An analysis of experimental fishing traps in the coastal area of the United Arab Emirates

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Abstract- The fisheries of the United Arab Emirates are considered as a traditional fisheries and provide a source of income, employment and recreation. With the advancement of marine industries, fisheries are a major source of food security. The main fishing gear in the United Arab Emirates is a dome-shaped wire trap. Despite the economic important of the traps on the Arabian Gulf, scatter studies dealt with this fishing gear. The present study investigates the effect of trap size, season, trap soak time on the catch rate. Catch composition and trap loss rates were studied from March 2015 to February 2016. From 601 trap hauls weighed 2213.0kg for an average of 3.68kgs/trap/pull, catches were comprised of 47 species in which 18 were primary commercial species, 16 were secondary commercial fish species and 13 are by-catch fish species. Average catch for primary, secondary commercial species were 6.80 and 3.34kg/trap/haul respectively. On the other hand, the average of by-catch was 0.92kg/trap/haul for all trap sizes. Catch rate from the different trap sizes showed that, the trap with the diameter of 2.8m had the highest overall catch rate as well as the primary commercial species and contribute 37.04% of the catch rates for different trap sizes. Traps of 2.08m and 3.3m of diameter had the second and third highest overall catch rates and contribute 36.41% and 15.88% respectively. ANOVA results showed a significant difference ($P<0.01$) between catch rates of different size traps for primary, secondary and by-catch. In the present study, there was not relationship found between trap soak time and catch rate. It's mean meaning the catch rate not increase with increasing soak time. The present study recommended to use medium and large trap sizes and avoid using of small trap.

Index Terms- Trap, catch composition, species composition, Arabian Gulf, soak time.

I. Introduction

The fisheries of the United Arab Emirates are small-scale in nature, with the vast majority taking place in the Emirate of Abu Dhabi, which is reported to comprise over 60% of the country's marine area [1]. Fishers employ two distinct fishing vessel types: fiberglass *tarrads* (speed boat) and traditional wooden *dhows* (lanch). *Tarrads* are typically 6-8m in length and equipped with 1-2 outboard engines, allowing a crew of 1-4 people to fish for 6-8 hours at a time [2]. *Dhows*, on the other hand, range from 12- 22 m and are equipped with inboard diesel engines and insulated cool boxes, allowing the crew of 4-6 people to fish for 3-5 days at a time. The UAE's fisheries are multi-gear and multispecies, with over 100 species occurring in the catch [3]. The main fishing gear is a dome-shaped wire trap called *gargoor*, hand lines, intertidal weirs (*hadrah*), trolling, gillnets, and encircling nets are also used [4]. Trap, *gargoor* is a traditional demersal fishing gear, which was in the past made of palm leaves woven into a semi-circular shape, where fish bait is placed inside to attract fish and changed over-time to galvanized steel wire. The diameter of the trap base varies between 1 and 3m, they are supported by tubular steel bars and have a funnel entrance. Most fish species caught by traps belong to the families Serranidae, Lethrinidae, Lutjanidae, Haemulidae, Carangidae and Mugilidae. Though fisheries are of minor importance to the UAE's economy, they are valued for the recreational opportunities they provide, for their contributions to food security, and as a part of the country's cultural heritage. The present study aims to evaluate and analyze of the experimental trap fishery in the sea area of the UAE, catch analysis (catch composition, identification and quantity), catch per unit effort (CPUE) and the impact of soak time on the fisheries.

II. Materials and Methods

A. Study Area and Period

The traps were deployed in three different locations within the UAE's fishing ground, the first location with the Latitude of 25°37.303'N, Longitude of 55°34.639'E, second location with Latitude 25°36.793'N, Longitude of 55°34.281'E and third location with Latitude of 25°36.254'N, Longitude of 55°34.246'E Fig. 1. The study started from March 2015 to February 2016.

