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Development of Trawl and Shrimp Fisheries at the Egyptian Mediterranean Area

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Abstract: Trawling is the most important fishing method for catching demersal fish and shrimp along the Mediterranean coast of Egypt. The landed catch of trawling comprise 43.6% by weight of the total yearly landed catch. Experimental fishing operations were carried out in the present study using the Italian trawl net at the area off the Nile delta during Spring and Summer, 2008. This study indicated that shrimp comprised 49.52% of the trawl catch. *Pagellus erythrinus, Merluccius merluccius* and *Siganus rivulatus* comprised high percentages in that catch. Most of the commercial fish species are caught with average sizes below 15.0 cm., therefore they are mostly caught before attaining their first sexual maturity. Fisheries management and fish stock conservation for sustainable fish and shrimp production is strongly recommended in the study area. This can be achieved through the application of minimum landing size of fish, trawl net cod-end mesh regulation and closed season for all fishing activities.

Key words: Trawling % Shrimp fisheries % Fisheries management % Mediterranean % Egyptian fisheries % Socio-economics

INTRODUCTION

The most economically important fishing gear along the Mediterranean coast, of Egypt is trawling. Among the yearly total catch taken from such coast some 36.600 tons of fish are the estimated landings of trawling, comprising about 43.6% of that total. [1]

The fishing boats using trawl nets at the Egyptian Mediterranean water are 1220 in number with sizes range from 10 to 24 m [1]

The central part of the Mediterranean coast of Egypt – from Alexandria to Port Said – is the richer fishing area, falling off the Nile delta. The continental shelf is the widest at this area and provides ample opportunity for fishing, though the fishery seems to have suffered considerably from over exploitation during the last two decades.

The increased exploitation levels of demersal fish resources at the continental shelf off the Nile delta have resulted in the need for improved fishery management program at such fishing area.

The goal of management program is to reduce fishing mortality to levels which allow stocks within the complex to initially rebuild above minimum biomass [2].

The basic data required for fisheries management in the study area are very limited. Knowledge of total catch removed from each stock is essential and little can be done without some estimate of the effort or catch per unit effort and of the sizes or ages of fish being caught.

The present investigation was carried out to survey the demersal fish populations in the study area, collecting data on the size composition, breeding season and catch per unit effort of these populations. Moreover, experimental fishing operations were carried out at the area of study during 2008 where bottom trawl net was used in these experimental surveys.

MATERIAL AND METHODS

Bottom trawl surveys were undertaken at the Mediterranean coast of Egypt during spring and summer of 2008. Fishing depths ranged between 20 and 215 m during spring while these depths were between 28 and 225 m in summer.

The trawl net used in these surveys was of the Italian design. The mesh sizes of various parts of the net ranged between 10.0 cm at the wing to 1.5 cm mesh bar measure at the cod end. The whole net is manufactured from nylon twines.

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The length of fishing rope ranged between 1.89 to 7.44 times the water depth during Spring fishing while it ranged between 1.30 to 5.00 times the water depth during Summer surveys.

Approximately 25 stations were sampled during each survey. Stations were allocated to strata approximately in proportion to the area of each stratum.

Sub samples of the catch were transplanted to the laboratory for species identification as well as weight and lengths measurement.

Length frequencies of fish were recorded to determine whether the trawl net affected the size composition of fish populations at the area of study.

RESULTS

`Results of the catch taken by trawl net from the area off the Nile delta during spring are shown in Table 1. Weights of various species (g) caught at each sector are given in the table.

The given data indicated that the highest catch was taken from Rosetta area, whereas it reached 57.74 kg followed by that caught from Abu Qir area amounting 54.22 kg. The depths of water at these two sectors ranged between 170 to 210 m at Rosetta sector,while it was about 95 m at Meadia area.

Table 2 shows data relevant to the weight of fish caught from the various areas during Summer. It appears from the figures given that the highest catch was taken from Borollus sector at a depth of 30 m. This catch comprised 37% by weight of the total catch taken off the Nile Delta during Summer. Comparatively high catches were taken also from Abu Qir and Rosetta sector, whereas these catches comprised 22.89 and 21.57% by weight of the whole taken catch.

The target catch taken by trawl net in Summer was categorized as finish and invertebrates as shown in Table 3. The finfish comprised 42.83% by weight of the catch,while the invertebrates formed 57.17% of that catch. Shrimp was the major component of invertebrates comprising 42.52% of the whole catch.

