The Regional Organization for the Conservation of the
Environment of the Red Sea and Gulf of Aden

A STUDY ON STOCK ASSESSMENT AND FISHERIES MANAGEMENT OF INVERTEBRATES IN YEMENI WATERS

Progress Report

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Contents

SUMMARY

Upon the agreement between the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) and Marine Science and Resources Research Center (MSRRC) for national consultants to conduct a study on stock assessment and fisheries management of invertebrates with special reference to shrimp and destructive impacts of trawl fishing in Yemeni Red Sea and Gulf of Aden,
A work has been started in that respect. A training course on Fish Stock Assessment was held at MSRRC in Aden, two surveys were executed in the Gulf of Aden one on shrimps and the other on cuttlefish during the closed seasons of both species and a work plan was put for biological and statistical data collection. A pre-season survey has been started to determine the biomass and total allowable catch of cuttlefish for the coming season.

ACKNOWLEDGEMENT

I would like to thank Mr. Abdulla M. Hammadi, Director General of Marine Science and Resources Research Center for his support and assistance, Mr. Adel Hussein Al Kumeim Director General of Reydan Corporation for Marine Investment & Development, Mr. Mo Chang Won Operation Manager and the Captain and the crew of Reydan vessel for their cooperation. Thanks also to al researchers and technicians from Marine Science and Resources Research Center who involved in data collection.

1. INTRODUCTION

Yemen has a coast line of more than 2500 km which lies in the Red Sea and Gulf of Aden. There are variety of marine species in Yemeni waters. Invertebrates, specially shrimps and cuttlefish, have great importance in Yemeni fisheries economy. They are caught by both artisanal and industrial fleets in the Red Sea area and Gulf of Aden. Stock assessment work on cuttlefish was done in the seventies and eighties in the Gulf of Aden (Ayoma *et al* 1979, Sanders 1979, Sanders 1981), these studies need to be updated. Shrimp stock in the Gulf of Aden was first studied in 1986 (Abdul-Wahab 1989).
According to the Terms of Reference of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) for national consultants to conduct a study on stock assessment and fisheries management of invertebrates with special reference to shrimp and destructive impacts of trawl fishing in Yemeni Red Sea and Gulf of Aden, a new work has started to gather available information on shrimps and cuttlefish as two important invertebrates inhabiting Yemeni waters and to put a work plan for collection biological and statistical data during the assignment period.

2. MAIN FINDINGS

Little biological information and literature are available specially about the Red Sea area. There are some statistics of catch and effort.

2.1 Cuttlefish

The main cuttlefish species commercially caught is *Sepia pharaonis.* It is caught in the eastern waters of the country from June to November each year by trawlers. Recently the species has caught by traditional fishermen using traps. Total catch varied from 7296.8 tons in 2001 to 2808 tons in 2002 (Tables 1 and 2) which represent 51.3% and 17.5% respectively of the total catch of the industrial fleet operated in the Gulf of Aden. Marine Science and Resources Research Center (MSRRC) conducts a two week pre-season survey in the eastern water of the country using two fishing vessels during the first half of May to estimate the biomass, total allowable catch and the corresponding effort. Data obtained from the survey are analysed using "Swept area method" For 2003 fishing season the biomass was estimate was 22241 – 29630 tons and the total allowable catch was 6672 – 8289 tons (Ali, 2003). Data on length frequency were collected onboard Reydan fishing vessel, 37 meters in length and 1700 h.p. main engines, from the area around Aden and Abyan (Fig. 1) in April-May 2003. Figure 3 shows the length frequency of *S. pharaonis* in that area. The data were analysed using Bhattacharya method, two cohorts were identified in March with mean lengths 11.4 cm and 18.0 cm and three cohorts in April with mean lengths 10.4 cm, 16.1 cm and 20.7 cm. This results cannot be discussed at this early stage. Figure 5 shows the total catch of the industrial fleet operated in the Gulf of Aden during 1967-2002.