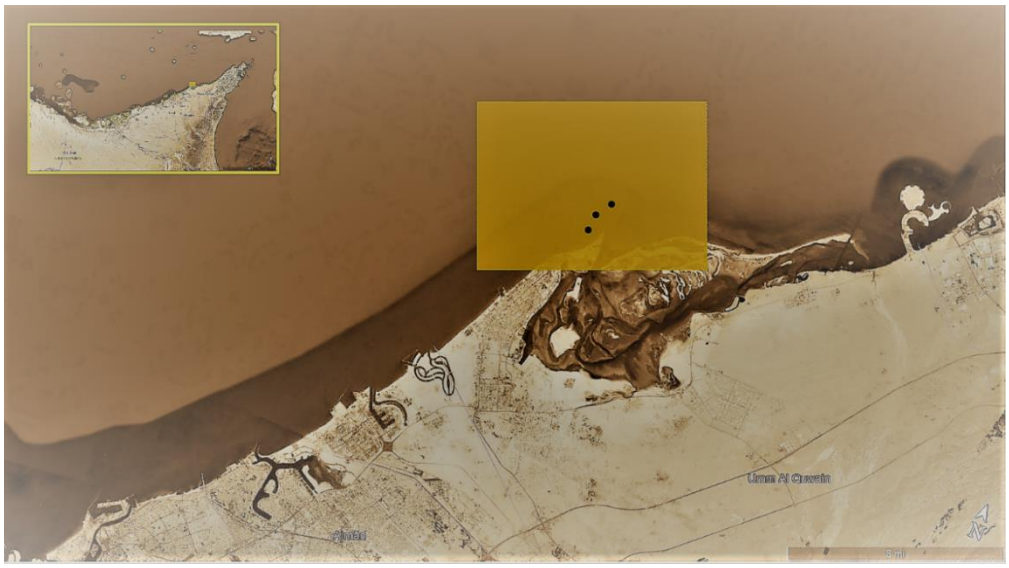

Figure 1. Map of the United Arab Emirates showing the experimental locations

B. Experimental Design and deployment

The field experiment covered at least one full year to study the seasonal variation in the catch rate and species composition of the fish trap fishery. The most common trap size in UAE's fishery is a trap with a base of 143 cm, however, the fishermen also used other sizes of traps. These trap sizes were tested to consider if different trap sizes would result different catch rates and species composition. The experimental trap used are four different sizes, Extra Large (with base length of 190cm, height of 103cm, diameter of 330cm, panel length and width of 75cm), Large (with base length of 176cm, height of 81cm, diameter of 280cm, panel length and width of 60cm), Medium (with base length of 143cm, height of 64cm, diameter of 208cm, panel length and width of 45cm), and Small (with base length of 93cm, height of 45cm, diameter of 150cm, panel length and width of 75cm). Numbered plastic plates was attached to each trap. The traps position was recorded using Global Position System (GPS) but were not marked by buoys to avoid poaching from other fishermen. Sets of four different sizes were deployed on each location.

C. Sampling Procedure

Traps were monitored twice weekly and sometimes more than two times due to weather condition and in some cases of traps lost. The trap soak time was between 2 to 4 days and during the experiment the number of soaking time reach to 15 days to check the relationships between catch rate and soak time and between trap loss and soak time. The catch from each trap was sorted, identified and subsamples were taken to measure total, forked lengths and total, gutted weights. The species identification followed the methods of Carpenter *et al.* 1997 and Forese &Pauly, 2008 [5&6].

D. Data Analysis

Catch data were analyzed and grouped by month, catch size, the pulled traps, and catches were grouped into primary commercial fish, secondary commercial fish, and by-catch. The primary commercial fish that species are popular and has high market value. Secondary commercial species are marketable but has lower value. By-catch are fishes not common and has the lowest value and sometimes returned to the sea. The catch rates for different species categories and of different sizes were obtained similarly and tested with analyses of variance ANOVA for significant difference.

