocks required a reduction of fishing effort.

The results obtained from both Schaefer (1954) and Fox (1970) models clearly indicated that the rational exploitation of small pelagics with special reference to sardine, caught by purse-seine required a reduction of fishing effort.

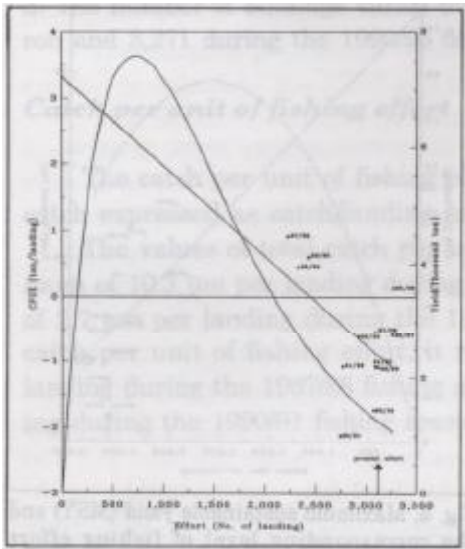


Fig. 8. Maximum sustainable yield (MSY) and the corresponding level of fishing effort (fMSY) of the sardine catch in the Gulf of Suez using the model of Fox (1970).

The results of the Fox (1970) model seems to be more realistic than those of the Schaefer (1954) model. This can be clearly seen by comparing the data concerning sardine catch and number of purse-seiner during the period 1960-1966 with data during the period 1987/88-1998/99 (Table 3).

It is obvious that during the first period, the mean annual sardine catch was 6,369.7 ton compared with a mean of 2,215.5 ton in the second period. In the first period the mean number of purse-seiners was 13 while in the second period this number increased to 84. As a result of increasing the fishing effort (number of purse-seiners) the catch per unit of fishing effort decreased from 489.98 to 26.38 ton per purse-seiner.

Table 2. Estimated constants of the models of Schaefer (1954) and Fox (1970).

| Parameters       | Total catch |          | Sardine catch |          |
|------------------|-------------|----------|---------------|----------|
|                  | Schaefer    | Fox      | Schaefer      | Fox      |
| a                | 18.82116    | 4.02245  | 5.16189       | 3.33266  |
| b                | -0.00452    | -0.00081 | -0.00151      | -0.00136 |
| r                | -0.6600     | -0.6916  | -0.7219       | -0.5253  |
| MSY              | 19609.3     | 25229.7  | 4408.5        | 7580.8   |
| f <sub>MSY</sub> | 2084        | 1228     | 1708          | 736      |

Table 3. Sardine catch and no. of purse-seiner during the periods 1960 to 1966 and 1987/88 to 1998/99

| Fishing period  | Mean annual sardine catch (ton) | Mean No. of purse-seiners | Catch per purse-seiners (ton/purse-seiners) | Source            |
|-----------------|---------------------------------|---------------------------|---------------------------------------------|-------------------|
| 1960-1966       | 6,369.7                         | 13                        | 489.98                                      | Latif, 1974       |
| 1987/88-1998/99 | 2,215.5                         | 84                        | 26.38                                       | The present study |

The obtained results are in a good agreement with the findings of Sanders and Kedidi (1984). They concluded that, the stocks exploited by purse-seiners in the Gulf of Suez are fully exploited. They also mentioned that, any additional effort to the purse-seine fishery in the Gulf of Suez will be associated with an annual decrease in the catch.

Mehanna, 1999 estimated the yield per recruit of *Trachurus indicus*, *Decapterus maruadsi* and *Rastrelliger kanagurta* in the Gulf of Suez and came to the conclusion that, these fish stocks are overexploited. She also found that, the maximum yield per recruit can be obtained by reducing the fishing mortality which is related to the fishing effort by about 33%, 38% and 51% for *Trachurus indicus*, *Decapterus maruadsi* and *Rastrelliger kanagurta*, respectively.

In other words, the reduction of fish production costs will be associated to an increase in the total purse-seine catch as well as sardine catch and consequently fish price can go down.

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