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By-Catch and Discarding of Trawl Fisheries at the Mediterranean Coast of Egypt

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Abstract: Trawling remains a controversial method of fishing due to the poor selectivity of trawl net and the resultant catch of huge amount of non target species. This work aimed to throw light on quantitative data of the catch composition, by- catch levels and discard estimates of bottom trawling along the Mediterranean coasts of Egypt. Experimental fishing operations using the Italian trawl net during 2008 pointed out the following: The non target catch comprised 51.07 and 37.04% of the total catch of trawl net during spring and summer seasons, respectively. A category of the non target catch comprising 21.52 and 7.86% of the total catch were discarded during spring and summer seasons, respectively. The by-catch taken through the period of study embodied 13 commercial fish species, the average length of which was 4.7 to 10.9 cm attaining average weight of1.1 to 21.2 g. Furthermore most of the target fish species were retained in the cod end with small sizes before reaching the length at first maturity. In conclusion, to conserve the fish stocks of demmersal species, it is strongly recommended to increase the mesh size of trawl nets used on commercial scale along the Egyptian coast of the Mediterranean.

Key words: Trawl fisheries % Target catch % Discarded fish % Egyptian coasts

INTRODUCTION

The impacts of fishing activities, especially trawling on the marine environment have been of great concern to the sustainable management of marine resources. Trawl nets are designed to catch economically valuable target species, especially shrimps. As a mobile non-selective fishing gear the bottom trawl net collects every organism in its path and the incidental capture of non target species- by catch- has become a major concern allied to trawling.

The term by catch means the retained catch of non target species, while the term discard catch or discards demotes the portion of the by catch returned to the sea.

In fact, 17% of the worlds marine fishery resources is over-exploited, 52% fully exploited and 20% moderately exploited [1]

Intensive fishing activities besides being detrimental to marine biodiversity, have started affecting the complex ecological processes of the Egyptian coastal water which in the long term effects the sustainability of marine fisheries that is already exhausted.

The present study was designed to deal with quantitative data of catch composition, by-catch levels and discard estimates of bottom trawling operating along the Mediterranean coast of Egypt. However, the data given may contribute in understanding the destructive impacts of small meshed cod-ends attached to Italian trawl nets on fish populations at the study area.

MATERIAL AND METHODS

Data and samples of the present study were collected by research team aboard commercial trawlers operating along the Mediterranean coast of Egypt between Alexandria and Port Said during 2008.

Trawling operations were carried out using the Italian trawl net. The fishing depths as shown in table 1 ranged between 30 and 225 m through the course of the present study.

For each operation, the discarded catch (or a random sub sample) was sorted to species, whereas the distribution of weight and length of each species was recorded.

Sub samples of the by-catch were transplanted to the laboratory for species identification as well as lengthes and wieghts measurements

Trawl Nets Used in the Egyptian Fisheries: It is generally accepted that the trawl nets used in the Egyptian water is below up to date the technical standards and that its constructional qualities as well as its catching ability must be subjected to improvement.

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Table 1: Target and non target species caught by Italian trawl net from the Egyptian Mediterranean water during spring

			Non target Sp (kg)				
Area	Depth (m)	Target Sp (kg)	Market	Discard	Total	Total catch kg	% of non target to total catch
Abu Qir	152	7.902	0.68		0.68	8.58	7.93
Abu Qir II	191	12.000	2.50	9.00	11.50	23.50	48.94
Abu Qir III	29	10.00	7.50	42.00	49.50	59.50	83.19
Abu Qir IV	85	5.00	3.00	-	3.00	8.00	37.50
Abu Qir V	86	16.00	7.50	-	7.50	23.50	31.91
Meadia	97	46.00	6.00	-	6.00	52.00	11.54
Abu Qir- Ros.	29	44.00	20.00	20.00	40.00	84.00	47.62
Rosetta I	29	10.00	5.50	45.00	50.50	60.50	83.47
Rosetta II	160	18.50	1.50	-	1.50	20.00	7.50
Rosetta III	144	25.50	12.00	-	12.00	37.00	32.43
Rosetta IV	144	41.00	6.00	-	6.00	47.00	12.77
Rosetta V	216	35.00	8.00	-	8.00	43.00	18.60
Rosetta VI	194	20.00	6.00	-	6.00	26.00	23.08
Rosetta- Bor	171	11.00	6.00	-	6.00	17.00	35.29
Rosetta deep	275	12.50	10.00	-	10.00	52.00	19.23
Borollus I	21	14.50	40.00	-	40.00	54.00	74.07
Borollus II	20	8.00	10.00	-	10.00	18.00	55.56
Borollus III	20	4.00	0.70	-	0.70	4.70	14.89
Borollus IV	36	6.50	10.00	-	10.00	16.50	60.61
Borollus- Dam	31	3.00	40.00	-	40.00	43.00	93.02
Damietta I	43	12.00	-	85.00	85.00	97.00	87.63
Damietta II	36	3.00	20.00	-	20.00	23.00	86.96
Port Said I	32	43.00	50.00	-	50.00	93.00	53.76
Port Said II	198	20.00	3.00	-	3.00	23.00	13.04
Total		456.90	275.90	201.00	476.90	933.80	
		(48.92)	(29.54)	(21.52)	(51.07)		