III. RESULTS AND DISCUSSION

A. Traps Catch Analysis

Table I shows the species composition from 601 trap hauls weighed 2213.0kg for an average of 3.68kgs/trap/pull, catches were comprised of 47 species in which 18 were primary commercial species, 16 were secondary commercials fish species and 13 are by-catch fish species. From the total catch, 1361.38kg (61.52%) were primary commercial species, comprised of (greatest to least order). 667.672kg (30.17%) were composed of secondary fish species and 183.96kg (8.31%) from the total catch were monitored as a by-catch. The primary commercial species was dominated by *E. coioides* and represent 10.09%, followed by *L. nebulosus* and *S. canaliculatus* by 7.60% and 6.82% respectively. The dominant catch for secondary commercial belongs to *Sepia sp. and* Scarus *persicus* and represent

4.63% and 3.82% respectively. While *Platax orbicularis* contribute 2.0% and was dominant in by-catch. The catch composition of the trap in Saudi territorial waters of the Arabian Gulf was studied and the results declared that [7], all species caught by trap are belong to 10 major families and the dominant families were Lethrinidae, Carangidae and Serranidae (23.95%, 18.7% and 15.5% respectively. He stated also that, the catch composition was the same in both large and small boats and the only difference was in fish size and quantity. On the northern part of the Arabian Gulf, Chen *et al*, 2012[8] stated that from 1745 trap hauls weighed 7840kg, for an average 4.5Kg/trap/haul (ranging from 2.45 to 7.97kg) and the catches were comprised of 70 species, the primary commercial species (56.94%) dominated by *Argyrops spinifer*, *Epinephelus coioides* and *Plectorhincus pictus* and contribute 13%, 12.24 and 6.83%. Secondary commercial species (34.52%), of which seven species contributed 30.25% and the *Netuma bilineatus* and *Pomadasys stridens* constitute 8.83% and 7.0% respectively. The study also revealed that, the average catch rate of trap has been declining since 1991 Gulf War. The average catch rate from 1980 through 1989 was 5.8kg per trap ranging from 2.8kg to 11.0kg [9]. The average catch rate of trap was estimated by [10] as 3.57kg/trap/haul and mentioned that *Lethrinus spp* was ranked first by 15.5% and *E. coioides* accounted 14.8%.

Table I. Species composition of the total catch from the experimental traps.

Scientific Name	Common name	Catch(kg)	Percentage (%)
Overall 2213.00			
Primary commercial fish species		**1361.38**	**61.52%**
Epinephelus coioides	Orange-spotted Grouper	223.40	10.09%
Lethrinus nebulosus	Spangled emperor	168.12	7.60%
Siganus canaliculatus	White-spotted spine-foot	150.90	6.82%
Lethrinus lentjan	Pink ear emperor	118.90	5.37%
Gerres oyena	Common silver-biddy	88.60	4.00%
Rhabdosargus sarba	Gold-lined seabream	82.40	3.72%
Acanthopagrus bifasciatus	Two-bar seabream	73.60	3.33%
Portunus pelagicus	Blue swimming crab	70.60	3.19%
Carangoides bajad	Orange spotted trevally	68.40	3.09%
Plectorhinchus sordidus	Sordid rubberlip	63.80	2.88%
Lutjanus argentimaculatus	Red snapper	43.60	1.97%
Epinephelus areolatus	Areolate Grouper	42.30	1.91%
Argyrops spinifer	King soldier bream	36.00	1.63%
Diagrama pictum	Painted sweetlips	32.20	1.46%
Valamugil seheli	Bluespot Mullet	32.16	1.45%
Lethrinus borbonicus	Snubnose emperor	26.70	1.21%
Lutjanus malabaricus	Malabar red snapper	22.90	1.03%
Plectorhinchus schotaf	Minstrel sweetlips	16.80	0.76%
Secondary commercial fish species		**667.67**	**30.17**
Sepia sp.	Cuttlefish	102.40	4.63%
Scarus persicus	Gulf parrotfish	84.60	3.82%
Gerres acinaces	Whipfin silver-biddy	60.61	2.74%
Lutjanus quinquelineatus	Five-lined snapper	55.40	2.50%
Parupeneus cyclostomus	Gold-saddle goatfish	55.40	2.50%
Lutjanus fulviflama	Blackspot snapper/Dory snapper	54.30	2.45%
Nemipterus sp.	Threadfin bream	42.80	1.93%
Lutjanus ehrenbergii	Blackspot snapper	40.30	1.82%
Siganus javus	Streaked spinefoot	38.10	1.72%
Lethrinus microdon	Smalltooth emperor	28.40	1.28%
Cephalopholis hemistiktos	Yellowfin hind	22.20	1.00%
Plectorhinchus gaterinus	Blackspotted rubberlip	20.90	0.94%
Gerres filamentosus	Whipfin silver-biddy	17.16	0.78%
Alepes sp.	Scad	16.40	0.74%
Acanthopagrus latus	Yellowfin seabream	15.10	0.68%
Lutjanus rusellii	Russell's snapper	13.60	0.61%
By-catch		**183.96**	**8.31**
Platax orbicularis	Orbicular batfish	44.34	2.00%
Abudefduf saxatillis	Indo-pacific sergeant	35.40	1.60%
Pomacanthus maculosus	Yellowbar angelfish	51.20	2.31%
Arius thalassinus	Giant catfish	7.60	0.34%
Monodactylus argenteus	Silver moony/Silver moonfish	9.40	0.42%
Arothron stellatus	Stellate puffer	10.12	0.46%
Scolopsis sp.	Threadfin bream	9.60	0.43%
Chaetodon obscurus	Black-spotted butterflyfish	7.40	0.33%