Data concerning the average lengths (cm) of the various commercial fish species caught from the area of study are given in Table 4.

As indicated in the table these lengths were compared with the lengths of fish at which they attain their first maturity. This comparison may contribute in understanding the effects of trawl fisheries on the breeding processes of the fish populations living in the Egyptian water. The given data show that many of the demersal species are caught with small sizes. These sizes appear to be in most cases below the marketable sizes. It is indicated also that most of the species are caught with sizes less than their sizes at first maturity.

Table 1: Species composition of the catch taken by trawl net during spring as weights in g

Species	Abu Qir 30m	Abu Qir 150-190m	Meadia 95m	Rosetta 30m	Rosetta 170-210m	Bor. 20m	Dam. 30m	Total	%
Pagellus erythrinus		5340	24000	2000				31340	15.40
Mullus surmulatus		6280	8000		5000			19280	9.48
Merluccius merluccius		5695	328		37500			43523	21.39
Trigla lucerna		1603			1137	560		3300	1.62
Boops boops	23	420	230					673	0.33
T. mediterraneus		482		48				530	0.26
Teropon puta		295	8000			82		8377	4.12
Serranus hepatus	424	151	704		12	171		1462	0.72
Cithorus linguatuca		1437	500					1937	0.95
Trigla lastoviza		280		2000				2280	1.12
Centropristis SP.		394						394	0.19
Trachinus draco		212						212	0.10
Arisoma balearieum	873	769	562	1074	72	510	24	3884	1.91
Sporisoma cutaneus		600						600	0.29
Bothus podas	2000	82			282	1405	640	4409	2.17
S. notata	26	248						274	0.13
Raja SPP.		1500						1500	0.74
Spicara flexusa	3000		406	408				3814	1.87
Synodus saurus	2000		1500					3500	1.72
Callionymus filamentosus	49			239	168	91		547	0.27
Solea impar	165			185				350	0.17
Gobius niger	583		2046	1984	110	3455	1656	9834	4.83
Pagrus pagrus	17							17	0.01
Trigla cavillone	65		2384				864	3313	1.63

Table 1: Continued

Trigla lyra	24							24	0.01
Trachurus trachurus			2000					2000	0.98
Sepia	1000	1500			10000		2016	14516	7.13
Octopus		2000	402			300		2702	1.33
Penaeus kerathurus	2000		3000	3000		3000		11000	5.41
Metapenacus monaceras	13000							13000	6.39
Penaeus stibbing			142					142	0.07
T. curvirostrus				3000	3000	4000	4000	14000	6.88
Crabs			16		460	120	128	724	0.36
Total	25249	29288	54220	13938	57741	13694	9328	203458	
	(12.41)	(14.40)	(26.65)	(6.85)	(28.38)	(6.73)	(4.58)		

Table 2: Species composition of commercial species caught at various experimental fishing localities during Summer

Species	Abu Qir 100m	Rosetta 50m	Rosetta 105m	Rosetta 150m	Rosetta 200m	Borollus 30m	Total	%
Pagellus erythrinus	400	58					458	0.24
Bothus podas	1900		500	200			2600	1.37
Serranus hepatus	541					94	640	0.34
Boops boops	6000	3500				291	9791	5.15
Spicara flexusa	5200		250				5450	2.84
Trigla lastoviza	8383	3357	3000	2000	442	672	17854	9.39
Trigla cavillone	6928						6928	3.64
Trigla lyra	5500						5500	2.89
Mullus surmuletus	2500	1250	1000			2373	7123	3.75
Synodus saurus	850					4200	5050	2.66
Solea impar	1500	500				450	2450	1.29
Pagrus pagrus	700	1250		100			2050	1.08
Sparus aurata	700					500	1200	0.63
Scomber japonitus	900	480			44		1424	0.73
Epinephalus	1500					13000	14500	7.63
Merluccius merluccius			35000	4000	10300		49300	25.94
Sargus sargus		90					90	0.47
Trachurus trachurus		650			95		745	0.39
Pagellus acarne		89					89	0.05
Spicara smaris			250	500		389	1139	0.60
Trigla lucerna				2000		850	2850	1.50
Lepidopus caudatus			1000	4000	318		5318	2.80
Stephanolepis hispidus						250	250	0.13
Seriola dumirili						700	700	0.37
Siganus rivulatus						45500	45500	23.94
Crenidens crenidens						300	300	0.16
Mullus barbatus						273	273	0.14
Diplodus anularis						250	250	0.13
Sphyraenu						250	250	0.13
Total	43502	11224	41000	12800	11199	70342	190072	
	(22.89)	(5.91)	(21.57)	(6.73)	(5.89)	(37.00)		

