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Revised catch estimates for tuna and tuna-like species caught by artisanal boats in Yemen

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Summary

The catches and numbers of artisanal fishing crafts operating off Yemen have seldom been reported to the IOTC. Until recently, the IOTC Secretariat had been using catch information from the FAO FishStat database. However, information from several sources indicates that catches of tuna and tuna-like species in the FAO database might be greatly underestimated, especially those of yellowfin tuna. Given this, the Secretariat, carried out a review of the Yemen catch data. Due to the paucity information available, the revised catch estimates had to be derived after much interpolation and extrapolation and by making numerous assumptions. While the new estimates are still highly uncertain, they are, arguably, much more realistic than before. In general they are markedly higher than those recorded by the FAO, especially for the last decade.

Background Information

Fisheries

Little information is available on the domestic tuna and tuna-like fisheries in Yemen.

Hamba[3] reported that lines (hand or troll) and gillnets (drifting or set), are the main gears used by artisanal vessels. The use of small purse seines is very limited. Dead or live baitfish or other artificial lures are used to attract fish (trolling). Artisinal fishers typically use 8-10 m long fibreglass boats powered by outboard engines (15-75 hp).

Reliable catches or craft data are only available for several landing places, never for the whole country. Total catches are apparently estimated by raising available catches by a constant factor (Shotton[4]). This is probably an underestimate due to the rapid expansion of the Yemen fisheries during the last decade (Shotton[5]).

Catches of tuna and tuna like species have seldom been reported to the IOTC. And while FAO FishStat database reports some information, the same catch estimates have been repeated for the last seven years (1997-2003) indicating that no catch information has been reported to the FAO either.

Reports from Consultants[6] indicate that up to 40,000 t of tunas are currently caught in Yemen annually. Export data on yellowfin tuna from some processors[7] for two months in 2004 amount to more than four times the catches recorded for this species for the whole of 2003. Other reports indicate that the size of the artisanal fleet and the number of fishermen at least tripled since 1992 while catches more than doubled (World Bank[8]). This indicates that FAO's catch information, and therefore IOTC's catch information are clearly underestimated. This review attempts to provide fisheries scientists and managers with more reliable information on the Yemen catch estimates of tuna and tuna-like species.

Data Collection

Several recent reports indicate that the data collection system currently in place in Yemen (Shotton[9] and McAlister Elliot and Partners *pers.com.*) lacks coordination between the Department of Statistics at national level, fisheries cooperatives and the Ministry of Fish Wealth branches and institutions in the governorates.

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[3] The Artisanal Tuna Fishery in Yemen (Proceedings of the 7th Expert Consultation on Indian Ocean Tunas, Victoria, Seychelles, 9-14 November, 1998)
[4] Personal communication Ross Shotton (FAO)
[5] *Ibid*. 4
[6] *Ibid*. 4 and White (Assessment of the Exploitable Fish Stocks in the Waters Adjacent to the Republic of Yemen, 19/09/1992)
[7] Personal communication, Stephen Akester. MacAlister Elliot and Partners, 2005
[8] Republic of Yemen: Fisheries Sector Strategy Note, June 14, 1999.
[9] *Ibid. 4*

Some landing statistics were apparently collected in the former Peoples Democratic Republic of Yemen and Yemen Arab Republic before the unification of the country in 1990. The new government of the Republic of Yemen has not yet consolidated the two systems.