2.2 Gulf of Aden Coastal Shrimp

The main species is *Penaeus semisulcatus.* It is caught by trawlers in the eastern water in Al-Mahara Governorate area. Fishing season extends from August to November. A survey was conducted out of the fishing season onboard Reydan fishing vessel during April 2003 for about fifteen days in Al-Mahara area to obtain information on shrimp stock.

The survey took place at Seihut, Nishton and Tabut areas (Fig. 1) in depths between 5m and 18m. A total of 93 shots were made over the fifteen days. The duration of each shot was 2-3 hours. Two species were found, i.e. *Penaeus semisulcatus* and *Metapenaeus monoceros* . The first one was dominant in the catch. Total catch of shrimp during this period was 4426 kg.

Shrimps were sorted onboard the vessel into grades according to their size, advantage was taken of this sorting and 8 kg of each available grade were sampled in the morning and evening for length distribution, carapace length was taken for this purpose.

Since *P. semisulcatus* is the main target species, length frequencies were estimated for males and females of this species during sampling period (Fig. 2 and 3).

Bhattacharya's method (Bhattacharya, 1967) was used to analyse the data, two cohorts or length groups were identified for males with mean carapace lengths 33mm and 42mm. While three cohorts were identified for females with mean carapace lengths 33mm, 40mm and 53mm.

Another survey was carried out in May 2003, Figures 2 and 3 show the length frequency in this month.

Total catch of coastal shrimps was 157.3 tons in 2001 and it was 139.5 tons in 2002 (Tables 1 and 2) which represent 1.1% and 0.9% of the total catch respectively of the industrial fleet in the Gulf of Aden.

By catch and discards comprised more than 90 % of the total catch. These consisted of:

70 % stomatopoda (crustacean)
10 % crabs
15 % fish
5 % shrimp

The main fish species were:

Catfish, croakers, soles, ponyfish, carangids, hairtails (Trichiuridae), lizardfish, rays, sardines and sharks.

2.3 Red Sea Coastal Shrimp

The main species is *Penaeus semisulcatus.* It is caught by both artisanal and industrial fleets from September to April. Little information is available from this area. However, some catch information was made available from this area (Figure 6). A training course was held at MSRRC for researchers from Hudaida and a work plan was put to carry on data collection and analysis for shrimp stock assessment in the Red Sea area.

3. TRAINING COURSE

A training course was held at MSRRC in Aden in Fish Stock Assessment during the period September 2002 – March 2003 for 15 participants from MSRRC branch in Hudaida with the purpose of training counterparts on tasks given in Terms of Reference mentioned earlier including species identification, sampling the catch, data collection, stock assessment methods and fisheries management. The references for this course were Gulland 1969 and Sparre and Venema 1992.

4. WORK PLAN

A work plan and related forms (Appendix) were designed for biological and statistical data collection in the coming seasons of shrimp and cuttlefish in the Red Sea

and Gulf of Aden areas. A visit will be paid in May by the Director General and the Consultant to Hudaida branch for arrangements of the implementation of the work plan.

5. CONCLUSION

- Due to lack of and insufficient references and literature on shrimps and cuttlefish in PERSGA member countries, PERSGA is requested to provide MSRRC with such literature.
- Except the few sampling surveys mentioned earlier, the consultancy has been conducted during closed seasons of both species, so the catches were not observed sufficiently.
- Arrangements are going on to collect further statistics and biological data through sampling onboard fishing vessels during the coming period in various fishing grounds in the Red Sea and Gulf of Aden. The results will be shown in the next report.
- It is strongly recommended to begin biological and statistical data collection programme for shrimps onboard a research vessel or fishing vessels and at the traditional landing sites in the Red Sea area.

