

ASSESSMENT OF PURSE SEINE FISHERY AND SARDINE CATCH OF GAZA STRIP

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ABSTRACT

Catch and effort data of purse seine fisheries in Gaza Strip from 1997 to 2002 was analyzed. Two types of purse seines are operating in Gaza Strip; purse seine launch and Hassaka. More than 60% of the fleet landing at Gaza city that has the only fishing port in the Strip. Annual catch fluctuated during the study period starting by the maximum at 1997 (2915 tonnes) and reaching the minimum at 2001 (1248 tonnes). Landing was affected by sardine catch fluctuation which was the most important and target species that has two fishing seasons; during April- June and Sept-October. Catch per unit effort (CPUE) of the purse seine launch ranged from 148 to 570 kg/day/boat, while for purse seine Hassaka ranged from 122 to 339 kg/day/boat. Maximum Sustainable Yield (MSY) was calculated for *Sardinella aurita* as 4099 tonnes with corresponding fishing effort (f_{MSY}) equal 41900 fishing day. Results suggested that sardine stock is underexploited; moreover the catch can be doubled by applying suggested recommendations.

INTRODUCTION

Gaza Strip has fishing ground estimated by about 1,600 km² which extends 37 km off the 45 km coastline length in the southeastern part of the Mediterranean Sea. Four landing sites are present in Gaza Strip; Gaza, which has a fishing port, Dir El-Balah, Khan-Younis, and Rafah (Fig. 1). Purse seine (shanshula) is one of the most common fishing methods for pelagic fishes in Gaza Strip. During the period from 1990 to 1993, more than 70% of the total number of fishermen in the Strip used purse seine producing about 90% of the catch. Target species are sardines, mackerels, and occasionally amberjacks (CARE/MAAN-Centers, 1996).

Few studies have described the catch landings and catch composition for Gaza Strip (Fossi and Nick, 1994; and CARE/MAAN-Centers, 1996), they did not recommend a management processing for pelagic stocks in this area.

Catch and fishing effort statistics are of vital importance for the evaluation of an exploited fish stock status. The catch per unit fishing effort (CPUE) is a good measure of the relative abundance of the exploited stocks. In addition, information about effort and catch per unit effort is essential data for the estimation of maximum sustainable yield (MSY) and the corresponding level of fishing effort (f_{MSY}) by means of surplus production models (El-Gammal, 1994). The "surplus production model" which is mainly applied to determine the optimum level of effort that produces the maximum yield that can be sustained without affecting the long-term productivity of the stock and so-called maximum sustainable yield (MSY) which has been reviewed by many authors ((Ricker, 1975; Caddy, 1980; Gulland, 1983; Pauly, 1983).

The aim of the present in is to analyze the annual catch and effort data of six successive years in Gaza Strip in order to assess and provide a brief overview of the changes in

fishing strategy and catches, focusing on sardine which is the main target species.



Fig. 1: Fishing area in Gaza strip

MATERIAL AND METHODS

The present study utilizes the catch and effort statistics data from 1997 to 2002 that has been recorded by the Palestine Directorate of Fisheries, Ministry of Agriculture.

The maximum sustainable yield (MSY) of *Sardinella aurita*; the dominant pelagic species in purse seine fisheries of Gaza Strip, was calculated using the "Y/f" (catch per effort) and "f" (effort) data for a series of years (study period) as expressed by Schaefer model (Pauly, 1983). The relationship constants (a & b) was estimated through a linear regression analysis, and the corresponding yield curve was given by the following equation:-

$$Y = af + bf^2$$

The curve has a maximum sustainable yield (MSY)

$$MSY = -a^2 / 4b$$

And the effort for the maximum sustainable yield (f_{MSY})

$$f_{MSY} = -a / 2b$$

Fishing gear and vessel description:

Two types of purse seines are operating in Gaza Strip, the first is purse seine launch of 14-18 meters length and 85-100 hp engines, and the second is purse seine Hassaka of 6-8 meters length made of fiberglass with 40 hp outboard engines.

