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BOTTOM TRAWL DISCARDS IN THE GULF OF SUEZ, EGYPT

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ABSTRACT

A bottom trawl survey was conducted on the northern part of the Gulf of Suez. The survey was carried out on a commercial trawler for a period of 11 days in March 2003. Data collected on board from about 77 hauls were used to estimate discarded quantities. About 56.1 % of the total catch was discarded at sea. Rate of discards per hour was found to be 28.2 % higher than the rate of landed catch per hour. The main components of the discards were fish and crustaceans. The discarded quantities were studied in relation to depths, duration of the hauls, marketable yield of each haul and the area (eastern and western sides of the Gulf of Suez). The discarded yield of fish showed more precise relationship with their marketable yield in each haul than did crustaceans and echinoderms. Discard percentage is decreasing with the increase in depth. The size of discarded fish and invertebrates proved to be a good measurement to study discarding, to compare differences between the two areas and to investigate the discarding procedure in relation to depth.

INTRODUCTION

Discards refers to part of the gross catch not used in any way but is thrown back into the sea (Saila, 1983). Several abundant species are discarded, dead or dying, either because of their small size or because of poor commercial value. The high rate of discarding in fisheries may cause ecological effects on benthos, vertebrate species and finally the whole ecosystem (Pascoe, 1997). The reasons for discarding are many and varied comprising legal, economic, environmental and biological factors (Stratoudakis *et al*., 1999; Allen *et al*., 2001). The highest rates of incidental catch of non-target species as identified by Alverson *et al* (1994) and other workers are associated with shrimp trawling. In a global assessment of fisheries bycatch and discards, the estimation of annual discards in commercial fisheries was about 27 million tons with a range of 18-40 million tons representing 20% of the total marine harvest (Pascoe, 1997).

Discarding at sea is a key issue in fisheries and a major source of uncertainty in fisheries management. Fishery biologists and management agencies have recognized the importance of reliable quantitative information on the discrepancies between landings and actual catches of a species (Alverson *et al*., 1994; Stratoudakis *et al*., 1999). Among the different fishing gears the trawl is responsible for the bulk of discards (Stergiou *et al*., 1998; Hall, 1999).

Conclusions derived from stock assessment studies are clearly affected by the availability and reliability of information on the quantities of fish discarded at sea (Tsimenides *et al.,* 1995; Stergiou *et al.,* 1998; Stratoudakis *et al.,* 1999a). So far, stock management has relied heavily on landings. However, estimates of fishing mortality based on landings rather than catches (which include discards) are likely to be biased downwards, since discarded organisms do not generally survive, and represent a potentially significant, economic

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loss (Chen and Gordon, 1997; Philippart, 1998; Stratoudakis *et al.,* 1999b; Machias, 2001and 2003).

Rizkalla (1995) studied the trash catch of the Egyptian Mediterranean trawlers; also Faltas *et al*. (1998) analyzed the size and species composition of the bottom trawl trash catch in Abu-Qir bay. In the Red Sea and the Gulf of Suez, information about the discarded fraction of trawl catches is not available.

The present study is the first attempt to investigate the discards of trawl catches in the northern part of the Gulf of Suez. The quantities of discarded fish, crustaceans and cephalopods were estimated, and the discard ratio compared with the landed catch. Moreover, the factors that affecting discarding rate were studied by determining relationships between discards, depths, duration of the hauls, and landings were examined. Furthermore, quantitative relationships between discards and landed catches were calculated to determine the possibility of obtaining short-term estimation of discards from landings.

MATERIAL AND METHODS

A bottom trawl survey was conducted on the northern part of the Gulf of Suez Fig (1). The survey was carried out on a commercial trawler for a period of 11 days in March 2003. The vessel used in the survey was 27 m in length, and powered by an engine of 425 hp. Length of the fishing gear was about 25 m. with cod-end mesh size of 1.8 cm. Hauls ranged in duration from 90 to 180 minutes.

Data collected on board from about 77 hauls. After hauling the gear the catch was discharged onto the stern fish deck. Fish of commercial value were sorted by the fishermen, the numbers of boxes of each species group category were counted and their weight calculated. The species composition of discards was listed as fish, crustaceans and cephalopods, where the identification was made to the species level. Other by-catch organisms, such as algae, marine plants, some bivalves and other taxa were classified as "other invertebrates". Length frequency distributions for the major discarded fish and invertebrate species were carried out. In cases, where certain species numbered many specimens, a representative sample was examined.

