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Discards of small scale fisheries (SSF) in the Suez Gulf, Red Sea, Egypt

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ABSTRACT

The present study aims to describe the species composition of discards and catch rates of trammel and gill net commercial catch on the coast of Egypt. The fishing operation was investigated between October 2018 and February 2019 at depths less than 10 m. The weight and number of specimens of all species caught were registered, as well as the amount of discarded catch and retained by fishermen. A total of 15 fish species and 1 crustacean species were identified in the trammel net catch, with discards of about 13.08% of the total catch weight. However, 5 species were discarded in the catch of gill nets, represented by 6.1% in weight of the total catch. The results of the experiment showed that no significant differences were observed between the total catch of trammel and total catch of gill nets (ANOVA, p=0.114), while there were highly significant differences were observed between the total discards of trammel and total discards of gill nets (ANOVA, p=0.0000). A decrease in soak time together with the appropriate choice of mesh sizes could contribute to a reduction in discarding and to improved sustainability and use of scarce resources in the small-scale, inshore multi-species fisheries of Suez Gulf.

INTRODUCTION

Discarding is one of the most top challenges in fisheries management, because it is a waste of resources, a source of uncertainty for fisheries scientists and decision-makers, and a factor impacting biodiversity and community **(Alverson *et al.*, 1994).** The capture of immature individuals and non-marketable species, on the other hand, may raise the catch composition's discard ratio. Because trammel netting is widely considered as a nonlethal capture technique, trammel nets are frequently used when assessing populations of rare fishes **(Hubert, 1996)**. Three layers of multifilament netting constitute a trammel net, with a small-mesh inner netting layer between two layers with largest mesh.

Gill-nets are often used in small-scale fisheries because they require little in the way of equipment and are successful at catching fish populations that are widely dispersed **(Reis & Pawson, 1992)**.

With an increasing emphasis on multi-species and ecosystem conservation and management, it's more necessary than ever to evaluate discarding practices and quantify waste composition and mortality in order to better understand the implications at the population, trophic, and ecosystem levels **(Bozzano & Sardaà, 2002** and **Vu *et al.*, 2015)**.

Suez Gulf is the most important commercially exploited fish resources in the Red Sea. It's the most suitable spawning ground which connected between Red sea and Mediterranean Sea. The Red Sea fisheries are highly divers in term of species and fishing gear used. The small codend mesh size is commonly used in the trawl fishery of the Red sea might be used high amount of discards than other **(El-Ganainy *et al.*, 2005** and **Saber & Gewida, 2020)**.

In the Red Sea and the Suez Gulf, small-scale vessels play an essential socio-economic role and have a great history **(Saber & Gewida, 2020** and **Saber *et al.*, 2020 & 2022)**. There are approximately 318 boats, which represent 85% of the total Suez Gulf fleet **(GAFRD, 2019)**.

The ratio of discards in small-scale fisheries in the Red Sea, in a particular, is very varied and based on a variety of factors such as transport, market impact, and fishing techniques **(Veiga *et al.*, 2016)**. Moreover, the ecological impact of discarding is usually detected by survival probability, which is very varied and species-specific. Unfortunately, estimating survivability is difficult, but even rough predictions might be used to suggest landing exceptions. The current reported discard rates of trawl net fishing in the Suez Gulf range from 25% to 55% **(El-Ganainy *et al.*, 2005** and **Saber 2014)** depending on the species targeted. Discarding can vary significantly over time, depending not only on the content of the catch, but also on market conditions and regulatory requirements.

There is a growing interest in small-scale fishing, which is usually done using set gears, and the partial replacement of trawl nets with set gears, which are more selective, might be advantageous to fishermen's lives **(Fabi *et al.*, 2002)**.