Typically launch purse seine (shanshulla) uses a net with 300m headline whereas a Hassaka shanshulla has a purse seine net with a head line length of 200m (ranged from 180 to 220m). The twine sizes stocked are 210/3, 210/6 and 210/12. Their color is always green. From measurements made on the beach, their mesh sizes varied between 17 and 22 mm.

In general, purse-seiners carry two seines of different dimensions (one for daytime and other for nighttime) used according to the season and the target fish. Fishing at night is done with four Feloukas (light boats with oars), with three gas lamps on each. A Hassaka with an outboard engine can also be used as Lampara net. Hassaka is also useful for the transshipment, as launch stays at anchor if the weather is good.

Most launch shanshulla have a second type of purse seine much stronger than sardine nets to catch large size rays (30-100 kg) with a mesh size of 45-70 mm. for targeting large devil fish.

RESULTS

Distribution of purse seine fleet:

During 2002 there were 57 purse seine launches in all landing sites; Gaza, Dir El-Balah, Khan-Younis, and Rafah, and 71 small boats (Hassaka). More than 60% of the fleet landing at Gaza city that has the only fishing port in the Strip while Dir El-Balah has only hassaka boats (Fig. 2). The number of purse seine launch has increased 24% during the period of study (from 46 boats in 1997 to 57 in 2002). The purse seine Hassaka increased from 61 boats in 1997 to 71 boats in 2002.

Annual catch:

The annual catch of Purse seine in Gaza Strip fluctuated during the study period starting by the maximum catch at 1997 (2915 tonnes) and reaching the minimum at 2001 (1248 tonnes) then increased to 1785 tonnes at 2002 (Fig. 3). The annual lunch catch was always higher than hassaka catch. Generally, they are close to each other except during 1998, the hassaka catch dropped. For both methods catch decreased from 2915 tonnes during 1997 to 1248 tonnes in 2001 with a slight increase in 2002 to reach 1786 tonnes.

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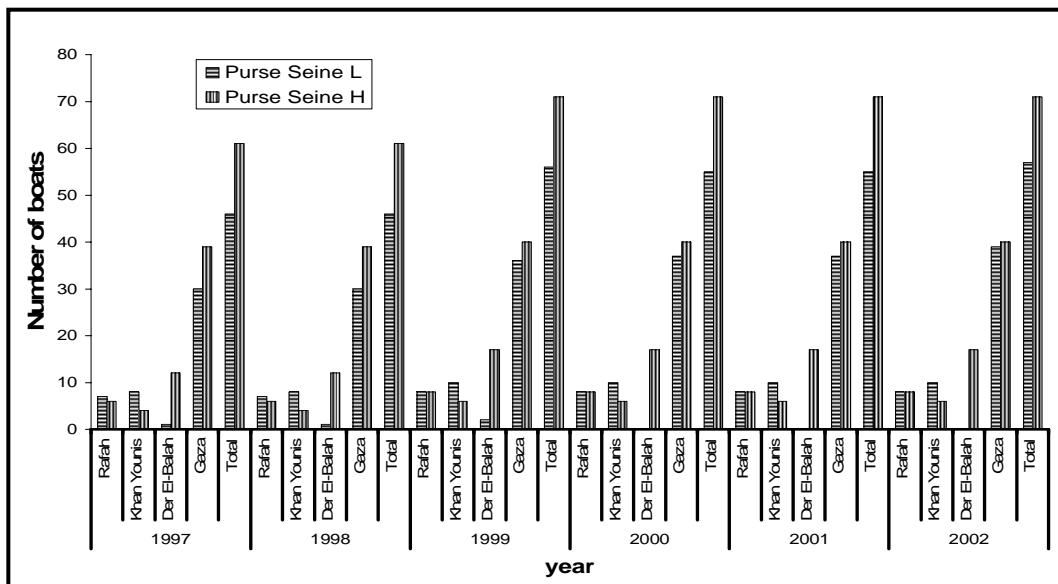


Fig.2: Distribution of purse seine fleet at different landing sites of Gaza Strip during the study period (1997- 2002) (L is Launch and H is Hassaka).