Since the introduction of otter trawl into Egypt (more than 60 years ago) the trawls used were being of the Italian type. This net is composed of upper and lower layers. This trawl is low opening type with very long and heavy sweeps. The height of the Italian trawl net opening ranges from 90-120 cm with an average of 1.0 m while trawling.

Alsayes [2] Indicated the following design characters for trawl net used in Egypt (Fig. 1)

- The relationship between head rope length and engine horse power can be represented by the following equation.
  HR = 0.06302 HP + 16.505, where:
  HR = Length of head rope in m.
  HP = Horse power of boat engine.
- The various parts of the upper layer of the Italian trawl are manufactured from polyethylene twines and the lower parts are manufactured from polypropylene material.
- The cod end is a rectangular piece of webbing joined to the upper and lower bellies. It is manufactured from the most heavier twines with very narrow mesh size of a stretched measure of 2.50 cm.
- The otter boards are flat rectangular shape manufactured from wood with iron frames. The relationship between the area of the board used (A) and engine horse power (P) is expressed by the following equation.

  A = 0.00677 (P) + 0.546

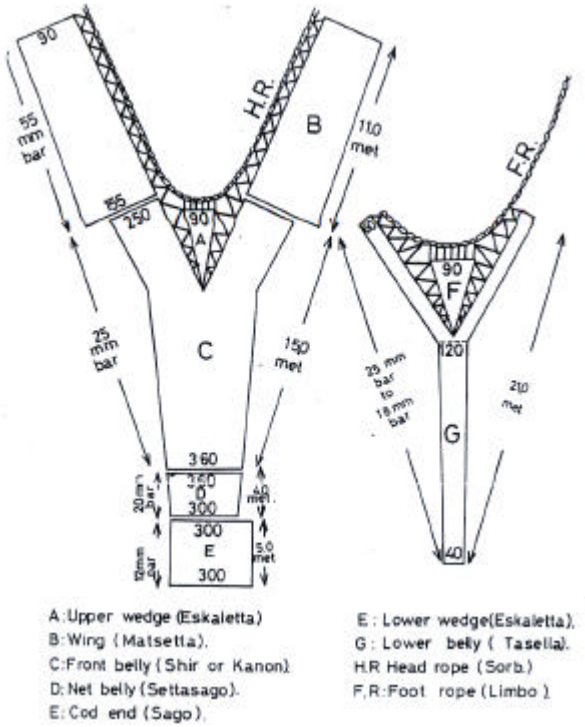

Fig. 1: The various parts of the Italian trawl net used by local fisherman in Egypt

RESULTS

Experimental trawling using the Italian design of trawl net was carried out along the Mediterranean Coast of Egypt. Data concerning the catch taken at different areas of the coast during spring and summer seasons are shown in tables 1 and 2, respectively.

The catch per unit effort ranged between a minimum of 4.70 to 97.0 kg during spring, while, it ranged between 8.887 and 118.087 kg during summer. In general the target catch was taken with higher rates from the eastern areas of the coast during spring. In summer the area of Rosetta produced comparatively higher catch rates of the target species.

Table 2: Weight (kg) of target and non target catch taken by Italian trawl net in summer

			Non target catch		
Locality	Depth (m)	Target Catch (kg)	Landed	Discard	Total (kg)
Abu Qir I	122	18.730	40.000	-	58.730
Abu Qir II	107	24.040	20.000	-	44.040
Abu Qir III	81	18.750	25.000	40.000	83.750
Rosetta I	54	8.280	7.000	30.000	45.280
Rosetta II	65	17.463	3.000	-	20.463
Rosetta III	225	83.087	35.000	-	118.087
Borollus I	26	77.800	-	-	77.800
Borollus II	30	5.887	-	-	5.887
Borollus III	27	13.730	5.000	-	18.730
Borollus IV	28	13.192	60.000	-	73.192
Borollus V	153	117.403	10.000	-	127.403
Borollus VI	104	28.350	35.000	-	63.350
Abu Qir IV	81	19.418	20.000	-	39.418
Rosetta VII	108	114.845	-	-	114.845
Total		560.975	260.000	70.000	890.975
		(62.96)	(29.18)	(7.86)	