Although several research on bycatch and discard strategies conducted across the world **(Alverson *et al.*, 1994; Rochet *et al.*, 2002; Sánchez *et al.*, 2004; Catchpole *et al.*, 2005; Hall & Mainprize, 2005; Gonçalves *et al.*, 2007** and **Tzanatos *et al.*, 2007)**, only a few studies were conducted in small scale trammel nets fisheries in the Red Sea **(Gabr & Mal, 2016; Saber *et al.*, 2020** and **Saber & Gewida, 2020)**.

In the Red Sea and the Suez Gulf, there is a lack information about the discarded of small scale fisheries (trammel net and gill net), fraction of discards and discard ratio. The purpose of this work was to assessment the discards ratio and species composition of discards in the Suez Gulf.

MATERIALS AND METHODS

Study area:

The Suez Bay area was surveyed in this study, The Bay is a shallow extension of the Suez Gulf, with a generally eltic form and a primary axis running from north to south. It is located between longitude 32° 28 and 32° 34 E, latitudes 29° 54 and 29° 75 N **(Fig. 1)**, where the trammel and gill net fishing operations were investigated. It has an average length of 13.2 kilometers along the major axis, an average width of 8.8 kilometers along the minor axis, a mean depth of 10 meters, and a horizontal surface area of 77.13 kilometers squared **(Hamed, 1992)**.

Collecting of samples:

In October 2018 and February 2019, two fishing trips were conducted along the Suez Gulf. Two commercial boats, each equipped with two sets of trammel nets, were used to do the sampling; fishing were carried out at depths ranging from 1 to10 meters in three different stations of the Suez Bay, Suez Gulf, where the fishermen mainly carried out their fishing activities. A set of trammel net inner panel was made of monofilament webbing with 34 mm mesh sizes (stretched mesh size), a depth of 50 mesh size for the inner panel. The outer panels of all nets were monofilament materials with mesh sizes 70 mm were used in the study. The inner panels of the trammel nets, the length were 35 m, depth was 50 meshes, and the twine for monofilament net was Ø 0.2 mm and 210d /3 for outer layer and 210d/4 for inner layer no, respectively, with a hanging ratio of 0.50 **(Fig. 2)**.

Gill net design characteristics of the typical gill nets operated in the Suez Bay and used in the fishing survey of the present study are presented in the **Fig. (3).** Unwanted catch were kept on ice and transported to the laboratory for examination, measuring and weighing.