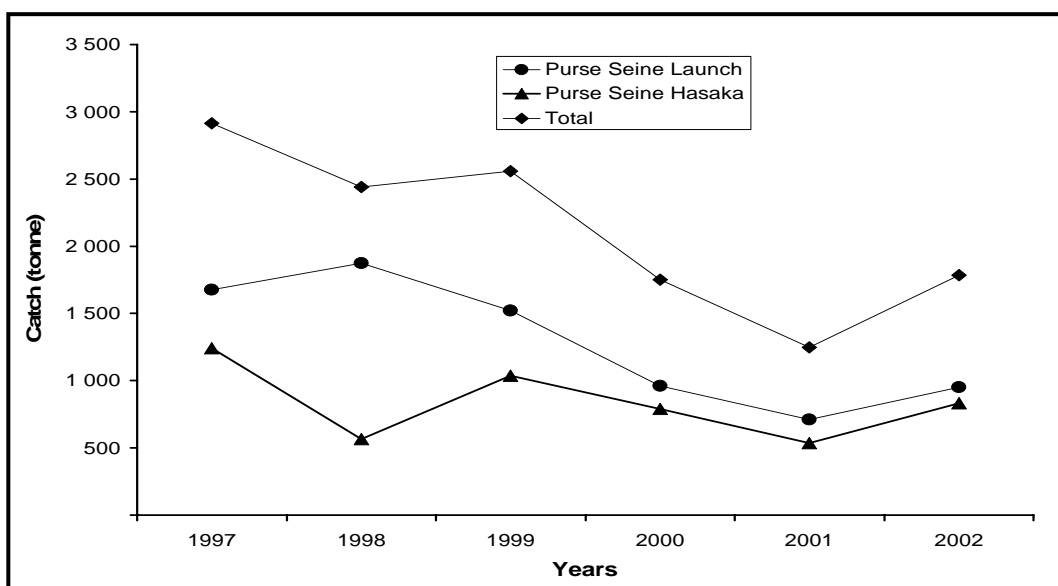


Fig. 3: Annual variation of purse seine catches during the study period (1997-2002).

Catch and Catch Per Unit Effort (CPUE):

During the study period the average annual catch of purse seine launch was about 1286 tonnes caught through 3353 fishing day, which represented about 43% of the total landing at the Strip. About 79% of catch landed at Gaza port, 13% at Khan-Younis, 7% at Rafah and only 1% came at Deir El-Balah. While the average purse seine Hassaka catch was 834 tonnes caught through 3840 fishing day represented 28% of the total catch, and out of it, 59% came from Gaza port, 23% from Deir El-Balah, 15% from Rafah, and

only 3% came from Khan-Younis (Table 1). The average catch by both methods was calculated as 1060 tonnes by 3597 fishing day.

The catch per unit effort (CPUE) of the purse seiners ranged from 148 to 570 kg/day/boat with an average over the whole period of 371 kg/day/boat for purse seine launch. While for purse seine Hassaka it ranged from 122 to 339 kg/day/boat with an average over the whole period of 226 kg/day/boat. For both methods the average CPUE was 295 kg/day/boat.

Table 1: Average annual catch by launch and Hassaka purse seines and number of trips in different landing sites in Gaza Strip during the study period (1997-2002).

