Bull. Fac.Agric., Cairo Univ., 51 (2000): 139-150.

FISHERY HARVEST AND OPTIMUM YIELD FOR QATAR DEMERSAL RESOURCES USING CATCH AND EFFORT DATA DURING 1991- 1994

(Received: 7.8.1999)

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ABSTRACT

The artisinal fishery of Qatar is mostly based on the catch of demersal fishes. The study included the analysis of fishery statistics during the period 1980-1994. It was evident that fishery was under-exploited during 1980 - 1989 due to the small size of the fishery fleet during that period. Maximum harvest from Qatari water took place in 1991. The decline in catch rate per boat per year during period 1991 - 1994 had instigated this study. Analysis of annual catch, effort (3 options) and catch per unit effort data during 1991-1994 by Shaefer (1954) model, indicated that maximum fish harvest that can be obtained based on current fishery grounds during 1991-1994 for demersal and large pelagic fishes can range between 7884-8003 tonnes of commercial valuable fish of species highly valuable by Qatari people. The fishing effort required to harvest this amount of fishes is 386 standard Qatari boats or 1897 fishermen as working power or a mechanization level of the fishery fleet of 34,412 horse power. The Qatari fishermen are advised to increase catch of fish above that level, by exploiting new fishery grounds within the Qatari territorial water or giving more attention to the neglected pelagic fishery. The decrease in catch per unit effort from 18.79 tonnes of fish per boat during 1991 to 10.52 tonnes of fish per boat during 1994 could be attributed to the increase in the level of effort above requirements. This was due to the increase in fishery fleet and mechanization (horse power) above the requirement needed for the

limited fishery grounds.

Key words: *demersal fish resources, maximum yield, optimum effort, Qatar.*

1. INTRODUCTION

The Arabian Gulf has water area of 226,000 square kilometer. The maximum potential yield(mpy) that could be harvested from the Arabian Gulf on annual basis was estimated of 400,000 tonnes for small pelagics, 40,000 tonnes for large pelagics and 300,000 tonnes for demersal fish species(FAO, 1980).The recent harvest from the Arabian gulf is less than 50% of the mpy. The maximum harvest of fishes that could be obtained from Qatar water was estimated as 25,000 tonnes for small pelagics (such as sardines) and 14,000 tonnes for demersal fish species(Sivasubramaniam,1981a&b ivasubramaniam and Ibrahim 1982a&b).

Data collection from commercial fisheries started in 1980, although some data were available from early 1950. The estimated potential harvest of demersal fisheries was in the range of 7500-10,000 tonnes per year for current fishery grounds in the State of Qatar(FAO, Unpublished). The decline in catch rate per boat per year during the period 1991-1994,Ministry of Municipal Affairs and Agriculture (1991,1992,1993,1994). had instigated this study. The objectives of the present study were to investigate optimum catch and effort that could be applied to demersal fishery without depleting fish stocks using catch and effort data during 1991-1994.

2. MATERIALS AND METHODS

Data on annual catch during the period 1980-1994 of marine fisheries were classified for a total of 16 species (mostly demersal) and were collected from the State of Qatar(Table 1). Since intensive fishery started in 1991, catch and effort data were analyzed only during the period 1991-1994. It was evident from the data that demersal fishery resources were under-exploited during the period 1980-1990 which may be due to the small size of the fishery fleet working in these grounds. The fishery harvest during that period did

Table (1) : Species composition of harvested fish and % of commercial fishes in the total catch during 1991-1994.

Scientific name	Arabian name	Catch (tonnes/ year)				% in total catch
		1991	1992	1993	1944	
Epinephelus sp.	هامور	1205	1163	1145	951	16.27
Scombermorus commerson	كنعد	706	762	635	406	9.12
Caranx ignobilis	جش	547	406	360	198	5.0
Plectorhychus cinctus	فرش	617	568	730	620	8.54
Lethrinus sp.	شعرى متوسط	411	452	461	366	8.3
Lethrinus sp.	شعرى صغير	393	409	355	269	6.4
Lethrinus sp.	شعرى كبير	295	370	453	284	5.8
Signaus sp.	صافي	327	312	280	193	4.2
Gnathanodon spectosus	ربيب	311	220	223	122	3.24
Gerres oyena	بدح	177	151	114	50	1.68
Creniden crenidens	كرقفان	204	150	158	111	2.16
Argyrops spinifer	كوفر	147	176	173	127	2.54
Carangoides malabricus	ربيدى	107	206	206	101	3.20
Lutjanus malabricus	حمرة	171	145	128	111	2.16
Alepes mate	كراري كبير	147	125	148	101	2.16
Scarus ghobban	لين	142	121	143	132	1.82
Subtotal	-	5907	5736	5712	4042	82.59
Others	اخرى	1328	1257	1282	1043	17.41
Total	المجموع	7235	6993	6993	5085	100

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not exceed 3500 tonnes/ year as total catch. For this reason catch and effort data were ignored during that period. The fishing effort was estimated in 3 directions namely: 1) number of boats working on the current fishery grounds of 1991-1994 , 2) numbers of fishermen working in these grounds and 3) mechanization level of this fleet in horse - power (Table2).