For each haul the following data were recorded: (1) the haul number, latitude, longitude, minimum and maximum depths of shots and duration of the haul; (2) the landed and discarded fraction of each species; (3) the percentage of the landed and discarded proportion of fishes, crustaceans, cephalopods and "other invertebrates".

Discards rate was estimated as (weight discarded/total weight). Relationships between discards, depths, duration of the hauls, and landings were established by multiple regression analysis.

RESULTS AND DISCUSSION

Description of Discards

The Red Sea is known by its variety of fishes and invertebrates; the total catch usually consists of many species, in particular the trawl fishery. Besides, a single group of fishes may be represented by more than one species. The trawl fishery in the Gulf of Suez is directed for shrimp but many finfish species and invertebrates are caught as by-catch which is defined as incidental catch and discarded or released catch. Incidental catch is that which is not targeted but is still retained and marketed (Clucas, 1997). The mixed-species trawl fishery in the Gulf of Suez generates the most by-catch and also produces a large amount of discards. The ratio of shrimp catch to by-catch in the Gulf of Suez is 1:15, which is higher than that recorded (1:10) by Slavin (1982) for tropical shrimp fisheries.

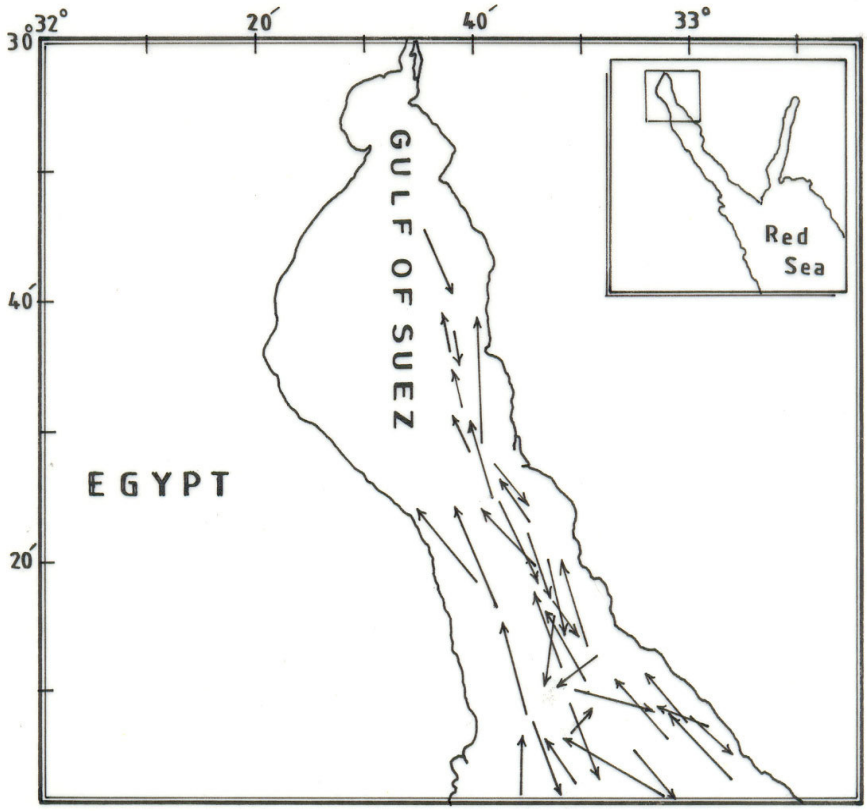

Fig. (1): Map of the northern part of the Gulf of Suez showing the surveyed area.

Designing regulations for effective management of both shrimp resources and fisheries for species caught as by-catch requires first quantitative information of by-catch and discards and knowledge of species composition. The species composition of fish and invertebrates discarded by the trawl fishery in the Gulf of Suez were classified into two categories the first is the commercial species that consisted of landed and discarded proportions; the other is the discarded species which always had only a discarded fraction. Twenty fish species had both landed and discarded fractions, while 36 species had only a discarded fraction. Two crustacean species and 3 cephalopod species had landed and discarded fractions while another 10 crustaceans and 30 other invertebrate species had only a discarded fraction (Table 1).

Table (2) show that The most abundant fish species in discards constituted about 85% of the fish discarded and composed of the slip mouth (*Leiognathus berbis*) followed by the gapers (*Champsodon capensis*) then the pony fish *Leiognathus elongates* and the flat fish *Pseudorhombus arsius*. The commercial species with unmarketable sizes constituted about 15% of discarded fishes. In regard with discarded invertebrates, the most abundant species is the swimming crab (*Charybdis helleri*), and the echinoderms sand dollar (*Lagunum depressum* and *Clypeaster reticulates*), then sponge and algae they all represent about 65% of the discarded invertebrates (Table 2).