Table 3: List of species comprising the by-catch taken by trawl net, from Mediterranean coast of Egypt

Ariasoma balearicum	……
Apogon imberbi	……
Apogon teaneatus	……
Serranus hepatus	……
Gobius paganelllus	……
Bothus podas	……
Ophichthus barbatom	……
Trachinus radiatus	……
Trachurus mediterraneus	……
Uranoscopus scaber	……
Callionymus filamentosus	……
Solea solea aegyptica	……
Pogellus erythrinus	……
Spicara flexuosa	……
Lithognathus mormyrus	……
Stephanolepis hispidus	……
Xyrichthys novacula	……
Boops boops	……
Spicara sumaris	……
Pagellus acane	……
Sparisoma certense	……
Mullus barbatus	……
Gobius niger	……
Mullus surmuletus	……
Sepia	……
Octopus	……
Oratosquilla massavensis	……
T. curvirostrus	……
Crabs	……

Table 4: Species and size composition of the by catch taken through experimental fishing

	By-catch of trawl net (Summer)						
Species	No.	% No.	Weight (gm)	% wt	Av. Length	Av. Weight	Length Range
A. balearicum	20	0.36	194	2.05	18.5	9.7	15.0-23.0
A. imberbi	3	0.05	13	0.14	7.7	4.3	7.0-9.0
A. teaneatus	1	0.02	6	0.06	7.0	6.0	7.0
S. hepatus	4	0.07	30	0.32	7.8	7.5	7.0-9.0
G. paganellus	22	0.39	100	1.06	8.3	4.5	6.0-10.0
B. podas	52	0.93	66	0.70	5.2	1.3	4.0-10.0
O. barbatom	4	0.12	42	0.33	13.2	10.5	13.0-14.0
T. radiatus	1	0.02	5	0.05	10.0	5	10.0
T. mediterraneus	24	0.43	48	0.51	6.6	2.0	5.0-9.0
U. scaber	2	0.04	6	0.06	5.5	3.0	5.0-6.0
C. Felamentosus	33	0.59	197	2.08	10.7	6.0	8.0-15.0
S. aegyptaica	11	0.20	42	0.44	7.4	3.8	6.0-9.0
P. erythrinus	4925	87.81	5358	56.61	4.7	1.1	4.0-9.0
S. flexuosa	24	0.43	90	0.95	8.1	3.8	6.0-9.0
L. mormyrus	17	0.30	246	2.60	10.9	14.5	10.0-12.0
S. hispidus	10	0.31	212	1.67	10.2	21.2	9.0-12.0
X. novacula	5	0.09	44	0.46	9.2	8.8	8.0-12.0
B. boops	39	0.70	329	3.48	8.9	8.4	6.0-11.0
S. smaris	4	0.07	6	0.06	7.0	1.5	6.0-8.0
P. acarne	70	1.25	489	5.17	8.9	7.0	6.0-11.0
S. cretense	2	0.06	14	0.11	8.0	7.0	8.0
M. Barbatus	1	0.02	4	0.04	8.0	4.0	8.0
C. niger	4	0.07	48	0.51	10.3	12.0	9.0-11.0
M. surmuletus	4	0.07	26	0.27	9.0	6.5	6.0-10.0
Sepia sp.	2	0.06	34	0.27	13.0	17.0	13
Octopus	30	0.53	1258	13.29	20.9	41.9	16.0-42.0
O. massavensis	12	0.39	64	0.50	9.2	5.3	6.0-10.0
T. curvivostsus	310	5.53	828	8.75	7.3	2.7	5.0-10.0
Crabs	3	0.05	32	0.34	3.0	10.7	3.0
Total	5609		9465				

Table 5: Economic aspects of trawling fishing trips

Aspect	spring trip	summer trip
Horse power of boat engine	230 HP	375 HP
Gross tonnage of boat (ton)	72.32	73.47
Net tonnage (tons)	45.68	44.55
Holding capacity (tons)	15	14.85
Crew (persons)	6	7
Duration of trip (days)	7	4
Days of fishing	6	3
Number of fishing operations	27	14
N º of operations/ day	3.9	3.5
Total fishing time (hours)	96.75	48.43
Duration of fishing operation (hours)	3.6	3.45
Uncompleted fishing operation	5	-
Gross income of trip (L.E)	6500	10976
Fixed expenses (L.E)	850	470
Variable expenses (L.E)	7725	6374
Gross expenses (L.E)	8375	6844

The species composition of the by-catch taken from the area of study is listed in tables 3 and 4. A total number of 24 fish species-most of them having commercial value-were participated in the by-catch. Another 5 species of the marine invertebrates were found in that by-catch.