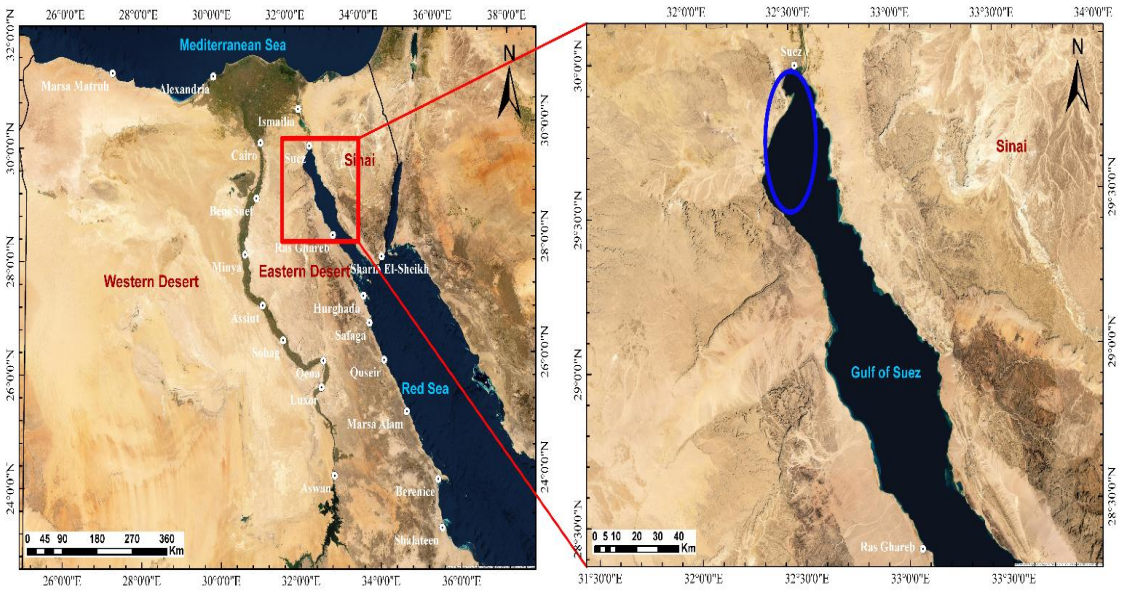

Fig. (1). A map of the Suez Bay, Gulf of Suez

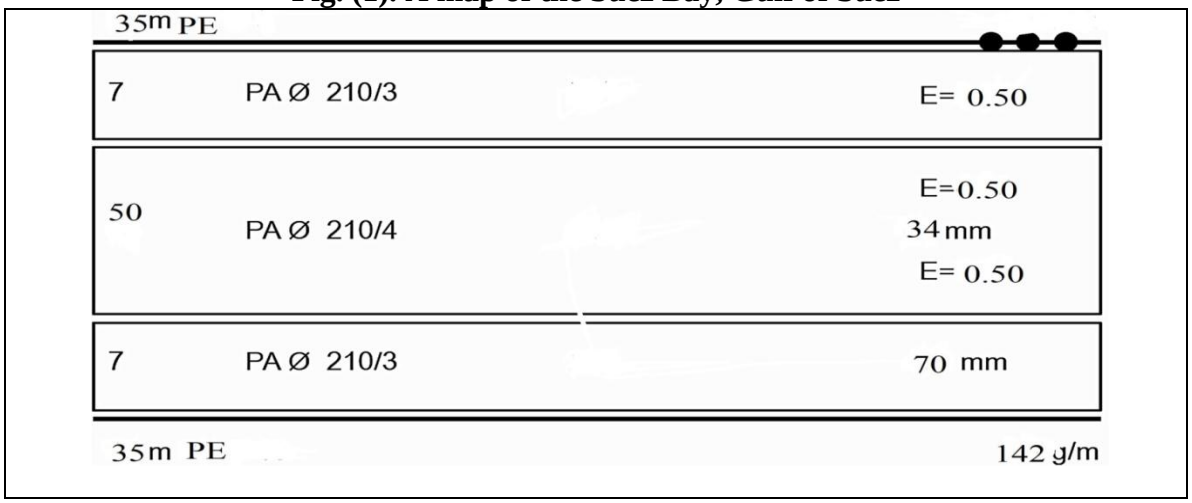

Fig. (2). Specification of the trammel net used in Suez Bay during the present study (PA, polyamide; PE, polyethylene; ø: diameter; E: hanging ratio.)

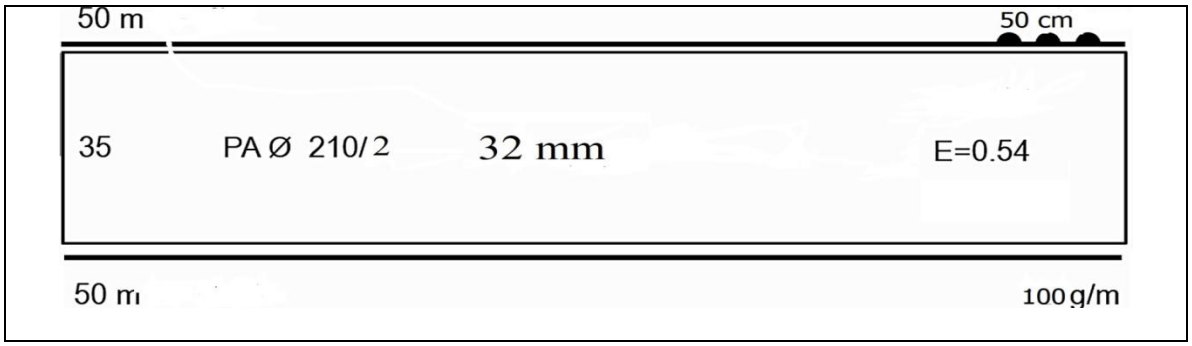

Fig. (3).specification of gill net fishing gear used in Suez Bay, Suez Gulf (PA, polyamide; PP, polyethylene; ø: diameter; E: hanging ratio)