Fishing takes place in both sides of the Gulf of Suez, the most obvious difference between the eastern and western sides of the Gulf is that fishes, particularly *Leiognathus berbis* and *Leiognathus elongates,* dominated the discards of the eastern side while, crustaceans (particularly the swimming crab *Charybdis helleri*) dominated the discards of the western side The percentage of the discarded species were significantly different between the two sides of the Gulf ($P< 0.005$).

Discard Quantities

The estimated discard rate was found to be 56.1% of the landed weight. It was also found that the average discarded catch per hour was 31.52 $\pm$ 20.781 kg/hr while the average landed catch per hour was 22.619 $\pm$ 13.067 kg/hr. These results indicate that the discards rate is 28.239% higher than the landed catch rate. This large amount of discards can reflect the destructive impact of trawl fishing in the Gulf of Suez.

Regression Analysis

Regression analysis revealed that discarded yield per hour was positively correlated with the landed yield per hour and the duration of each haul, and negatively correlated with the depth of the shots. The statistically significant relationship between discarded and landed yield (Fig 2) indicate that high catch rates are associated with high discard rates, which could be related to homogeneity of the environment, owing to the intensive unselective trawling (Jennings and Kaiser, 1998). The positive relationship between discards and duration of the hauls (Fig 3) show that hauls of long duration usually resulted in higher catches and discards per hour. The strong relationship between discards rate and depths (Fig 4) show that shallow hauls had higher discarded fractions of fish and invertebrates with smaller sizes than deep hauls.

Length Frequency Distributions of Discards

The length frequency distributions of the most abundant fish in the discarded catch are given in Fig. (5) and Table (3). It is obvious that the pony fish *Leiognathus berbis* and *L. elongates* attain the smallest length range (4-11 cm), while the length range of *Champsodon capensis* and *Pseudorhombus arsius* is relatively wider (3-14 cm). The largest discarded fish was *Stephanolips diaspros* whish attained a length range of 9-17 cm. The bulk of the discarded invertebrates that have no commercial value

consisted of the swimming crab *Charybdis helleri* (2-5 cm), followed by the sand dollar *Lagunum depressum* which had a diameter of the range 2 to 15 cm. Squids represent the most important discarded invertebrates (4-7 cm) which is a valuable commercial species, the main reason for discarding this species is the unmarketable sizes that have low or negligible value.

Concerning the length frequency distributions of the commercial discarded fish species, Fig (6) and Table (3) showed that the bulk of the discarded size ranged from 4 to 14 cm. The lizard fish *Saurida undosquamis* attained length range of 4 to 13 cm, with mean length of 9.44±1.66, this species is the most economic species constituting more than 40% of the landed trawl catch; the mean discarded length is smaller than the length corresponding to the length at recruitment (El-Ganainy, 1992). The thread fin *Nemipterus japonicus* had length range of 5-12 cm and the mean length was 7.42±1.22, this length is smaller than the minimum recorded length in the landed catch (El-Ganainy and Mehana, 2003). The horse mackerels *Trachurus indicus* and *Decapterus maruadsi,* attained length range of 6-11 cm, the lower market price resulted in higher discard sizes of these species. The goat fish *Upeneaus sp* had relatively larger but narrow length range of 9-12 cm. The stripped piggy *Pomadasys stridens* had the largest length range of the commercial discarded fishes (9-14 cm).

It is obvious that there is a large proportion of commercial but unmarketable species discarded by trawl fishery. As a result, the discard of commercial catches greatly affects the estimation of fishing mortality which relies upon landings (Chen and Gordon, 1997; Philippart, 1998; Machias, 2001).

Length in Relation to Depth

The mean length of the most common fish species in the discarded catch showed a good relationship with depth of hauls (Fig 7). Deep hauls yielded larger specimens than shallow hauls.

CONCLUSION

The trawl fishery in the Gulf of Suez is directed for shrimp, but many finfish species are caught as by-catch which is defined as incidental catch and discarded or released catch**.** The mixed-species trawl fishing in the Gulf of Suez generates the most by-catch and also produces a large amount of discards (about 56.1% of the total catch). The results of this study revealed that discarding practices on board have a destructive impact on the demersal stocks.