Table 3: Weights of finfish and invertebrates caught through the experimental fishing

			Invertebrates		

Locality	Depth (m)	Fish	Shrimp	others	Total
Abu Qir I	122	16030	700	2000	18730
		(85.58)	(3.74)	(10.68)	
Abu Qir II	107	10040	12000	2000	24040
		(41.76)	(49.91)	(8.32)	
Abu Qir III	81	13250	1500	4000	18750
		(70.67)	(8.00)	(21.33)	
Rosetta I	54	6953	120	1207	8280
		(83.97)	(1.45)	(14.58)	
Rosetta II	65	8463	2500	6500	17463
		(48.46)	(14.32)	(37.22)	
Rosetta III	225	11235	67500	4352	83087
		(13.52)	(81.24)	(5.24)	
Borollus I	26	70300	6000	1500	77800
		(90.36)	(7.71)	(1.92)	

Table 3: Continued

Borollus II	30	1884 (32.07)	2500 (42.55)	1503 (25.58)	5887
Borollus III	27	5730 (41.73)	8000 (58.27)	-	13730
Borollus IV	28	6292 (47.70)	2800 (21.22)	4100 (31.08)	13192
Rosetta V	153	16558 (14.10)	97500 (83.05)	3345 (2.85)	117403
Rosetta VI	104	16500 (58.20)	4200 (14.81)	7650 (26.98)	28350
Abu Qir IV	81	12193 (62.79)	2500 (12.87)	4725 (24.33)	19418
Rosetta VII	108	44845 (39.05)	70000 (60.95)	-	114845
Total		240273 (42.83)	277820 (49.52)	42882 (7.64)	560975

DISCUSSION

Trawl is recognized as one of the most efficient fishing gears for harvesting finfish and shrimps. This method has become popular in the Egyptian water since more than 30 years.

Catch assessment of the Italian trawl net was carried out at the Egyptian water off the Nile Delta during Spring and Summer seasons. In Spring, *Merluccius merluccius* and *Pagellus erythrinus* dominated the catch, whereas the two species comprised about 36% by weight at the catch. In Summer, *M.merluccius* extended its abundance in the catch and comprising about 25% of the catch while *Siganus rivulatus* appeared with considerable percentage constituting about 24% by weight of the catch. It is a matter of fact that the variations in species composition of trawl catch can be attributed to various factors, the most important of which are the environmental conditions with special reference to water temperature. In this concern, Matsushita [3] pointed out that the quality of the trawled fish depends to large extent on time of fishing, water temperature and type of substrate.

The current data indicated that the catch taken from Abu Qir Sector is characterized by its high species diversity either during Spring or Summer seasons. The high bio-diversity of Abu Qir bay catch may be attributed to the fertility of its water as a result of the high rates of agriculture water discharge into that Bay.The deeper water in some sectors of the study area exhibited higher catch rates in both seasons. In fact, the fish populations living in the shallow water are exposed to high rates of exploitation due to the use of large number of simple fishing methods,specially trammel and gill nets.

It can be pointed out that shrimp species which are belonging to family *Penaeidae* comprise a high percentage of the catch. This can be attributed to the high efficiency of Italian trawl in catching shrimp. The heavy sweep line of the net, small mesh size of the cod end as well as the low vertical opening of the net, all contribute in increasing the efficiency of the net in catching shrimps.

Because most fishing gears have imperfect size selection they may retain fish that are too small to have any commercial value. Trawls for example usually retain a range of sizes below the minimum target size and these are typically discarded [4,5]..

In agreement with the average sizes of 28 of the commercial fish species caught by the Italian trawl net from different depths and sectors of the study area are given in Table 4. The data given in the table show that the average sizes of six fish species were 10.0 cm or below. The other fish species were mostly caught with average sizes below their marketable sizes.

The average lengths at first maturity of some commercial fish species are shown in Table 4 [6].