Table (2): Harvest of fishes (tonnes), effort and catch per unit effort (CPUE) statistics for the State of Qatar during 1991-1994.

Description	1991	1992	1993	1994
Artisinal harvest (tonnes/ year)	7235	6993	6994	5085
Fishing effort				
Number of boats	385	414	456	483
Horse power of fleet	33594	36298	40267	45007
Number of fishermen	1871	2017	2237	2369
Catch per unit effort				
Harvest / boat / year	18.79	16.89	15.33	10.52
Harvest / one horse power / year	0.215	0.193	0.174	0.113
Harvest / fisherman / year	3.87	3.46	3.12	2.14

Statistical analysis depended on catch and effort data to estimate catch per unit effort for each species, then regression was made against effort for each species using Shaefer 1954 model. The constants of the regression line were used to calculate maximum yield for each species that could be obtained from these fishery grounds as well as optimum effort for 1991-1994 period. The estimated catch per unit effort (CPUE) was calculated as catch divided by effort (C/F) for a total of 16 species as well as for each species in the three effort categories to investigate the causes of decline in the harvest rate per boat per year over time during the period 1991-1994. The analysis was done for 16 fish species that constituted 82.59% of the total harvest during that period.

3. RESULTS AND DISCUSSION

The study included the analysis of fishery statistics during the period 1980 - 1994. Maximum harvest from Qatari water took place

Table (3): Maximum harvest of fish (tonnes/year) and optimum fishing effort of fishery fleet for demersal and large pelagic fishes in 1991-1994 fishery grounds.

Scientific name	Number of boats		Number of fishermen		Horse power	
	Max. yield (tonnes/yr.)	**Opt.Effort (boats)**	**Max. yield (tonnes/yr.)**	**Opt. Effort (Fishermen t)**	**Max. yield (tonnes/yr.)**	**Opt. Effort (horse power)**
Epinephelus sp.	1273	595	1266	2876	1250	50150
Scombermorus commerson	748	338	745	1666	744	29853
Carignobilis	630	271	616	1337	614	24100
Plectorhychus cinctus	609	458	610	2234	615	41512
Lethrinus sp.	498	329	493	1627	480	30984
Lethrinus sp.	409	341	408	1679	407	30226
Lethrinus sp.	426	332	419	1654	423	30254
Siganus sp.	340	321	338	1581	337	28517
Gnathandon specious	334	281	327	1389	329	24881
Gerres oyena	214	270	209	1333	209	24032
Creniden crenidens	210	294	206	1407	206	26202
Argyrops spinifer	209	304	206	1503	195	28755
Carangiodes malabricus	222	596	225	3005	218	50059
Lutjanus malabricus	188	288	185	1424	185	25668
Alepes mate	166	308	165	1516	165	27222
Scarus ghobban	134	397	134	1947	135	37652
Subtotal	6610	357	6552	1761	6512	31867
others	1393	-	1381	-	1372	-
Total	8003	386	7933	1897	7844	34412

in 1991 when the fishery fleet increased to 385 boats as a working power that harvested 7235 tonnes of fishes mostly of demersal origin. The harvest stabilized during 1992-1993 (6993 - 6994 tonnes / year) and decreased during 1994 to 5085 tonnes/year.

The analysis of harvest, effort and catch per unit effort was necessary during that period since catch per unit effort (*e.g.*, harvest rate) decreased with time from 18.79 tonnes of fish per boat per year during 1991 to 10.52 tonnes of fish per boat per year during 1994. The same trend took place with the increase in other measures of efforts as number of fishermen and horse power of the fishery fleet. For this reason, statisitical analysis was done by regression of catch per unit effort on effort in three dimensions: boats, fishermen and horse power of the fishery fleet, respectively.

The artisinal fishery of Qatar was mostly based on the catch of demersal fishes. The fishery grounds during 1991-1994 were mostly located in areas of good demersal fish density and high catch rate per fishing time. These grounds were mapped and explored by FAO and are located in areas- more than 40 kilometers away from shores to the east of the mainland. The rest of Qatari territorial waters had minor fishing activities (personal interview with fishermen during that period). The pelagic fishes which constitute 60-70% of the total fishery resources in the Arabian Gulf (FAO, 1980) are neglected by Qatari fishermen except for large predator fishes.