Terapon jarbua	Jarbua terapon	3.20	0.14%
Amblygobius albimaculatus	Butterfly goby	0.90	0.04%
Alutea monoceros	Unicorn leatherjacket filefish	0.20	0.01%
Platycephalus indicus	Bartail flathead	1.20	0.05%
Aphanius dispar	Arabian pupfish	3.40	0.15%

B. Catch Per Unit Effort

The average monthly catch per unit effort as (kg/trap/haul) for different species categories was obtained and the results declared that, the average catch for primary species was 6.80kg/trap/haul, while the average catch for secondary commercial species was 3.34kg/trap/haul. On the other hand, the average of by-catch was 0.92kg/trap/haul for all trap sizes. Table II shows the catch seasonality for primary, secondary and by-catch. It is obvious that the catch per unit effort for overall species reach to maximum catch during spring (7.83, 4.26 and 1.14 kg/trap/haul respectively). In general, the mean CPUE for primary species constitute the highest rate 6.80kg/trap/haul then followed by secondary and by-catch by 3.34 and 0.92kg/trap/haul respectively. This is probably related to fish spawning, feeding behavior and change of water temperature. The period from March to May are the main spawning seasons for most of the commercial species. Fishes such as *L. nebulosus* and *E. coioides* aggregate in open water for spawning. In summer, water temperature exceeds 32ºC and fishes then move to deep water to avoid the high water temperature. In the territorial Saudi waters [7] the CPUE sharply decreased for both large and small traps during Winter season (7.7 and 2.3 kg/trap, respectively). The study indicated also that, the average catch/fishing day relatively fluctuated in the large boats during the years, while it tended to increase in small boats. In addition, it can be noticed from the trips observations that the loss percentage of traps was higher in large boats (about 12%) than in small boats (about 8%), this may be due to the different ecological factors including water moving in deeper and shallow waters of the fishing areas. Chen *et al*, [8] showed seasonal changes, the monthly catch rates were high (>6kh/trap/haul) from April through July and in December, while the low catch rate (2-5kh/trap/haul) was recorded in August through October and from February through March. Shabani *et al*, [11] recorded a similar peak of catch rate (3.9kg/trap-month) in May for the trap along the East side of the Arabian Gulf.

Table II. Catch seasonality (kg/trap/haul) for the primary, secondary and by-catch caught by different trap sizes.