Potential solutions of the discard problem in the Gulf of Suez might include temporal and spatial closures and continuous monitoring of the fishery in addition to prohibition of fishing in shallow waters. Another regulation of great effect is increasing the cod-end mesh size of the trawl gear.

Table (1) Species composition of discards of the trawl fishery in the Gulf of Suez.

Scientific name	English name	Length range (cm)
Fishes		
Abundant discarded species		
Family Leiognathidae		
Leiognathus berbis	Slip mouth	4.0 - 10.0
Leiognathus elongatus	Slip mouth	4.0 - 11.0
Family Champsodontidae		
Champsodon capensis	Gapers	3.0 - 14.0
Family Bothidae		
Pseudorhombus arsius	Flat fishes	3.0 - 14.0
Commercial discarded Species		
Family Synodontidae		
Saurida undosquamis	Lizard fish	4.0 - 13.0
Trachinocephalus myops	Lizard fish	9.0 - 15.0
Synodus variegatus	Lizard fish	7.0 - 12.0
Family Nemipteridae		
Nemipterus japonicus	Thread fin bream	5.0 - 12.0
Family Carangidae		
Trachurus indicus	Horse makerel	6.0 - 11.0
Decapterus maruadsi	Scads	6.0 - 11.1
Decapterus macrosoma	Scads	6.0 - 11.0
Alepes djedaba	Jacks	7.0 - 12.0
Family Haemulidae		
Pomadasys stridens	Striped piggy	10.0 - 13.0
Family Mullidae		
Upeneus japonicus	Goatfish	9.0 - 12.0
Upeneus asymmetricus	Asymmetical goatfish	9.0 - 12.1
Upeneus tragula	Freckled goatfish	9.0 - 12.2
Upeneus oligospylus	Freckled goatfish	9.0 - 12.3
Upeneus sulphorus	Sulphur goatfish	7.0 - 10.0
Family Monacanthidae		
Stephanolepis diaspros	Brunner	9.0 - 12.0
Family Sparidae		
Diplodus noct	Red Sea bream	
Rhabdosargus haffara	Haffara sea bream	
Family Gerreidae		
Gerres oyena	Common silver-biddy	
Belonidae		
Tylosurus crocodilus	Hound needlefish	
Mugilidae		
Liza carinata	Keeled mullet	
Common discarded species		
Family Scorpaenidae		
Apistus carinatus	Scorpionfish	
Scorpaenopsis barbatus	Scorpionfish	
Scorpaenopsis diabolus	Scorpionfish	
Synaceia verrucosa	Stonefish	

Continued

Scientific name	English name	Length range (cm)
Pterois radiata	Radial firefish	
Family Plotosidae		
Plotosus lineatus	Striped eel-catfish	
Family Triglidae		
Lepidotrigla multispinosa	Trigla	
Family Platycephalidae		
Platycephalus bassensis	Sand flat head	
Family Terapontidae		
Terapon jarbua	Jarbua terapon	
Family Monacanthidae		
Aluterus sp.	Brunner	
Family Cynoglossidae		
Cynoglossus sp	Flat fishes	
Family Bothidae		
Engyprospon grandisquamis	Flat fishes	
Pseudorhombus sp.	Flat fishes	
Bothus pantherinus	Flat fishes	
Family Ostraciidae		
Tetrasomus gibbosus	Trunkfish	
Family Apogonidae		
Apogon fasciatus	Cardinalfish	
Family Nemipteridae		
Scolopsis ghanam	Thread fin bream	
Family Blenniidae		
Petroscirtes breviceps	Blenny	
Family Tetradondidae		
Lagocephalus inermis	Pufferfish	
Lagocephalus sceleratus	Pufferfish	
Family Congridae		
Conger cinereus	Mustache conger	
Family Fistulariidae		
Fistularia commersonii	Cornetfish	
Fistularia petimba	Cornetfish	
Family Syngnathidae		
Corythoichthys schultzi	Pipefish	
Family Holocentridae		
Adioryx ruber	Squirrelfish	
Family Kyphosidae		
Kyphosus cinerascens	Blue sea chub	
Kyphosus bigibbus	Grey sea chub	
Family Dasyatididae		
Taeniura lymma	Reef Stingray	
Dasyatis sp.	Rays	
Family Sphyraenidae		
Sphyraena jello	Barracudas	
Family Gobiidae		
Istigobius ornatus	Ornate Goby	
Family Engraulidae		
Stolephorus punetifer		