Table 4 shows the percentages of number and weights for each species participated in the catch. *Pagellus erythrinus* which is considered as one of the most commercial species was caught with high number with average size of 4.7 cm.

DISCUSSION

The trawl net is the most destructive type of the mobile fishing gears, as it is dragged on the sea bottom gathering a wide array of organisms as by-catch [3]. Shrimp trawling contributes the highest level of discard catch ratios of any fisheries, ranging from 3:1 to 15:1 and the amount of by-catch varies in relation to target species [4]. In the Egyptian Mediterranean water, the most common fishing gear is the Italian trawl net whereas, about 1200 trawlers operate at this area. Historically, catch reporting in the Egyptian trawls fisheries focused on the landed rather than the total catch. Therefore, little information exists on the true composition of discarding.

The data given in the present study indicated that 51.07% by weight of the catch taken by trawl net during spring was categorized as non target catch. Nearly half of this catch was discarded. In summer,the non target catch comprised about 37.04% of the catch taken by trawl net through 14 fishing operations along the area of study. About 20% of such non target catch was discarded. Taking in consideration those (discard: Catch) ratios as well as others in different areas of the world, Moreover, it can be indicated that discarding contributes major problems in most of the bottom trawl fishing grounds. In this concern, Kumar and Deepthi [1] indicated that globally, shrimp trawling contributes the highest level of discard/ catch ratios of any fisheries, whereas, it ranges from 3:1 to 15:1 and the amount of by-catch varies in relation to target species, seasons and areas.Andrew and Pepperell [5] estimated total global discards of 16.7 million tons by-catch from shrimp fisheries alone. On the other hand, Alverson *et al*.[3] documented the quantity of fihsery by- catch and discards in various oceans and sea from trawling contributes about 27 million tons of discards.

Generally speaking trawl fishing has both direct and indirect impacts on the marine ecosystem as well as on biodiversity as this method of fishing collects and kills huge amounts of non-target species and young ones of commercially valuable species as well as mechanically disturbs the sea bottom. However, according to Watling and Norse [6], the environmental damage caused by bottom trawling can be substantial and irreversible.Thomas *et al*. [7] in their study on the effect of bottom trawling on the physico-chemical parameters of the inshore waters recorded an increase in temperature and nitrates and a decrease in dissolved oxygen, organic matter and organic carbon due to the churning action of the trawl net on the sea bottom. To show the impact of trawling on fish populations and biodiversity of fish species along the Mediterranean coast of Egypt the by-catch taken by Italian trawl net at this area was examined for species composition 24 fish species were participated in the by-catch, 13 of which having commercial values. On the other hand,5 species of the invertebrates appeared in that catch whereas, they were

mostly crustaceans. *Pagellus erythrinus* dominated the by-catch comprising 87.81% by number and 56.61% by weight of that catch. *Lithognathus mormyrus, Boops boops pagellus acarne, Arisoma balearicum* and *C. flamentosus* were found in the by-catch with higher percentages in comparison with the other fish species. The five species of the invertebrates (*Cephalopodes* and *Crustaceans*) comprised 23.15% by weight of the by-catch. However.the appearance of 13 commercial fish species among a whole number of 24 species comprising the by-catch means that the fish populations of commercially important species are supposed to be drastically affected as a result of trawling their living grounds.

The data given on the length range, average lengths as well as average weights of the 29 fish and invertebrates species which were considered as by-catch indicated that the length range of *Pagellus erythrinus* which comprised 87.81% by number of the by-catch lied between 4.0 to 9.0 cm with an average length of 4.7 cm. The average weight of fish at this length is only 1.1 g.The average lengths of whole fish comprising the by-catch were mostly below 10.0 cm attaining average weight below 10.0 g. The average lengths of the 13 commercial species in the by-catch were 10.0 cm or below with average weight in the range of 1.3 to 21.2 g.These figures emphasize the destructive action of trawling with narrow meshed cod ends attached to the trawl net used on a wide, commercial scale along the Mediterranean coast of Egypt.