Type	Landing site	Catch (tonnes)	% of Catch	No of trips	% of Trips
P.S. Launch	Gaza	975	75.82	2634	78.56
	Der El-Balah	12	0.93	46	1.37
	Khan Younis	189	14.70	441	13.15
	Rafah	110	8.55	232	6.92
	Total	1286	100	3353	100
P.S. Hassaka	Gaza	425	50.96	2256	58.75
	Der El-Balah	217	26.02	879	22.89
	Khan Younis	36	4.32	125	3.26
	Rafah	156	18.71	580	15.10
	Total	834	100	3840	100
All P.S.	Grand average	1060		3597	

Species composition

Purse seine catch composed mainly of sardines 76.2%. The sardine catch was divided to *Sardinella aurita* and *Sardina*

pilchards as observed by the authors (about 80% *Sardinella aurita*), its catch fluctuated from 85% at 1997 to 68% at 2001. Spanish mackerel *Scomberomorus commerson* came

next by 7.4% that reached the highest value (14%) at 1998 after the lowest value (4%) at 1997. Tuna *Ethynnus spp.* that represented about 5.8% of the catch showed gradual increase from 2% in 1997 to more than 12% in 2001 and dropped to 7% in 2002. Horse mackerel *Trachurus spp.* was another

important species (4.9%) which varied between 3% at 1997 and 8% at 2001. Other important species like Barracuda (*Sphyraena spp.*), Mulletts (*Liza spp.*), Flying fish (*Exocoetus spp.*) and Pompano (*Trachinotus spp.*) were caught occasionally (Table 2).

Table 2: Annual percentage composition of different fish species caught by both purse seines types operating in Gaza Strip from 1997 to 2002.

Species	1997	1998	1999	2000	2001	2002	Average
Sardine	85.16	73.05	79.15	69.86	68.29	72.74	76.20
Spanish mackerel	4.13	13.84	4.59	6.50	7.09	8.95	7.40
Tuna	2.03	2.50	4.98	12.08	12.19	7.24	5.80
Horse mackerel	3.42	4.73	3.73	4.51	8.40	7.02	4.90
Barracuda	3.48	3.68	3.91	5.92	3.32	2.90	3.80
Mulletts	0.64	1.43	1.49	0.92	0.59	0.98	1.00
Flying fish	1.07	0.72	2.09	0.15	0.03	0.17	0.90
Pompano	0.07	0.05	0.06	0.06	0.10	0.01	0.10

Sardine was the most important species in the Strip representing about 50% of the total catch. The catch of purse seine and the total Strip landing was affected by sardine catch fluctuation. During 1997, the total catch was

Maximum sustainable yield

The relationship between the fishing effort (fishing days) and catch per fishing day of *Sardinella aurita* was used to estimate its maximal sustainable yield (MSY) and corresponding fishing effort (f_{MSY}) of the Gaza Strip stock. The linear regression constants were calculated as: $a = 0.196$ and $b = -0.00000233$. According to Schaefer Model

maximum due to high amount of sardine, while during 2001, sardine catch was minimum and also the total landing. With increasing sardine catch in 2002, the total landing was recovered as shown in Fig. 4.

(Schaefer, 1954), the MSY was calculated as 4099 tonnes and f_{MSY} as 41900 fishing day (Fig. 6), i.e. the *S. aurita* stock of Gaza Strip is underexploited.