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Table 1. Monthly catch, effort and catch per unit effort (c.p.u.e) of the industrial fleet in the Gulf of Aden in 2001 (from Kedidi,2002)

Month	Catch (kg)					Effort		c.p.u.e.						
	Fish	Cuttlefish*	Shrimp	Other Molluscs**	Total	Fishing days	Shots	Fi/day	Fi/shot	Cutt/day	Cutt/shot	Sh/day	Sh/shot	Tot/day
Jan	477648	99437	3797	15934	596816	218	986	2191.0	484.4	456.1	100.8	17.4	3.9	2738
Feb	401799	371730	0	4614	778143	227	1087	1770.0	369.6	1637.6	342.0	0	0	3428
Mar	324340	526114	12188	6865	869507	282	1363	1150.1	238.0	1865.7	386.0	43.2	8.9	3083
Apr	496261	339713	0	809	836783	277	1383	1791.6	358.8	1226.4	245.6	0	0	3021
May	238432	167823	0	584	406839	237	1054	1006.0	226.2	708.1	159.2	0	0	1717
Jun	280568	1597360	6316	384	1884628	486	2635	577.3	106.5	3286.7	606.2	13.0	2.4	3878
Jul	624176	1491867	6932	4632	2127607	549	2645	1136.9	236.0	2717.4	564.0	12.6	2.6	3875
Aug	481152	614016	20940	27185	1143293	553	2632	870.1	182.8	1110.3	233.3	37.9	8.0	2067
Sep	248589	483425	19868	38867	790749	343	1541	724.7	161.3	1409.4	313.7	57.9	12.9	2305
Oct	667576	1046134	38871	124632	1877213	680	3009	980.3	221.9	1536.2	347.7	57.1	12.9	2757
Nov	1244281	420532	14502	16278	1695593	644	1210	1932.1	1028.3	653.0	347.5	22.5	12.0	2633
Dec	1011920	138616	33854	39150	1223540	514	2631	1968.7	384.6	269.7	52.7	65.9	12.9	2380
Total	**6496742**	**7296767**	**157268**	**279934**	**14230711**	**5011**	**22176**	**1296.5**	**292.96**	**1456.15**	**329.04**	**31.38**	**7.09**	**2839.89**

* Cuttlefish, *Sepia pharaonis*
** Other mollusks: other cuttlefish species and squids

Table 2. Monthly catch, effort and catch per unit effort (c.p.u.e) of the industrial fleet in the Gulf of Aden in 2002

Month	Catch (kg)					Effort		c.p.u.e.						
	Fish	Cuttlefish*	Shrimp	Other Molluscs**	Total	Fishing days	Shots	Fi/day	Fi/shot	Cutt/day	Cutt/shot	Sh/day	Sh/shot	Tot/day
Jan	609463	341380	0	22220	973063	434	2586	1404.3	235.7	786.6	132.0	0	0	2242
Feb	915137	423482	0	21228	1359847	437	2616	2094.1	349.8	969.1	161.9	0	0	3112
Mar	1749136	162514	0	2958	1914608	535	2575	3269.4	679.3	303.8	63.1	0	0	3579
Apr	1380145	126467	0	1800	1508412	464	1963	2974.5	703.1	272.6	64.4	0	0	3251
May	934185	308133	0	1368	1243686	514	2255	1817.5	414.3	599.5	136.6	0	0	2420
Jun	1320825	651859	0	7176	1979860	697	3452	1895.0	382.6	935.2	188.8	0	0	2841
Jul	734996	130278	28071	7315	900660	605	3032	1214.9	242.4	215.3	43.0	46.4	9.3	1489
Aug	554644	74510	52305	13366	694825	569	2757	974.8	201.2	130.9	27.0	91.9	19.0	1221
Sep	653817	193382	22548	11711	881458	561	2411	1165.4	271.2	344.7	80.2	40.2	9.4	1571
Oct	1335156	146267	11498	52600	1545521	712	3408	1875.2	391.8	205.4	42.9	16.1	3.4	2171
Nov	1262189	205103	7021	18118	1492431	618	2944	2042.4	428.7	331.9	69.7	11.4	2.4	2415
Dec	1444034	44577	18036	25334	1531981	597	2735	2418.8	528	74.7	16.3	30.2	6.6	2566
Total	**12893727**	**2807952**	**139479**	**185194**	**16026352**	**6743**	**32734**	**1912.2**	**393.9**	**416.4**	**85.8**	**20.7**	**4.3**	**2377**