Statistical analysis:

One-way ANOVA on log-transformed data and a post-hoc pairwise Tukey test were used to evaluate differences in the total weight of discards across fishing gear (trammel and gill nets). Differences in total catch weight between fishing gear trammel and gill nets were also investigated using a one-way ANOVA on log-transformed data and a post-hoc pairwise Tukey test. xlstat 2016 was used to do one-way ANOVA and post-hoc Tukey testing on log-transformed data in order to examine the influence of fishing gear on total weight of discard ratios and total weight of catch.

RESULTS

Overall, the composite gill-nets and trammel net were set 19 times across three sites. The total catches of trammel and gillnet were 119 and 59 kg and discards 18 and 4 kg, respectively. A total of 15 fish species and only 1 crustacean species were sampled in the trammel net catch. The catch of trammel net was found to be approximately 13.08 % of discards. The most abundant species in trammel net discards was *Stephanolepis diaspores* with a percent more than 84% from total discards, followed by *Pomadasys striden* with percent more than 5% from total discards. The other commercial species were represented in small percent **(Table 1).**

There was a statistically significant difference between the total weight of trammel net discards and the total weight of gill net discards. On the other hand, there wasn't any significant between the total weight of catch of trammel net and total weight of catch of gill net **(Table 2)**.

The total catch of gillnet in the Suez Gulf was containing about 6.1% discards. Fife fish species were identified in the catches of gill net fishery in the Suez Gulf. The most dominant species in the discards of gill net was *Liza carinata* with a percent about 36% followed by *Stephanolepis diaspores* with a percent about 32%. *Gerres oyena* represented by about 16% of total discards in the gill net catch **(Table 3)**.

Table (1): Total weight of catch (g) and total weight of discards (g) of nineteen fishing haul taken by trammel and gill nets that carried out in the Suez Bay, Gulf of Suez.

Trammel nets					Gill nets			
Hauls	Total landing (g)	Total weight of Commercial catch (g)	Total weight of discards		Total landing (g)	Total weight of commercial catch (g)	Total weight of discards	
			(g)	%			(g)	%
1	5862.0	5512.0	350.0	5.9	2374.0	2174.0	200.0	8.4
2	32588.0	31568.0	1020.0	3.1	1246.0	1096.0	150.0	12.0
3	8774.2	7724.2	1050.0	11.9	2050.0	2025.0	25.0	1.2
4	2942.0	2262.0	680.0	23.1	1354.3	1198.3	156.0	11.5
5	1977.3	947.3	1030.0	52.1	1999.5	1885.5	114.0	5.7
6	1502.3	852.3	650.0	43.2	714.0	694.0	20.0	2.8
7	6921.0	5491.0	1430.0	20.6	4065.0	3465.0	600.0	14.7
8	8429.0	8179.0	250.0	2.9	3859.0	3747.0	112.0	2.9
9	940.0	500.0	440.0	46.8	868.0	868.0	0.0	0.0
10	9509.8	7429.8	2080.0	21.8	1040.0	1040.0	0.0	0.0
11	4626.0	2200.0	2426.0	52.4	21825.0	21325.0	500.0	2.2
12	5240.0	4200.0	1040.0	19.8	371.6	371.6	0.0	0.0
13	10740.0	9320.0	1420.0	13.2	2670.0	2350.0	320.0	11.9
14	4870.0	4650.0	220.0	4.5	1090.0	1090.0	0.0	0.0
15	680.0	680.0	0.0	0.0	2410.0	2320.0	90.0	3.7
16	7050.0	6800.0	250.0	3.5	3920.0	3500.0	420.0	10.7
17	17500.0	15000.0	2500.0	14.2	1092.0	980.0	112.0	10.2
18	3450.0	3050.0	400.0	11.5	5700.0	4900.0	800.0	14.0
19	3388.0	2698.0	690.0	20.3	4200.0	3980.0	220.0	5.2