In terms of fishery resources, most of pelagic fishes in the Arabian Gulf are composed of small fishes such as anchovies and sardines. The fishery policy in Qatar is based on fishing valuable highly priced fishes which include demersal and large pelagic fishes. Sardines and anchovies are not eaten by native people in the Arabian Gulf. Small fishes are used as fish meal or organic fertilizer(for soils) especially in the United Arab Emirates and Sultanate of Oman.

The current fishery grounds in Qatar are restricted to locations that have high fish density, higher catch rate and good economic return per boat per fishing. The rest of Qatari territorial waters were not exploited either for shallowness or for lack of information among fishermen (personal interview). The fishery potential in Qatari territorial waters is intense, however , new fishery grounds should be exploited and small pelagic resources should enter the fishery.

The annual fishery yield in Qatar during 1991 - 1994 was

analyzed based on relative abundance of species, catch (tonnes/year) and effort exerted during fishing(Table 2). There were 16 important fish species that made 82.59% of total fish catch during 1991-1994. Two genera of fishes *Epinephelus* and *Letherinus* made more than 36% of total catch. Consequently, current fishery management should be based on these species.

From data analysis of total annual catch during 1980-1994,it was evident that the fishery was under-exploited during the period 1980- 1989 due to the then small size of the fishery fleet. The harvest from the sea reached climax in 1991 then stabilized and decreased thereafter.This was due to the increase in fishery fleet and mechanization (horse power)above the requirement needed for the limited fishery grounds(Table 2).

Analysis of annual catch, effort (3 options) and catch per unit effort data during 1991-1994 by Shaefer (1954) model, indicated that maximum fish harvest that can be obtained from the sea based on current fishery grounds during 1991-1994 for demersal and large pelagic fishes could range between7884-8003 tonnes of commercial valuable fish of species highly valuable by Qatari people. The fishing effort required to harvest this amount of fishes is 386 standard Qatari boats or 1897 fishermen as a working power or a mechanization level of the fishery fleet of 34,412 horse power(Table 3).

When catch and effort were calculated as number of boats, maximum harvest of valuable fishes reached 8003 tonnes/year based on total catch and the optimum fishing effort required to harvest this amount was 386 standard Qatari boats. However, the fishery fleet consisted of 483 boats in 1994 which represented over- load of 25% when compared to optimal effort. When catch and effort were calculated as number of fishermen, maximum harvest of valuable fishes reached 7933 tonnes/year and the optimum fishing effort to harvest the crop was a working power of 1897 fishermen. The working power during 1991-1994 consisted of 2369 fishermen which represented an over- load of 24%.

According to Shaefer (1954) model, optimum fishing effort as horse power (mechanization of all fishing vessels) was calculated as 34,412 horse power for the entire fishery fleet working in 1991 - 1994 fishery grounds. The meachanization of the Qatari fishery fleet during 1994 had 45,007 horse power which represented over- load of 30%.

Maximum harvest or maximum sustainable yield (msy)is the level for maximum harvest of fishes (in weight or tonnage) that could be obtained without over-fishing or depleting fish stocks living in the sea (Ricker, 1975). The age- structure of fish stocks living in the sea and biomass of spawners (adult fishes) are optimum at MSY. The reproduction rate of fish stocks and fish production is maximum when harvesting fish stocks at or less than this level (Sparre *et al.*, 1989).

When fishing effort as the number of boats working in the sea is increased above the optimum level, the fish stocks will be depleted and fish production will decrease (Ricker, 1975). The optimum size of fish stocks living in the sea will decrease when extra boats above optimal effort are added. The same holds true for the increase in horse power of the fishing fleet or the total number of fishermen. The extra effort above the optimum level will harvest extra fish biomass above the production capacity of fish stocks. Consequently, the size of fish stocks living in the sea and the percentage of spawners in the stock will decrease. The net profit to the fishery will decrease as well as the relative abundance of fish stocks.

Since fishing effort exerted to harvest fish from the current 1991-1994 fishery grounds was above the optimum level, the fishing vessels harvested more crops than the production capacity for these grounds. However, when the Qatari fishermen are willing to increase catch of fish above msy, new fishery grounds should be exploited within the Qatari territorial water or attention should be paid to the neglected pelagic fishery. Small pelagic fish are known to make most of the pelagic resourses world wide as well as in the Arabian Gulf.

The fishing effort during 1994 had an increase of 24% in the number of fishermen and 25% in the number of boats required to harvest demersal fishes . This should lead to a reduction in the size of demersal fish stocks located in these grounds.