*Cuttlefish, *Sepia pharaonis*

** Other mollusks: other cuttlefish species and squids

Figure 1. Fishing locations during the survey

Figure 2 : Length frequency of males *P. semisulcatus*

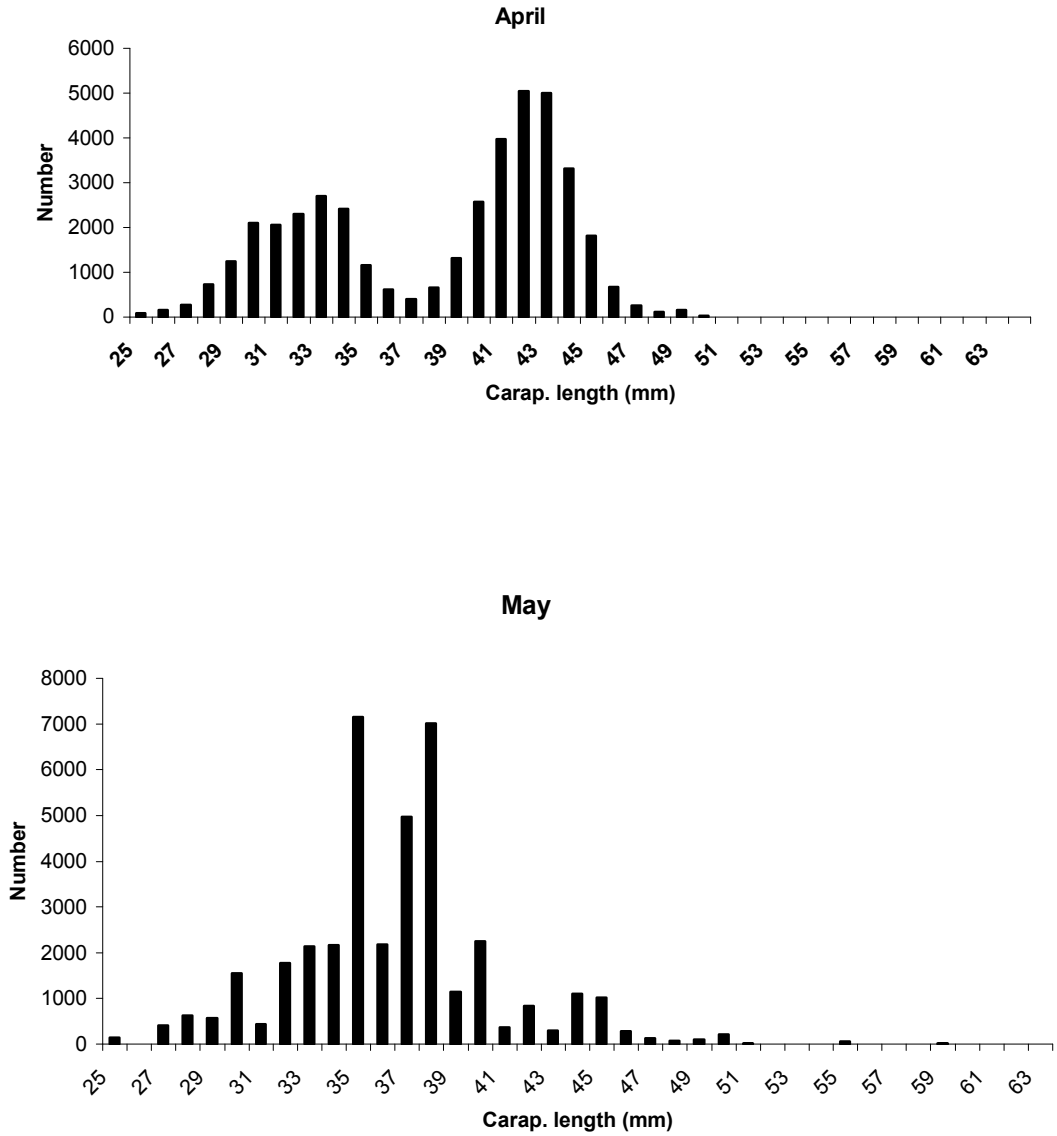


Figure 3. Length frequency of female *P. semisulcatus*

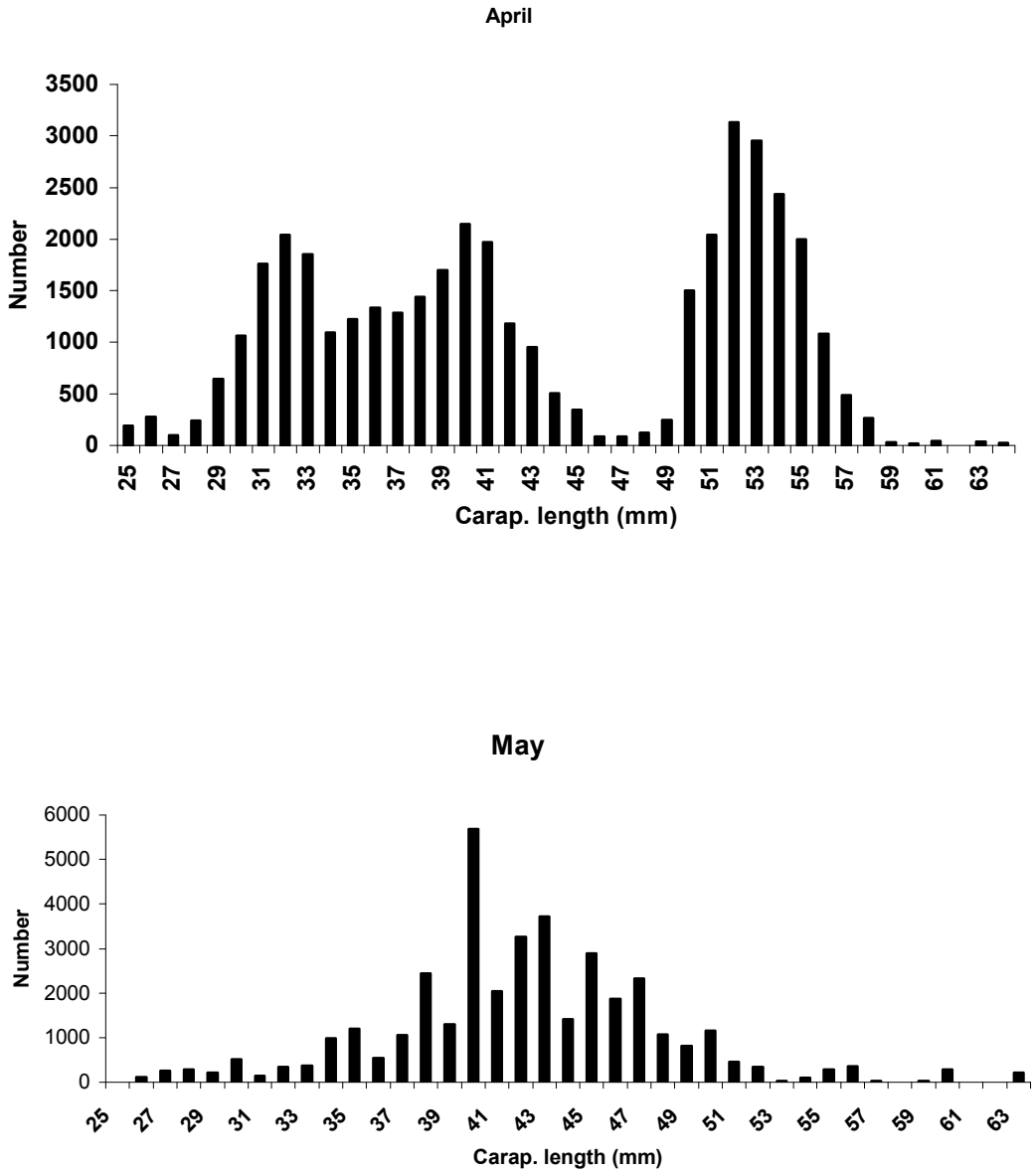
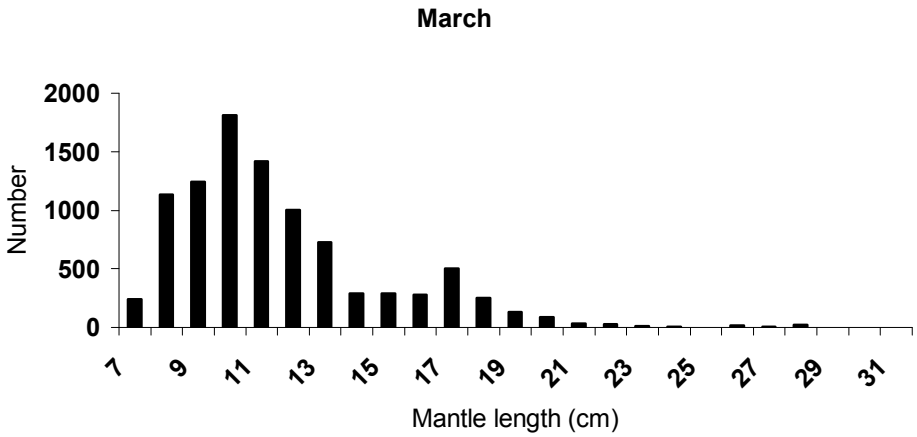