Table (2): Summary statistic between total catch and total discards that collected by Trammel net (A) and Gill net (B) in Suez Bay, Suez Gulf

	Total catch	Total discards
A	6266.505 a	943.474 b
B	3105.758 a	202.053 a
Pr > F	0.114	0.000
Significant	No	Yes

Table (3): List of the most common species in the discards in the two fishing gear trammel and gill nets in the Suez bay, Suez Gulf

Species	Common name	Target species	Sampling No.	Length Range (cm)	weight Range	
					(g)	%
Trammel net discards						
Stephanolepis diaspores	Reticulated leatherjacket	Yes- Medium	902	7-16.8	5.3-66.8	84.063
Pomadasys striden	Striped piggy	Yes- Medium	63	6.1-11.8	5.1-15.6	5.871
Sargocentron diadema	Crown squirrelfish	Yes- Medium	8	8.0-14.5	11.8-55.9	0.746
Gerres oyena	Smallscale mojarra	Yes- Low	9	9.6-14.7	14.8-36.6	0.839
Siganus rivulatus	Marbled spinefoot	Yes- Medium	9	10.4-11.2	13.6-17.1	0.839
Stolephorus puntife	Commerson's anchovy	Yes- Medium	6	5.4-7	1.1-1.8	0.559
Portunus pelagicus	Blue swimming crab	Yes- Medium	10	7.1-8.5	62.4-85.3	0.932
Parupeneus sp.		Yes- Medium	6	8.6-15	6.4-40	0.559
Epibulus insidiator	Sling-jaw wrasse	Yes- Medium	1	13.7	30.6	0.093
Thalassoma rueppellii	Klunzinger's wrasse	Yes- Medium	1	12.5	23.4	0.093
Chaetodon fasciatus	Diagonal butterflyfish	Yes- Low	3	10.6-12.7	34-54	0.280
Larabicus quadrilineatus		Yes- Medium	2	8.8-10.2	9-14.1	0.186
Pomacanthus maculosus	Yellowbar angelfish	Yes- Medium	4	8.9-26.8	23-360.3	0.373
Lagocephalus sceleratus		No	30	14.6-33.9	79.8-490.1	2.796
Lagocephalus suezensis		No	12	18.6-22.1	100.2-166.5	1.118

Hipposcarus harid	Candelamoa parrotfish	Yes- Medium	7	11.2-15.6	22-45.6	0.652
Gill net discards						
Stephanolepis diaspores	Reticulated leatherjacket	Yes- Medium	8	8.5-14.8	8.3-39.8	32.000
Gerres oyena	Smallscale mojarra	Yes- Low	4	6.2-12.3	10.2-22.1	16.000
Liza carinata		Yes- Medium	9	7.2-11.1	5.2-18.4	36.000
butterfly		Yes- Low	1	11.6-14.6	25.6-79.6	4.000
Siganus rivulatus	Marbled spinefoot	Yes- Medium	3	9.2-11.8	10.2-21.1	12.000

Target species= 1- yes=high commercial, 2- yes= Medium commercial, 3- yes low commercial,l 4- No= non commercial

DISCUSSION

Overfishing, destructive fishing methods, illegal mesh sizes of nets used, and an i ncrease in the rate of discards are all challenges facing small scale fisheries in the Suez Gulf, Red Sea **(El-Ganainy *et al.*, 2005; Mehanna & El-Gammal, 2007** and **Saber *et al.*, 2020)**. All of these variables have resulted in decreased productivity and yields in our marine fisheries; hence it is critical to consider small-scale fishing gear specifications and their relationship to the quantity of discards.