Comparing the average lengths of some species having commercial value caught by trawl net in the present study with their lengths at first maturity it can be concluded that these species are caught without reaching the size at first maturity. However, it is believed that fishing with trawl net with its present design and mesh sizes affects to large extent the breeding success of the following commercial species:*Pagellus erythrinus,Trigla lastoviza,Pagellus acarne,Trigla lucerna,Siganus rivulatus* and *Sphyraena Sphyraena*.Actually the data given in the present study show that these species comprise respected percentage of the catch. In this concern, Shepherd, [7] pointed out that killing juveniles removes potential yield and unless taken into account in assessment will detract from assessments and effective management decisions.

Table 4: Average lengths et commercial species compared to their lengths at first maturity.

Species	Abu Qir 100m	Rosetta 50m	Rosetta 105m	Rosetta 150m	Rosetta 200m	Boro. 30m	Average length	Length at 1st maturity	
								m.	f.
Pagellus erythrinus	9.70	13.50					10.03	14.3	13.2
Bothus podas	11.92		9.0	17.30			11.34		
Serranus hepatus	8.71					8.55	8.61		
Boops boops	14.50	12.36				9.75	13.18	11.0	13.0
Spicara flexusa	13.37		10.00				13.08		
Trigla lastoviza	14.91	12.19	8.48	15.10	18.77	12.68	12.41	14.5	15.3
Trigla cavillone	9.14						9.14		
Trigla lyra	15.00						15.00		
Mullus surmuletus	15.36	15.68	9.00			15.33	12.57	12.51	11.50
Synodus saurus	17.24					20.22	1987	17.5	17.0
Solea impar	15.23	11.50				16.50	14.41		
Pagrus pagrus	14.13	14.25		14.0			14.20		
Sparus aurata	21.00					14.00	16.95		
Scomber japonitus	13.00	17.00			20.0		115.83		
Epinephalus	15.80					18.41	18.06		
Merluccius merluccius			26.70	26.20	26.50		25.81		
Sargus sargus		10.00					10.00		
Trachurus		20.00			22.0		20.18		
Pagellus acarne		11.50					11.50	13.4	14.0
Spicara smaris			10.27			11.43	10.95		
Trigla lucerna				15.20		13.55	13.55	15.6	17.0
Lepidopus caudatus			41.60	43.60	42.50		43.14		
Stephanolepis hispidus						11.20	11.20		
Seriola dumirili						22.91	22.91		
Siganus rivulatus						14.81	14.81	17.0	24.0
Crenidens crenidens						13.00	13.00		
Mullus barbatus						11.25	11.25	10.0	12.0
Diplodus anularis						10.00	10.00		
sphyraenu						14.00	14.00	23.0	26.0

In the same trawl it was indicated that fishing of small sized fish caused by over fishing and discarding may change the balance between species within a multispecies population. It is a matter of fact that prior to the introduction of shrimp trawling on the coast of Malaysia the families of *Leiognathidae Carangidae* and *Nemipteridae* dominated the marine community. After the introduction of shrimp trawling the population of *Leiognathidae* dropped sharply [8].

A similar situation was noted in the population of *Leiognathidae* and *Dasayatidae* in the Gulf of Thailand over ten years of shrimp trawling [9]. It has also been noted that in the Gulf of Carpentaria (Australia) the balance between demersal and pelagic fish species has changed over a twenty year period with demersals declining and pelagics increasing in abundance [10].

It appears therefore that fisheries management is necessary for the development and conservation of fish resources along the Mediterranean coast of Egypt. Such management can be achieved through the application of:

a- Minimum landing size, below which, fish may not be landed for sale. This approach encourages fishermen to avoid concentration on juveniles and using nets with optimum mesh sizes to catch larger fish. The main problem that may face the application of this method is the complications that may result from mixed fisheries. The problem is that where one species has a minimum landing size another species may has different one.

b- Minimum mesh sizes can reduce the fishing mortality of under sized or juvenile fishes. It is a matter of fact that the main disadvantage of Italian trawl net used in the Egyptian water is the narrowness of net mesh while in operation where the meshes in most parts of the net are stretched or even closed specially at the cod-end. The angle between the bars of the stretched mesh was found to reach 15^{o} or even less [11]. Attachment of side lines along the net body is recommended to avoid this problem. The increase of cod-end mesh size to 40 mm mesh bar will on the other hand contribute in increasing the average lengths of retained fish.