Continued

Scientific name	English name	Length range (cm)
Algae		
Phaeophyta		
Dictyota dichotoma	Brown algae	
Coelothrix irregularis	Brown algae	
Sargassum latifolium	Brown algae	
Rhodophyta		
Galaxaura sp.	Red algae	
Grateloupia filicina	Red algae	
Chlorophyta		
Caulerpa prolifera	Green algae	
Sponges		
Callyspongia monilata	Finger sponge	
Cliona vastifica	Red sponge	
Ircinia felix		
Ircinia strobilina		
Soft corals		
Family: Alcyoniidae		
Sarcophyton sp		
Sinularia sp		
Crustaceans		
Family: Penaeidae		
Metapeneopsis stridulans	Fiddler shrimp	
Trachipenaeus curvirostrus	Fiddler shrimp	
Family: Portunidae		
Charybdis helleri	Swimming crab	2.0 - 5.0
Family: Dromiidae		
Dromia dehaani	Sponge crab	
Family: Leucosiidae		
Myra fugax	Pebble crab	
Philyra sp	Pebble crab	
Family: Dorippidae		
Dorippe frascone		
Family: Alpheidae		
Alpheus sp	Snapping shrimp	
Family:Squillidae		
Oratosquilla hesperia	Mantis shrimp	
Family: Paguridae		
Pagurus sp	hremit crab	
Clibanarius sp	hremit crab	
Cephalopods		
Family: Loliginidae		
Loligo duvaucelli	Squids	4.0 - 6.0
Sepioteuthis lessoniana	Squids	4.0 - 6.1
Family: Octopodidae		
Octopus vulgaris	Octopus	
Gastropods		
Family: Muricidae		
Murex tribulus		

Continued

Scientific name	English name	Length range (cm)
Family: Fasciolariidae		
Fusinus tuberculatus		
Family: Cypraeidae		
Cypraea sp		
Bivalves		
Family: Arcidae		
Anadara antiquata		
Family: Pectinidae		
Chlamys senatorius		
Pecten erythraeensis	Gmelin- scallops	
Echinoderms		
Family: Goniasteridae		
Stellastropsis fouadi	Sea star	
Family: Ophidiasteridae		
Gomophia egyptiaca	Sea star	
Family: Luidiidae		
Luidia maculata	Sea star	
Family: Astropectinidae		
Astropecten monacanthus	Sea star	
Family: Oreasteridae		
Pentaceraster tuberculatus	starfish	
Family: Laganidae		
Lagunum depressum	Sand dollars	2.0 - 15.0
Family: Clypeasteridae		
Clypeaster reticulatus	Sand dollars	
Family: Cidaridae		
Prionocidaris baculosa	Echinoid sea urchin	
Family: Holothuriidae		
Bohadschia sp	Sea cucumbers	
Holothuria sp.	Sea cucumbers	
Ascidians		
Family: Styelidae		
Styela partita		
Polycapa sp.		

Table (2) Percentage and catch per unit effort of the most abundant fish and invertebrate species in discards of the trawl fishery in the northern part of the Gulf of Suez.

Species	English name	Local name	Percentage	kg/hr
Fishes			**85%**	
Leiognathus berbis	Slip mouth	Erian	35%	8-25
Champsodon capensis	Gapers	Hret Kheshen	25%	6-18
Leiognathus elongatus	Slip mouth	Abou El-erian	15%	10-15
Pseudorhombus arsius	Flat fishes	Moussa	10%	5-8
Invertebrates			**65%**	
Charybdis helleri	Swimming crab	Kaboria	20%	9-20
Lagunum depressum	Sand dollars		10%	10-22
Clypeaster reticulatus	Sand dollars		10%	5-12
Callyspongia monilata	Finger sponge	Esphing	7%	15-25
Cliona vastifica	Red sponge	Esphing	5%	15-25
Algae	Algae	Tahaleb	8%	7-16

Table (3) The length range and mean length (cm) of the most discarded fish and invertebrate species of the trawl fishery in the northern part of the Gulf of Suez.