Season	**Primary**	**Secondary**	**By-catch**	**Mean**
Winter	7.79	3.92	0.67	4.13
Spring	7.83	4.26	1.14	4.41
Summer	5.97	2.37	0.88	3.07
Autumn	5.62	2.83	0.98	3.14
Mean	6.80	3.34	0.92	

C. Catch Rate by Trap Size

Catch rate from the different trap sizes showed that, the trap with the diameter of 2.8m had the highest overall catch rate as well as the primary commercial species and contribute 37.04% of the catch rates for different trap sizes. Traps of 2.08m and 3.3m of diameter had the second and third highest overall catch rates and contribute 36.41% and 15.88% respectively. ANOVA results showed a significant difference ($P<0.01$) between catch rates of different size traps for primary, secondary commercial catch and by-catch. On the other hand, trap size 1.5m diameter had significant lower catch rates of overall, primary, secondary commercial species and a highly significant difference in by-catch compared with the trap size 2.8m diameter. The catch rates of different trap sizes are shown in table III. Basically the traps of 2.8m and 2.05m in diameter had a significant higher overall catch rate as well as that of primary and secondary commercial fish. In Kuwait's water, Chen *et al*, [8] declared that, the highest overall catch rate as well as the primary species were not result from the largest diameter 2.25m but from the second largest size 2.15m and the study recommended the trap size 2.15m in diameter is appropriate size for Kuwait's trap fishery. The study also declared that, large size trap has more space within a trap and will be less affected by capture fish density especially when soak time is long.

Table III. Catch rate (kg) of different trap sizes

Trap Size	**Total Trap Haul**	**Overall**	**Primary**	**Secondary**	**By-catch**	**Mean**	**%**
3.3	68	430.70	98.4	58.9	27.63	61.64	15.88
2.8	79	761.70	229.5	79.4	11.32	106.74	37.04
2.08	62	736.80	225.63	125.32	43.82	131.59	36.41
1.5	58	283.80	66.08	36.2	45.8	49.36	10.66
No.	**267**						
Overall		**2213.0**					
Mean			**154.90**	**74.96**	**77.99**		

The average size (total length in centimeters and weight in grams) of fish caught from the different trap sizes showed that, the trap size 2.80m diameter, caught fish with an average length and weight (33.0cm and 413.0g), while the larger trap caught fish with an average length and weight (31.0cm and 388.0gm) Table IV. The study conducted by Tharwat and Al-Gaber [7] in Saudi Arabia, found that larger traps captured larger individuals due to the larger individual sizes to location (deeper waters) and larger opening of the entrance funnel. This would indicate that escape rings should be a solution to sizes election. Escape rings can be incorporated into the construction of the trap to reduce catches of undersized species. Being a multi-species gear, however, presents challenges whose solutions are not straightforward. Target species are not necessarily similar in shape, and because they mature at different ages (i.e., sizes), effort to select one size might be at the expense of other target species [10]. The study recommended that only the larger and medium sized traps be legal and the small traps with small opening funnel and mesh size have a passive effect on the reproductive cycle of many fish species, that they catch large number of immature fishes. Therefore, it could be recommended to operate the large and medium trap only while the small traps should be prohibited. The same results obtained by Chen *et al.* [8] in Kuwait's water, the 2.15m diameter captured large size fish that were only slightly smaller than those captured in the 2.25m diameter.

Table IV. Size composition of combined fish caught by different trap sizes

Parameters	Trap diameter (m)			
	1.50	**2.08**	**2.80**	**3.30**
Average length (cm)	23.0	28.0	33.0	31.0
Average weight (g)	280.0	350.0	413.0	388.0
Number of fish	345	1503	1135	980

The percentage of species composition (% in weight) of the most dominant species showed that, the traps with size 2.08m and 2.8m diameter had the same dominant species: *E. coioides, L. nebulosus, L. quinquelineatus and G. oyena* Table V. The dominant species of trap diameter 1.5m is *P. pelagicus*. On the other hand, the dominant species of trap diameter 3.3 are *L. nebulosus, L. quinquelineatus.* In the territorial waters of Saudi Arabia [7] obvious that emperors, sea breams, groupers, scads/jacks/ and trevallies, rabbit fishes, snapper and others (mainly crabs, Grunt, goatfish and bartail) were the common species in the catch. The different mesh sizes were not tested in this study and the common mesh size used by the local fishermen ranged from 40 to 50mm. Meanwhile, there were reports [11 and 12] stated that larger mesh sizes (e.g. 55mm and 70mm) had resulted in much higher percentage of fish scape [8].