South Yemen (former Peoples Democratic Republic of Yemen, PDRY): Reports identify two different data sources in south Yemen[10]:

Co-operatives: Between 30-50% of the fishermen are organised through cooperatives that play a major role in fisheries communities. The table below shows the main landing places and co-operatives in order of importance[11]:

Landing Place	Co-operatives
Aden	Fukum and Hadibo (Sokotra)
Hadramaut	Shihr, Qusayir, Dis-Al-Hami and Mukalla
Mahrah	Al-Gaydah, Saihut, Qishn
Shabwa	Bir-Ali
Abian	Shuqra, Bender(Ahwar)
Lahej	Ras-Al-Ara

Data on catches from cooperatives were available before the unification. These data were, apparently, of good quality. It is likely that landing statistics are kept at the cooperatives even if they are not reported. Some reports (e.g. Shoton[12]) indicate that there is an increasing tendency to avoid unloading catches at the cooperatives due to:

- Taxes; noting that taxes can amount to as much as 30 - 50% of the catch unloaded through cooperatives
- Insufficient auction sites to cope with the large amounts of fish unloaded

Private landing areas (other than Co-operatives): Information on catches that do not go through co-operatives are seldom available. In 1992, around 25% of the total catch was estimated to be landed outside the cooperatives[13]. More recent estimates indicate that this has increased greatly in recent years[14] but there are few data available to verify the extent of the increase.

Catches of large pelagic species are important in this area with very high tuna catches (YFT/LOT/SKJ/KAW/FRZ) during March-April[15].

There are several cold storage and freezing plants along the Gulf of Aden coast with storage capacities ranging from 150-2000 t[16] :

Governorate	Location	Storage Capacity (mt)
Aden	Fish Harbor	2000
	Aden Branch	800
	Maalla	1000
Hadramaut	Mukalla	800
	Qusayir	150
Mahra	Nishtun[17]	800

North Yemen (former Yemen Arab Republic, YAR): Data collected between 1983 and 1990 appear to be reliable but statistics before and after this period are unreliable. The table below shows the main landing places in order of importance:

Landing Center	Number of landing places[18]
Al-Hodeidah	8

[10] White's report (see footnote 4 above) also identifies a 'State Sector' although it is not clear whether this fleet is currently operating.
[11] White (Assessment of the Exploitable Fish Stocks in the Waters Adjacent to the Republic of Yemen, 19/09/1992)
[12] Personal communication Ross Shotton (FAO)
[13] White (Assessment of the Exploitable Fish Stocks in the Waters Adjacent to the Republic of Yemen, 19/09/1992)
[14] Republic of Yemen: Fisheries Sector Strategy Note, June 14, 1999.
[15] *Ibid. 14*
[16] *Ibid. 14* Only those having more than 100 t capacity are shown
[17] This plant was not operating at the time the report was released (1992)
[18] From *Ibid.14*, quoted as the most important landing places (Medi-Khoba-Hodeidah-Khokha-Mocha)

Landing Center	Number of landing places[18]
Al-Garira	
Al-Khoba	4
Bab-Al-Mandab	
Al-Kitaba	
Al-Khokha	8
Al-Medi	2
Al-Haima	
Al-Mocha	4

Catches of neritic tuna species, mainly COM and FRZ make up most of the 'catches of tropical tunas small' (1989 figures[19]).

The responsibility for the collection of fisheries statistics lies with the Ministry of Fish Wealth and Public Corporations (MFW) although recent changes in the legislation have transferred many responsibilities to the governorates. The MFW does not have a department of statistics.

Public Fisheries Institutions[20]

Ministry of Fish Wealth and Public Corporations: This agency is responsible for planning and implementing national fishery policies and projects, and for supervising the fisheries cooperatives. MFW is based in Sana'a having a branch in Aden and branch offices in, Hodeidah, Mukalla and Al Gheida. MFW has four corporations under its jurisdiction. The National Corporation for Services and Fish Marketing appears to be the only relevant as far as tuna catches are concerned.

Marine Science Research and Resource Centre (MSRRC): The MSRRC is an advisory body for the MFW, providing advice on landings, stock assessment and management matters. The main office of MSRRC is in Aden (Labor Island). No data collection activities are carried out.

Cooperatives: there are more than 50 fishing cooperatives and societies in the Gulf of Aden and about four fishing societies in the Red Sea Coast. The cooperatives and societies provide a range of serves including equipment (boats, gears, engines), marketing (fish outlet) and welfare. In the past they were only open to fishermen operating vessels owned by the cooperatives but now they are open to all fishermen for an annual fee.