Species	Length range	Mean Length	Number measured
Discarded fishes			
Leiognathus berbis	4-10	6.47 ± 1.03	1323
Champsodon capensis	3-14	8.81 ± 1.67	595
Leiognathus elongatus	4-11	8.02 ± 1.1	284
Pseudorhombus arsius	3-14	7.81 ± 2.34	187
Stephanolepis diaspros	9-17	12.6 ± 2.36	73
Commercial discarded fishes			
Saurida undosquamis	4-13	9.44 ± 1.66	136
Nemipterus japonicus	5-12	7.42 ± 1.22	207
Upeneus sp	9-12		132
Pomadysis stridens	9-14		143
Decaptrus maruadsi	6-11	8.83 ± 1.71	140
Tracurus indicus	6-11	8.57 ± 1.82	129
Discarded invertebrates			
Charybdis helleri	2-5	3.06 ± 0.73	679
Lagunum depressum	2-15	3.19 ± 2.09	830
Commercial discarded invertebrates			
Loligo duvaucelli	4-7	5.04 ± 0.77	489

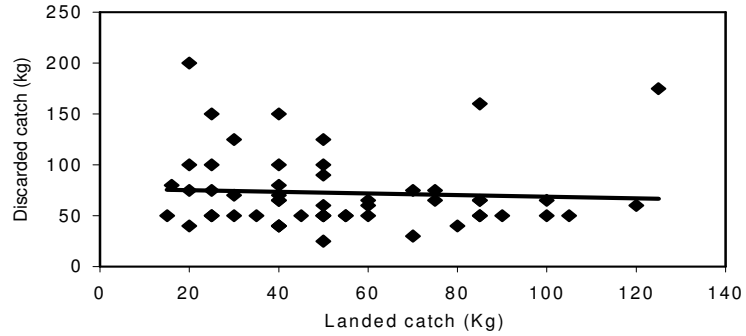

Fig (2) Relationship between landed and discarded catches for each haul

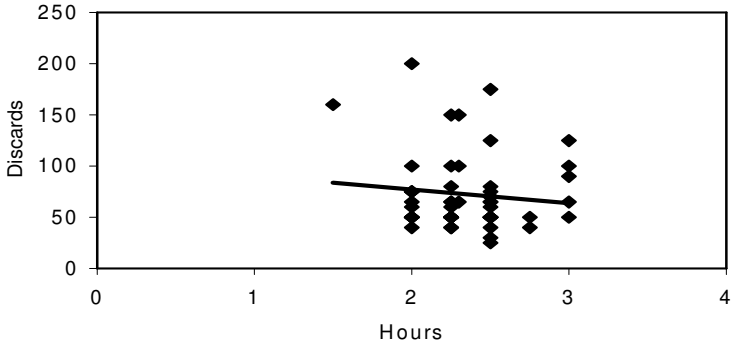

Fig (3) Relationship between discardes catch and duration of each haul

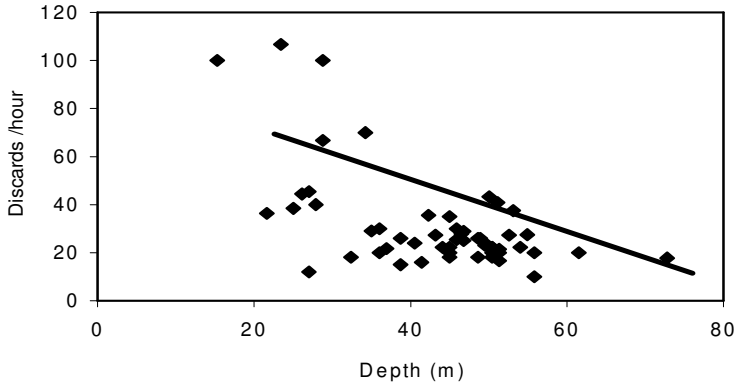

Fig (4) Relationship between depth of hauls and rate of discards

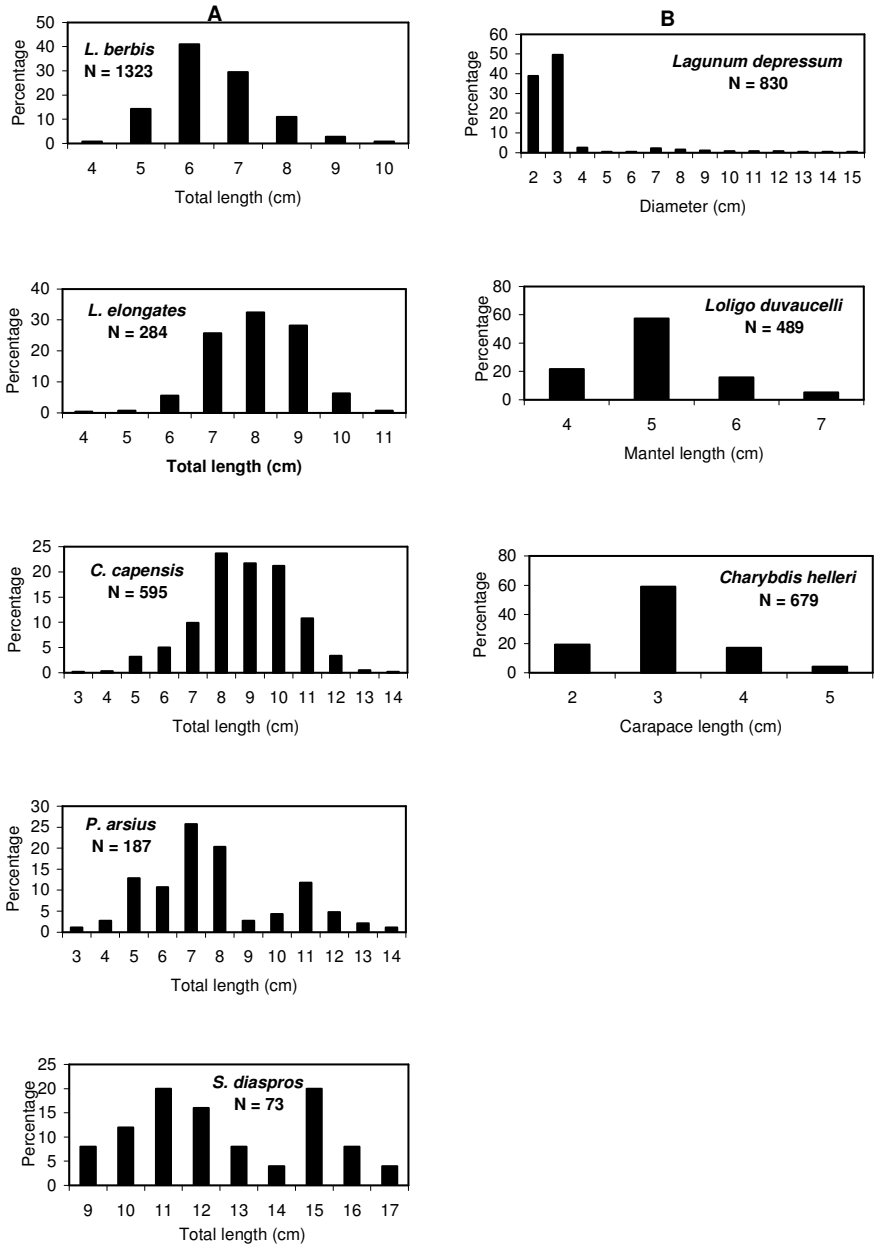

Fig (5) Length frequency distributions of the most abundant fish (A) and invertebrate (B) species in the discarded catch of the trawl fishery in the northern part of the Gulf of Suez.