The high economic value of shrimps is considered to be the principle reason for the expansion of trawl fishing through out the Mediterranean coast of Egypt. Therefore, the Italian design of trawl net is operated on a wide scale at the Egyptian coasts due its high efficiency in catching shrimps. Furthermore, other modifications were adopted to develop the efficiency of such trawl net in catching shrimps regardless the combined increase of its ability in collecting fish larvae and benthic fauna with drastic destructive rates. It was believed that the by-catch can be utilized in preparing fish meals. On the other hand it can be assumed that the use of the by-catch in producing fish meals or other secondary products can be considered as a loss for human food security. Even though it can be argued that better utilization of the by-catch is a solution for the problem, its impact on the fish stock and traditional fisheries remains to be investigated. The relation of the efficiency of the trawl net with its contact with the sea bottom is the major bottleneck in reducing mortality of benthic organisms due to bottom trawling. Occurrence of high quantities of by-catch requires immediate improvements in trawl design, so that the amount of by-catch retained in the trawl net could be brought down considerably.A variety of techniques have been developed in many parts of the world to improve the species selectivity and size selectivity of trawl nets and to reduce the by-catch particularly aimed at bringing down the mortality of juveniles and young ones of commercially important species. In this concern, Pillai [8] developed indigenous square-type window attachment radial type escapement device with guiding funnel and escape opening to reduce the by-catch in trawl net.Increase of cod end mesh size will increase the selection factor Therefore retention of juvenile fishes and smaller species could be considerably reduced. The present cod end mesh size of trawlers operating at the Mediterranean coast of Egypt is as low as 25 mm stretched measure against the 40 mm stipulated by law [2].The quick release of non target species back to the sea may also help in reducing their level of mortality. Declaration of certain coastal areas as closed for trawling would also help in reducing the amount of by-catch as well as conservation of marine organisms in the coastal areas of Egypt.

The economic aspects of the two fishing trips were discussed in this study. The following points can be observed from the given data.

- The gross expenses of trawling are higher in some cases than the gross income of the trip as it is the case of spring trip. On the other hand the expenses of the trip were less than its income of summer trip.
- Analysis of data concerning long series of income and expenses of both trawlers used in the present investigation indicated that the budgets invested in the construction of a trawler having an engine of about 230 HP reached 200.000 L.E. it was found on the other hand that such project had a social surplus close to construction.
- The social objectives of investment in trawl fishing industry can be as follows:
  - Conserving the fishing industry and fishers in the country due to the social and national importance of that industry.
  - Exploiting the demersal fishing resources of the country and providing an important source of protein for human consumption.
  - Allowance of positive social surplus which contributes in the social prosperity in Egypt.

In conclusion, About 51% by weight of the catch collected by bottom trawl net during spring could be categorized as not target catch. About the half of that by-catch was discarded. In summer the non target catch comprised 37.04 of the collected fish. About 20% of the by-catch was discarded. Juveniles of *Pagellus erythrinus* dominated the by-catch where it comprised 87.81% by number and 56.61% by weight of that catch.

The average lengths of 13 commercial fish species that appeared in the by-catch were 10.0 cm or even below with average weight ranging between 1.3 to 21.2 g.Declaration of certain coastal areas as closed for trawling would help in reducing the amount of by-catch as well as conservation of marine organisms at the coastal areas of Egypt.The budget invested in the construction of a trawler provided with an engine of about 230 HP reached 200.000 L.E. That project have a social surplus close to the above mentioned budget.

REFERENCES

1. Kumar, A.B. and G.R. Deepthi, 2006. trawling and by-catch: Implications on marine ecosystem. Current Sci., 90: 922-931
2. Alsayes, A.A., 2006. Commercial fishing gears and methods used at Mediterranean coast of Egypt. Technical report submitted to NIOF., pp: 21.
3. Alverson, D.L., M.H. Freebag, S.A. Muraweski and I.G. Pope, 1994. A global assessment of fisheries by-catch and discards. FAO Fish Tech. pp: 339-233.
4. Sarah, A.W., R.W. Leslie and H.S. Warwick, 2007. By-catch and discarding in the South African demersal trawl fishery. Fisheries Res., 86: 15-30.
5. Andrew, N.L. and J.G. Pepperell, 1992. The by-catch of shrimp trawl fisheries. Oceanogr. Mar. Biol. Annu. Rev., 30: 527-562.
6. Watling, L. and E.A. Norse, 1998. Disturbance of the seabed by mobile fishing gear; Conserv. Biol., 12: 1180-97.
7. Thomas J.V., P. Premtal, C. Sreedevi and B.M. Kutup, 2004. Immediate effect of bottom trawling on the physico-chemical parameters in the inshore waters of Kerala. Indian J. Fish., 51: 277-286.
8. Pillai, N.S., 1998. By-catch reduction devices in shrimp trawling. Fish. Chimes, 18: 45- 47.