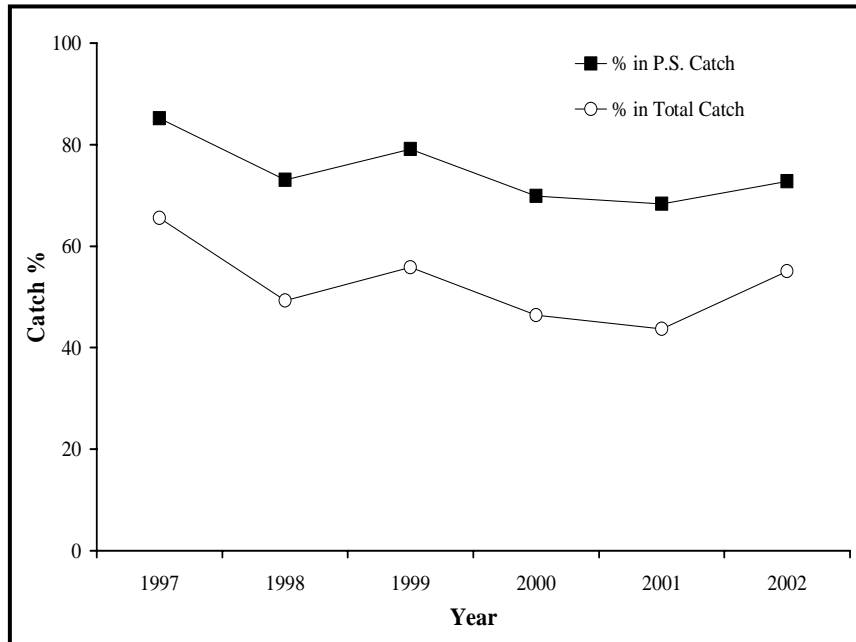


Fig. 4: Annual percentage variation of sardine catch in purse seine (P.S.) and total catch of Gaza Strip during the study period (1997-2002).

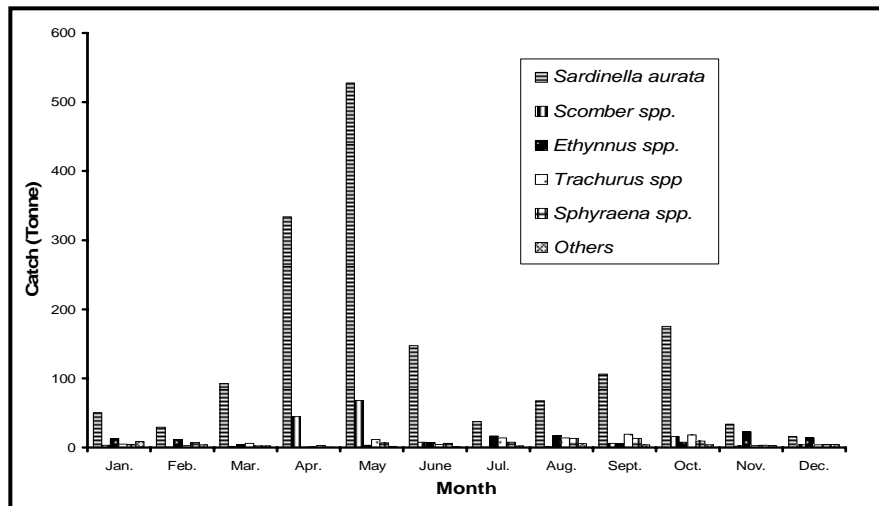


Fig. 5: Monthly variation in species composition of the purse seine catch in Gaza Strip during the period from 1997 to 2002.