The statistical analysis indicated that optimum effort on these mainly demersal fishery grounds should not exceed 386 boats or 1897 fishermen or 34,412 horse power. This could be managed in the State of Qatar by the following: 1) limitation of new licences for fishing boats and 2) introduction of closed seasons. This will improve the average size of fish in the catch as well as the economic returns to the fishery. The size of the Qatari fishery fleet could be expanded beyond that limit when pelagic resources enter the fishery or additional

fishery grounds be exploited within the Qatari territorial waters.

The commercial fishes of Qatar were divided to 3 categories according to sensitivities to the fishing effort (Table 3). The first category was tolerant to high level of effort and included *Epinephelus*, *Plectorhynchus*, *Scarus* and *Carangoides*. The second group had medium tolerance to the increase in fishing effort and included *Scomberomorus*, *Letherinus*, *Siganus*, *Argyrops* and *Alepes*. The third group was the lowest in terms of tolerance to the increase in the level of fishing effort and included *Caranx*, *Gnathanodon*, *Gerres*, *Crenidens* and *Lutjanus*. The increase of the level of effort above 386 boats will affect fishes or species of high sensitivities than the more tolerant species.

The management of fisheries should be imporved in three dimensions:

1)The decrease of fishing effort to 386 boats in grounds of 1991-1994.
2)The improvement of gear traps and gill nets.
3)The introduction of fishery research in the State of Qatar.

The decrease in catch per unit effort from 18.79 tonnes of fish per boat during 1991 to 10.52 tonnes of fish per boat during 1994 could be attributed to the increase in the level of effort above requirements lowering the catching efficiency to a low level and endangering the relative abundance of demersal fishes in these grounds.

It is recommended that the fishery fleet working for demersal fishery on 1991-1994 grounds be limited to 386 boats and 1897 fishermen with an average of 5 fishermen per boat. The mechanization level should not exceed 34,412 horse power for the demersal fishery fleet in 1991-1994 grounds unless the pelagic resources are exploited. The fishing effort data collected by the Qatari state should include the following criteria:

1) The fish harvest per boat per fishing trip.
2) The actual duration of fishing trips.
3) The number of fishing trips per boat per year.
4) The number of days spent fishing per boat per year.
5) The number and dimensions of gill net pieces used per boat.

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حصاد الاسماك وحسابات المحصول السنوى المثالى من الثروة السمكية القاعية بدولة قطر باستخدام بيانات الحصاد السنوى وحجم الاسطول السمكى خلال 1991-1994

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الملخص

يعتمد قطاع الاسماك الحرفى اساسا في دولة قطر علي حصاد الاسماك القاعية.إشتملت هذه الدراسة علي تحليل البيانات الاحصائية خلال الفترة 1994-1980. واتضح ان استغلال المخزون السمكى كان غير كامل خلال الفترة 1989-1980 وذلك لصغر حجم الاسطول السمكى خلال هذه الفترة ووصل محصول الاسماك الي اقصى ما يمكن خلال عام 1991 ومن تحليل البيانات الاحصائية أتضح أن معدل صيد الاسماك للقارب الواحد في السنة انخفض خلال الفترة 1991-1994 وهذا أدى الي الاهتمام بهذه الدراسة.

ومن تحليل محصول الصيد السنوى وحجم اسطول الاسماك (3 مقاييس) ومعدل صيد الاسماك باستخدام معادلات شيفر 1954 اتضح أن أقصى محصول سمكى يمكن الحصول عليه من الاسماك القاعية والاسماك السطحية الكبيرة يتراوح ما بين 7884-8003 طن من الاسماك التجارية ذات القيمة التجارية العالية في دولة قطر واتضح أن حجم الاسطول المثالي اللازم لحصاد هذه الكمية من الاسماك هو 368 مركب صيد قطرى قياسى أو 1897 صياد أو مستوى ميكنة قوة 34412 حصان وينصح هذا البحث الصياديين القطريين بالتوسع في صيد الاسماك في المناطق غير المستغلة داخل الحدود القطرية وكذلك الاهتمام بمصايد الاسماك السطحية.

ويرجع انخفاض معدل صيد الاسماك للقارب الواحد في السنة من 18.79 طن اسماك خلال عام 1991 الي 10.52 طن اسماك خلال عام 1994 الي زيادة حجم الاسطول والميكنة فوق الاحتياجات الضرورية المطلوبة لصيد الاسماك من هذه المناطق التي تتمتع بارتفاع كثافة الاسماك فيها.

المجلة العلمية لكية الزراعة -جامعة القاهرة -المجلد (51)العدد الثانى ابريل (2000):139-150.