Figure 4. Length composition of cuttlefish *Sepia pharaonis* from Aden - Abyan area in March and April 2003:



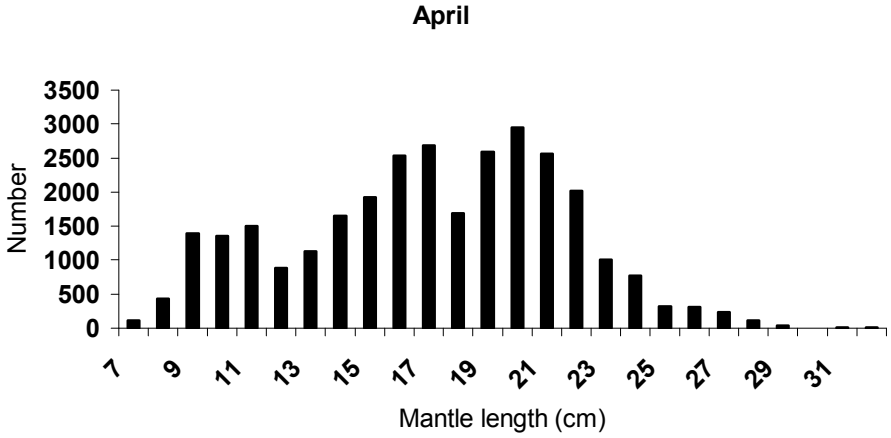


Figure 5. Total catch of cuttlefish during 1967-2002:

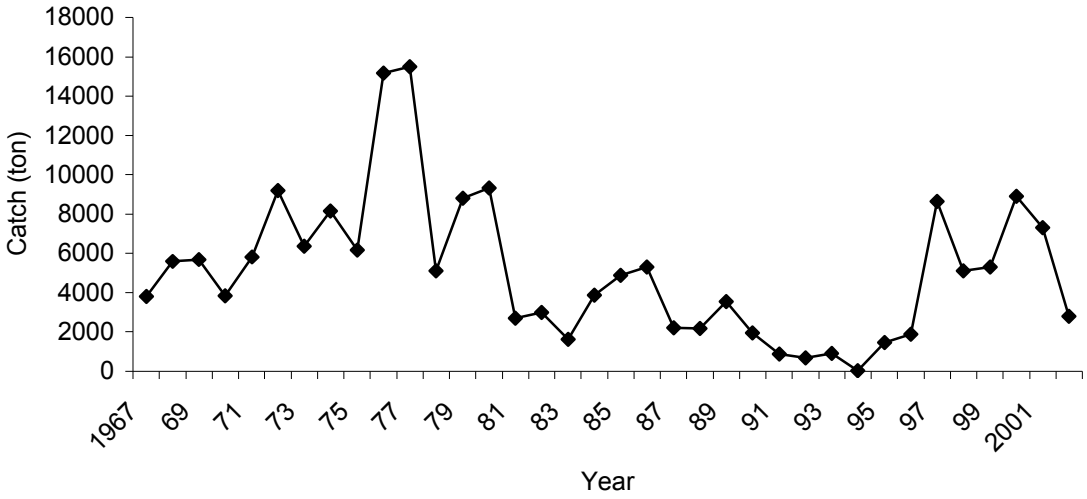
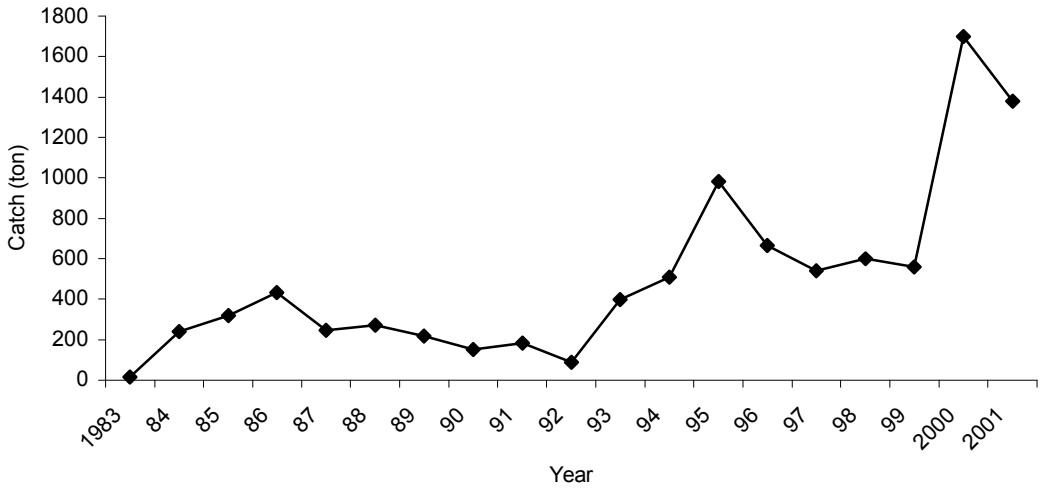


Figure 6. Total catch of shrimps in the Red Sea area during 1983-2002:



Appendix

Biological and statistical data collection prgrammes for shrimps and cuttlefish

Data Collection Programme for Shrimps

Industrial Fishery:

Daily Sampling for Length Distribution:

Shrimps are sorted onboard fishing vessels into several commercial grades depends on their size. During fishing some of those grades were caught.
Every day 4 kg of shrimp are sampled in the morning and 4 kg in the evening from each grade caught according to the following procedure:

1- Separating different species.
2- Separating males and females.
3- Recording carapace length in millimeters for each individual by sex.
4- Recording the following information:
   Date, vessel name, fishing location, fishing depth, number of shots in the day, duration of the shot, total shrimp catch per day, total fish catch.

Half monthly sampling:
30 to 50 individuals of shrimps of each species by sex group are selected randomly and the following information are recorded for each individual:
- Carapace length (mm)
- Total length (mm)
- Total weight (g)
- Sex (male/female)
- Females gonad maturity stage

Female maturity stage determination:

		Stage
Immature	Ovaries empty, containing no eggs and whitish in colour.	1
Maturing	Ovaries are relatively small, yet colouring green to yellow indicating the presence of eggs.	2
Mature	Ovaries are large and containing many green to yellow eggs.	3

By- catch and discards:
The quantity of the by-catch and discards are recorded along with recording the species discarded.

Artisanal Fishery:
The same procedures are followed as they are for the industrial fishery taking into account some differences between the two fisheries during handling.

Form 1

Ministry of Fish Wealth- Marine Science and Resources Research Centre, Aden
Shrimp Length and Sex Composition Data Form

Fishing location……..; Fishing day……..;
Fishing vessel……..; Fleet catch……..