Artisanal fisheries play a significant role in the Suez Gulf, Red sea fisheries. Seventy-three percent (429 of 587) vessels belong to the artisanal fishery in Suez Gulf **(GAFRD, 2018)**. Gill nets, trammel nets, longlines, dredges, beach seine are used in the Suez Gulf.

The catch composition of demersal gill nets and trammel nets in the Suez Gulf was investigated in terms of commercial and discard species rates. There are few studies of small-scale fisheries in the Suez Gulf that compare these two gear types in terms of gear competition and catch species composition **(Saber *et al.*, 2020)**.

Fifteen species and one crustacean species were gathering by the trammel net catch and retained to the sea as discards and the most dominant species by number and percent was *Stephanolepis diaspores* by 82%. **EL-Ganainy & Sabra (2008)** mentioned that the *Stephanolepis diaspores* representing by 7% of total trawl catch in the Suez Gulf.

Discarding sometimes lead to decline or depletion in marine stocks, it is may have a number of ecological impact in marine ecosystem, such as trophic web and habitats loss **(Belido *et al.*, 2011)**. For trammel net discards in the different countries that lays on the Mediterranean Sea for example, 65 species are eliminated in the Basque 16 ÜSUDERG/IUJFAS (2012) 27-2: 1-22 country (Spain), 105 species in the Algarve

(Portugal), 46 species in the Gulf of Cadiz (Spain), and 32 species in the Cyclades islands, according to reports, Greece **(Gonçalves *et al.*, 2007)**.

For gill net, five species were recorded in the discards of gill net in the Suez Gulf. Small size of *Liza carinata* was represented in the catch of gill net by 36 % followed by *Stephanolepis diaspores* 32%. The differentiations between the percentage *of Stephanolepis diaspores* that caught by trammel and gill net may be attributed to the mechanism of the fishing gear **(Losanes *et al.*, 1992** and **Acosta & Appeldoorn, 1995)**.

In the present study, there were no significant differences between total catch of trammel net and total catch of gill net. On the other hand, there was highly significant difference between total discards of trammel net and total discards of the gill net. This variation in discards may be attributed to the different mechanism of trammel net and gill net or because of the gill net is more selective then the trammel net **(Gabr & Mal, 2016** and **Saber *et al.*, 2020)**.

There are no definitive studies testing the impact of trammel net and gill net on marine resources (discards problems) in the Red sea. In a previous comparison of gill net and trammel net fishing in the Black Sea, trammel nets were shown to be more efficient than gill nets **(Özdemir *et al.*, 2005)**. While in the red sea **(Gabr & Mal, 2016** and **Saber *et al.*, 2020)**, who found that the gill net is more selective than the trammel net. Trammel nets catch twice as many prawns as monofilament gill nets, according to **Thomas *et al.* (2003)**. Trammel nets, on the other hand, have a better catch efficiency than gill nets.

Tzanatos *et al.* (2007) discovered a 10% discard percentage for small-scale fisheries in the Patraikos Gulf. **Stergiou *et al.* (1996)** found a 4% trash ratio for gill and trammel nets in the Evvoikos Gulf. **Gökçe (2004)** investigated the rate of non-target species in prawn trammel nets used in Zmir Bay and found that it may be lowered by using selvedge between the lead line and the net. Several researches have been conducted on the Zmir Bay focusing on discard problem; **Akyol (2003)**, who assess the discard rate in beach seines employed in the Aegean Sea is 21% of the total catch (Turkey).

CONCLUSION

In the Red Sea and the Suez Gulf, there a lack information about the discarded of small scale fisheries (trammel net and gill net) fraction of discards, discards ratio. This work aims to assess the discards ratio and species composition of discards in the Suez Gulf. This study revealed that there were no significant differences between total catch of trammel net and total catch of gill net. However, there was highly significant difference between total discards of trammel net and total discards of the gill net. The trammel net discards about 13.08% of the total catch weight. Gill net discards were 6.1% in weight of the total catch. This study revealed that there were problem in selectivity of trammel and gill net in the Suez Gulf which require some modification for commercial fisheries management.

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