Table V. Species composition (% in weight) for the catch caught by different trap sizes

Species	Trap diameter				
	1.5	**2.08**	**2.8**	**3.3**	**Mean**
Epinephelus coioides	2.50	12.40	14.30	4.60	8.45
Lethrinus nebulosus	4.50	8.60	7.90	6.30	6.83
Lutjanus quinquelineatus	2.80	6.80	7.90	5.40	5.73
Gerres oyena	4.30	8.90	5.30	3.20	5.43
Carangoides bajad	3.50	5.40	6.80	4.90	5.15
Portunus pelagicus	6.50	7.30	4.30	2.40	5.13
Siganus canaliculatus	3.20	4.70	7.80	2.80	4.63
Scarus persicus	4.50	6.40	5.20	2.10	4.55
Lethrinus lentjan	1.20	6.70	5.40	4.80	4.53
Rhabdosargus sarba	3.20	5.40	6.30	2.10	4.25
Lutjanus ehrenbergii	3.40	6.50	3.20	3.00	4.03
Acanthopagrus bifasciatus	2.30	5.40	4.80	3.20	3.93
Plectorhinchus sordidus	2.30	3.60	4.50	4.00	3.60

D. Effect of soaking time on the catch rate

In the present study, there was no relationship found between trap soak time and catch rate. It means the catch rate does not increase with increasing soak time. However, trap loss was positively co-related to soak time. The longest soak time in the current study is 15 days. Miller, 1983[13] reported that, the catch rate usually increases with soak time to some asymptotic bound or increase with soak time to maximum value and thereafter decrease with longer soak time [14&15]. Pengilly and Tracy 1998[16] stated the catch rate decreased with increasing soak time over the range of 12-72h in commercial king crab pots. After a certain soak time, mean catch rate either approach a maximum value or decreases with increased soak time. The result revealed that the trap loss increased as the soak time increased, about 35% of the trap lost with increase soak time to 10 days. However, the percentage increased to 56% with increasing soak time to 15 days. In Saudi territorial waters of the Arabian Gulf [7] found the estimated annual percentage of lost traps was higher for large boats

than of small boats. In Kuwait's water the catch rate did not increase with the increase of the soak time and this result harmonized with the current study. About 88% of the trap were lost after 100 days if the traps are not cleared during this period. While 36% of the traps were lost after 100 days if the traps were cleared at 20 days' intervals [8] and 60% of the trap lost due to lack of buoy. The present study explained the shorter soak time reduced the percentage of trap loss, although higher frequency of clearing trap will increase trap fishing effort and running cost. Mathew *et al*, 1987[17] reported the financial losses due to ghost fishing reach 3% - 13.5% of the total catch value in the trap fishery in Kuwait. In the Sea of Oman, the mortality could be as high as 78.36kg/trap in the 6-month period after a trap being deployed in water [18]. The present study recommended that to reduce loss of trap the soaking time not exceeding 7 days.

II. CONCLUSION

The fisheries in the UAE are small-scale, with catches increasing until 1999, after which started to decline. The main fishing gear is a dome-shaped wire trap called a *gargoor*. The present study describes and evaluate the catch and species composition caught by different sizes of the traps. The present study declared that small size of the trap should be avoid because the low catch rates and smaller average sizes of the catch. Soak time less than 10 days increase the catch rate and decrease the trap lost. Therefore, it could be recommended to operate the large and medium traps only while the small traps should be prohibited.

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