Table 5: Funding program conducted at Meadia region

Aspect	Number	Total Expenditure (LE)
Motors maintenance	89	2707000
Replacement of boat body	37	1865000
Establishment of new boats	67	2176000
Nets supply	36	779000
Shops for fishing gears supply	9	280000
Fish marketing shops	4	117000
Establish fish smoking factory	1	50000
Ice producers	1	200000
Net making workshop	1	35000
Boat maintenance workshop	2	135000
Total	247	8344000

c- The establishment of closed season in the Egyptian water seems to be a step in the right direction. It is believed that the protection of breeding process of the commercial demersal species is an accepted and significant strategy including plans for increasing the abundance of the spawning stock through better protection of juvenile fish.

In this concern Pascoe, [4] pointed out that area and seasonal closures have been implemented in some fisheries to reduce over fishing and unwanted catch. In some fisheries particularly shrimp fisheries seasonal closures have proved beneficial in both reducing the catch of juvenile fish and increasing the value of the catch.

In their study on breeding seasons of commercial fish species in the Egyptian water, Allam *et al.* [12] indicated that most of these species spawn during Spring and early Summer. Based on this information it is recommended to close fishing during this period.

As for the management of shrimp fisheries at the Italian water of the Mediterranean, Bianchini *et al*. [13] concluded that the adoption of a mesh size of 56 mm in the codend employed for red shrimp fisheries is strongly recommended.

On the other hand, the management and development of trawl fisheries in the Egyptian waters also need to face and deal with the following problems encountering fishing industry in the Egyptian waters.

- Absence of suitable fishing ports for entry and sailing of fishing boats through their fishing trips. Partial damage of the boats may occure from such problem.
- Lack of optimum platforms for boats to resort in cases of unloading the catch or to be provided with ice and trip requirements.
- Difficulty in performing the regular yearly maintenance to the wooden body of the boats due to the absence of modern tools to be used to lift or bring down the boats while being maintained.
- Construction and setting of engine and winches to the fishing boat is carried out through small undeveloped workshops. Workers in these workshops depend mainly on their inherited experience to design and establish these fishing boats, without following the advanced theories and techniques in boat manufacture. Therefore these boats perform with moderate or even low efficiency compared to the boats constructed in advanced workshops.
- Absence of updated motorized gears on board to operate the fishing nets. On the other hand, fishermen are mostly not highly qualified to deal with the developed fishing techniques adopted to bottom or midwater trawling.

However, the governmental authorities in Egypt attempted to deal with the above mentioned difficulties within a limited part of the fishing area in Egypt. In this concern a funding program was conducted at El-Meadia region in a way of giving loans to the owners of some fishing boats to maintain or reconstruct their boats (Table 5).

These loans were offered through a governmental organization for social development in Egypt during the period 1989-1999. This organization also contributed in developing the fishing industry through supporting some other activities as indicated in Table (5).

It is believed that the financial supports in these activities may have contributed in the partial development of trawl fisheries through the following aspects.

- Decline in the depreciation rate and accidental fishing boat sinkage due to either maintenance or replacement of boat engines.
- Increased duration of fishing trips and possibility to cover wide fishing areas situated at far distances.
- Giving the chance for further number of fishermen to be owners of new fishing boats.
- Establishment of well equipped workshops that are able to maintain the fishing boats within short periods of time.
- Establishment of ice producing factory able to cover the needs of fishing boats for ice.
- Conducting a number of training courses for fishermen at Meadia region where these courses concentrated on net making and maintenance as well as care of nets during the fishing operations.

Based on the above mentioned achievements it is recommended to conduct similar funding programs at other fishing areas in Egypt. This will with no doubt contribute in developing the yearly fish production of the country.

CONCLUSIONS

In conclusion the following aspects have to be considered

- Improve the design characteristics of the Italian trawl net specially the mesh size of cod end as well as the use of side lines along the net body.
- Conserve the fish stocks of demersal species at the area of study through the application of:
  - Minimum landing size of fish.
  - Closed season. The period from April to June is believed to be the most optimum for that.
- Conduct funding programmes through allowing loans to fisheries and boats owners.
- Dealing with the problems retarding fisheries development specially the care of fishing ports.

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