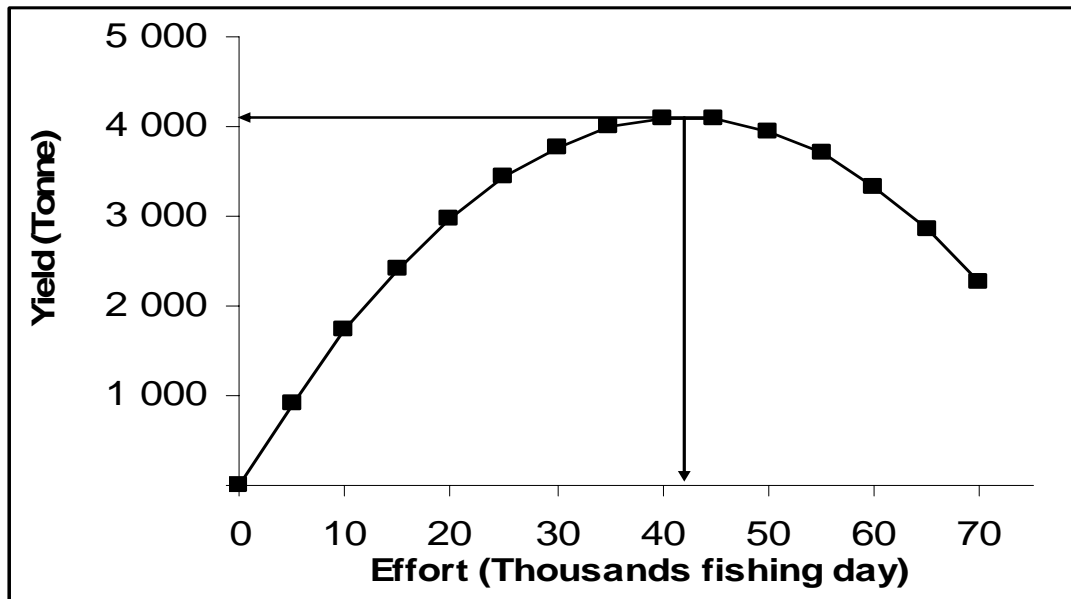


Fig. 6: Maximum Sustainable Yield (MSY) and corresponding fishing effort (f_{MSY}) for *Sardinella aurata* catch by purse seine in Gaza Strip.

DISCUSSION

The purse seine fleet of Gaza Strip is artisanal; composing of small boats concentrated in a single port near Gaza city and three primitive landing sites. The fleet needs to be developed with increasing boats size, navigation facilities and equipments for searching for fish schools offshore. Moreover, second port is necessary. The annual variation of purse seine launch catch between years 1997 to 1999 and 2000 to 2002 was due to political reasons and closure of the fishing grounds most of the time during the fishing season by Israeli Navy. The variation of purse seine Hassaka annual catch depends on how close or far the pelagic stocks pass the Palestinian waters, where the Hassaka cannot go deep because of their small size and lower power engines.

Sardine is the most important fish species in Gaza Strip. In the present study sardine was a mix from *Sardinella aurata* (about 80%) and *Sardina pilchardus* (less than 20%), catch of both species exceeded 85% of

all purse seine catch in some years (about 2500 tonnes). The amount of the Strip landing is affected by sardine catch. (Grofit, 1981) mentioned that although sardine catch in Egypt and Israel decreased during seventies, the north Sinai and Gaza Strip catch was not effected. Catch per unit effort (CPUE) or the catch rate is frequently the most useful index for long-term monitoring of a fishery. (Grofit, 1981), reported that the 1978 catch per unit effort for purse seine of Gaza Strip and North Sinai was 309 kg/ fishing day/ boat, which is similar for Gaza Strip purse seiners in the present study (295 kg/ fishing day/ boat, in spite of the reduction of fishing area and use more fishing gears in last few years. At north Sinai in 1979, CPUE was 1158 kg/ fishing day/boat for the period from May to early August (Hashem, 1983). These months is the peak of the fishing season that is similar to those recorded in the Strip while the estimated CPUE in the present study was the annual average not only the peak of the fishing season. The previous

study also mentioned that *S. aurita* represents 65% and *S. pilchards* 25% of the total sardine catch in North Sinai during summer 1979, concluding that *S. aurita* increases eastward for Egyptian Coast, such conclusion confirms the present study observation that *S. aurita* in Gaza was about 80% of the sardine catch all over the year.

The attainment of the maximum sustainable yield is, at least apparently, a reasonable and definable objective of management, so that if the stock abundance is less than that corresponding to the maximum sustainable yield, the fishing effort can be allowed to increase (Gulland, 1969). In the present study the Maximum Sustainable Yield (MSY) of *S. aurita* was estimated as 4099 tonnes corresponded to maximum fishing effort (f_{MSY}) about 41900 fishing day, while the maximum recorded catch of *S. aurita* by both methods of purse seine was about 2000 tonnes caught during 6627 fishing day at 1997, i.e. the sardine stock in Gaza Strip is underexploited.

These results suggest that it is possible to double the catch by increasing the fishing effort about six times. Such increase in fishing effort could be reached by the following recommendations:

1. Developing the purse seine fleet with boat size increase and advanced navigation equipment to operate offshore.
2. Building a new fishing port in the southern part of the Strip.
3. Introduce new fishing gear like mid-water trawl.
4. Increase the present fishing ground (which is limited by Israel marine force) to deeper waters in front of the Strip.

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