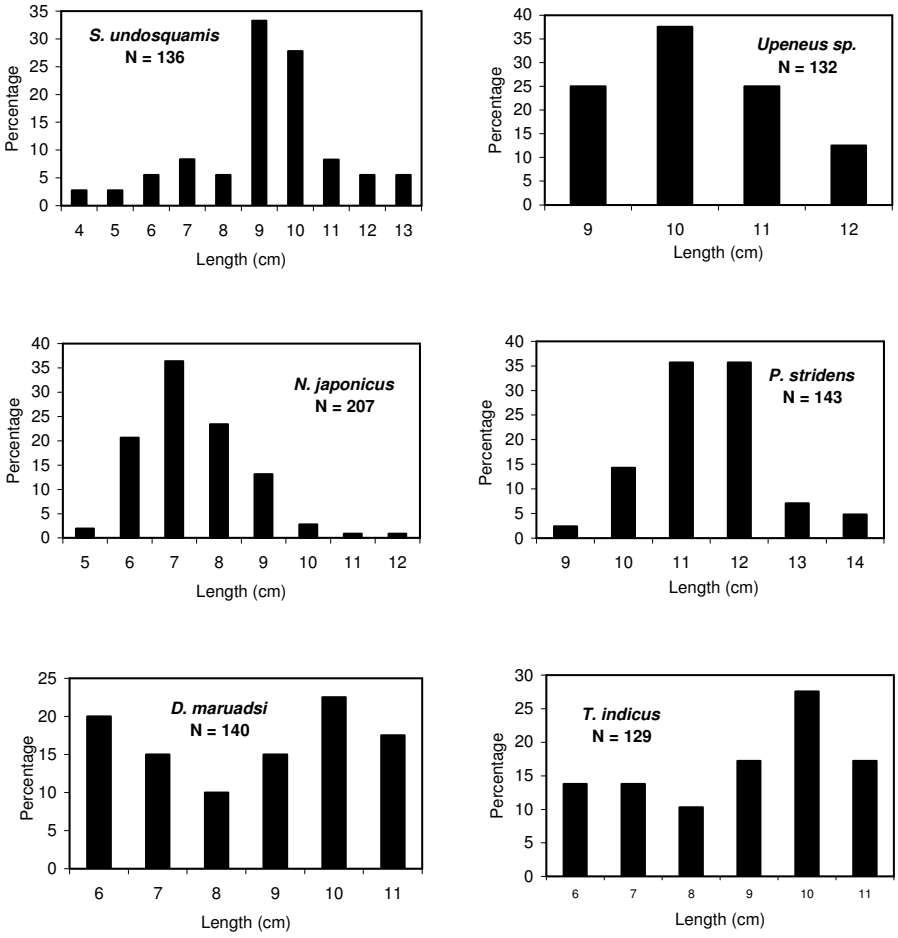

Fig (6) Length frequency distributions of the most commercial species discarded by the trawl fishery in the northern part of the Gulf of Suez.

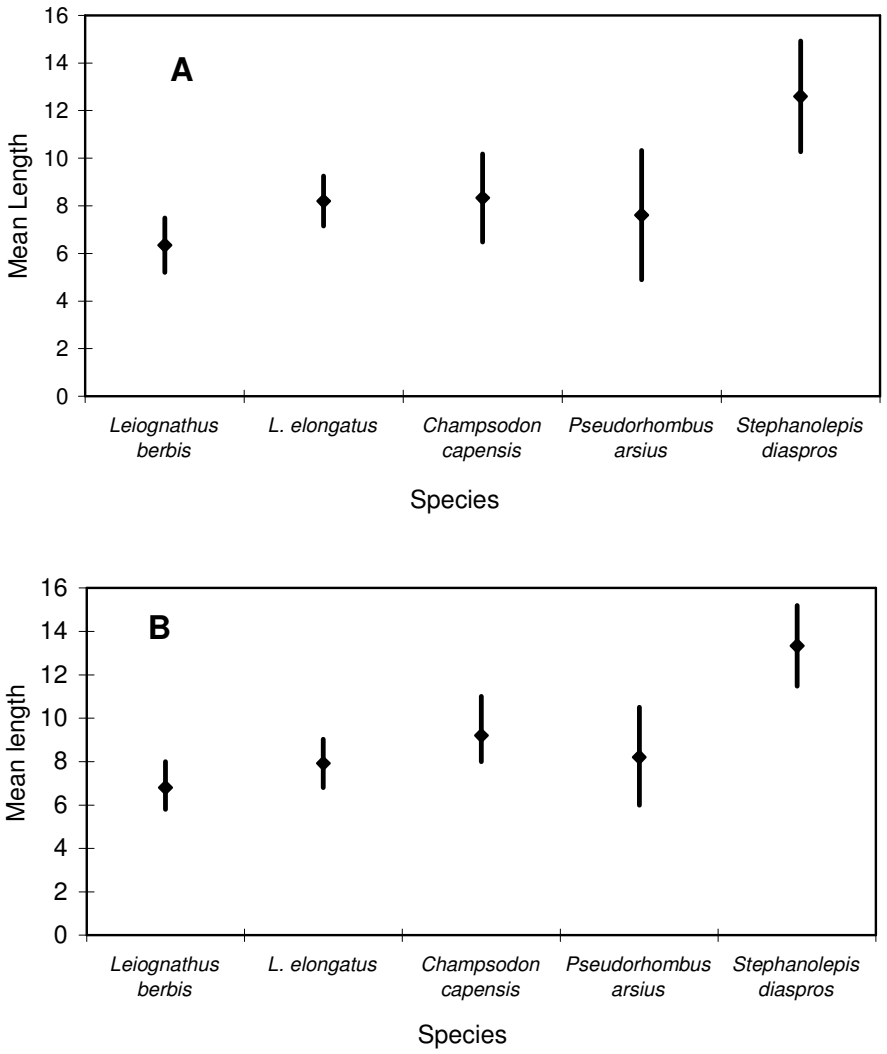

Fig (7) Mean length with confidence intervals of the discarded species in two depth strata (A) from 30 to 50 m and (B) from 50 to 70 m in the north part of the Gulf of Suez.

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