Grade:…… Weight:……kg				Grade:……..Weight:……kg			
Carap. Length (mm)	Species…… …….. Sex……...	Carap. Length (mm)	Species…… …… Sex……..	Carap. Length (mm)	Species…… …… Sex……...	Carap. Length (mm)	Species…… …… Sex……...
23		23		23		23	
24		24		24		24	
25		25		25		25	
26		26		26		26	
27		27		27		27	
28		28		28		28	
29		29		29		29	
30		30		30		30	
31		31		31		31	
32		32		32		32	
33		33		33		33	
34		34		34		34	
35		35		35		35	
36		36		36		36	
37		37		37		37	
38		38		38		38	
39		39		39		39	
40		40		40		40	
41		41		41		41	
42		42		42		42	
43		43		43		43	
44		44		44		44	
45		45		45		45	
46		46		46		46	
47		47		47		47	
48		48		48		48	
49		49		49		49	
50		50		50		50	
51		51		51		51	
52		52		52		52	
53		53		53		53	
54		54		54		54	
55		55		55		55	
56		56		56		56	
57							
58							

Form 2

Ministry of Fish Wealth- Marine Science and Resources Research Center

Length and Weight by Sex of Shrimp Species Data Form

Fishing Location……………………………………; Date…………………………….
Sampling Location…………………………………; Species…………………………

Carapace length (mm)	Total length (mm)	Total weight (g)	Sex	Maturity stage	Remarks

Form 3

Coastal Shrimp Study - Catch and Effort Data Form

Month …….. Vessel name……..

Date	Fishing Location	No. of shots	No. of Fishing Hours	Depth (m)	Shrimp catch (kg) by grade				Total shrimp catch	Fish (kg)	Remarks
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
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31											

Data Collection Programme for Cuttlefish

Aboard fishing vessels cuttlefish is sorted in trays. Each tray contains individuals of a particular grade according to their size. The grades are from the biggest EL, LL, L, M, S, SS, MT, ST and T.

Daily Sampling for Length:

On each day where possible, one tray sampled in the case of S, SS, MT, ST and T grades and two trays in the case of EL, LL, L and M grades in the morning time. The same thing is repeated in the evening.
The number of cuttlefish within each length group and the number of trays sampled for each grade are recorded on a recording sheet. The sample weight also recorded.

Monthly Sampling for Length, Weight, Sex etc.

On a monthly basis the length, weight, sex and gonad maturity stage are obtained for ten individual cuttlefish from each grade chosen randomly. The information is recorded on Form 2.

Length measurement:
The length taken must be the mantle length (see diagram) to the nearest centimeter using an ordinary plastic ruler.

Weight measurement:
The weight should be total weight to nearest 0.1 kg.

Determination of Sex:
The sex of cuttlefish is determined after dissection in a longitudinal direction through the ventral part of the mantle. Identifying the sexes requires visual observation of the presence of sperm sac in case of males and ovaries in the case of females.

Determination of Gonad Stage:

The following measures are used to assign the gonad stage:

Males:		Stage
Immature	Sperm sac without spermatophores	0
Maturing	Sperm sac with some spermatophores	1
Mature	Sperm sac filled with spermatophores	2
Spent	After release of spermatophores	3

Females:		Stage
Immature	No eggs visible in the ovaries	0
Maturing	Ovaries slightly enlarged with small opaque eggs	1
Mature	Ovaries enlarged considerably with large transparent eggs.	2
Spent	After release of eggs	3

Form 1

Sample length composition – Cuttlefish

Vessel name…… Date…….
Location…….

Mantle length (cm)	Grade								
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
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36									
37									
38									
39									
40									
41									
42									

Form 2

Cuttlefish Study
Length – Weight Data Form

Fishing Location……. Date…….. Vessel Name……

Grade	Length (cm)	Weight (g)	Sex	Gonad stage	Length (cm)	Weight (g)	Sex	Gonad stage	Length (cm)	Weight (g)	Sex	Gonad stage	Length (cm)	Weight (g)	Sex	Gonad stage	Length (cm)	Weight (g)	Sex	Gonad stage
T																				
ST																				
MT																				
SS																				
S																				
M																				
L																				
LL																				
EL																				