Data available for the estimation of catches of artisanal boats in Yemen

Data on catches and/or the numbers of crafts operating in Yemen is very scarce as there is an open entry fishery with no license requirements for vessels or fishing gears. While catch estimates are available for some species, years and locations, overall annual figures are seldom available. A description of the data available on the number of crafts and catches in Yemen is given below.

Fishing Craft and type of gear used

Fishing Crafts Database[21]: Data are available for only one year as a total number of boats active:

Country	Year	Gear	Mechanised	no.Crafts	Source
Yemen	1986	Unspecified	Outboard engines	2,093	Reported by Yemen

Fisheries censuses[22]: Data on the number of crafts operating in the Gulf of Aden and Red Sea is available for three years:

Area	1992	1997	2004
Gulf of Aden	**2,543**	**5,800**	**8,153**
Red Sea	**1,771**	**2,230**	**2,529**

[19] White (Assessment of the Exploitable Fish Stocks in the Waters Adjacent to the Republic of Yemen, 19/09/1992)
[20] Republic of Yemen: Fisheries Sector Strategy Note (World Bank, June 14, 1999)
[21] IOTC Secretariat
[22] Republic of Yemen: Fisheries Sector Review; McAllister, Elliot and partners, and *pers.com.*

Area	1992	1997	2004
Total	**4,314**	**8,030**	**10,682**

Two types of artisanal crafts are operated in Yemen:

Houris: Fibre-reinforced plastic boats ranging from 7-9 m long, slender with a shallow draught, powered with outboard engines (40-75 hp). They are engaged in single-day fishing and fish is not preserved by any means on board. Hand and troll lines are mainly used to catch small tunas and seerfish caught under entangling driftnets and surrounding nets.

Sambuqs: Wooden boats ranging from 15-25 m long powered by inboard diesel engines (40-150 hp). These vessels are engaged in multi-day fishing with trips ranging from one to three weeks targeting mainly sharks, which are preserved salted (carcasses) or dried (fins). Other species may be preserved using ice. A variety of nets and longlines are used.

The majority of crafts currently operated are *houris.* Between 100 to 150 *sambuqs* operate in the Gulf of Aden and about 600 operate in the Red Sea on a seasonal basis.

Nominal catches

Original (unrevised) Nominal Catches Database[23]: Data source is mainly the FAO. The table below shows the catches recorded before the present review. Note these data are considered to be highly unreliable:

Year	Total	LOT	KAW	COM
1950	**800**			800
1951	**800**			800
1952	**1,000**			1,000
1953	**1,000**			1,000
1954	**1,000**			1,000
1955	**1,000**			1,000
1956	**800**			800
1957	**800**			800
1958	**800**			800
1959	**1,000**			1,000
1960	**800**			800
1961	**800**			800
1962	**800**			800
1963	**800**			800
1964	**800**			800
1965	**900**			900
1966	**900**			900
1967	**1,100**		100	1,000
1968	**1,100**		100	1,000
1969	**1,100**		100	1,000
1970	**1,000**		200	800
1971	**1,100**		200	900
1972	**1,200**		200	1,000
1973	**1,300**		200	1,100
1974	**4,216**	1,240	372	2,604
1975	**4,964**	1,460	438	3,066
1976	**5,610**	1,650	495	3,465

Year	Total	YFT	SKJ	LOT	FRI	KAW	TUN	COM	KGX	SWO	BIP
1977	**5,950**			1,750		525		3,675			
1978	**6,502**			1,925		577		4,000			
1979	**6,000**			1,800		500		3,700			
1980	**7,425**	16	1	1,615		1,713		4,073		7	
1981	**7,031**	12	1	2,819	10	875		3,271		30	13
1982	**5,169**	5	1	1,355	3	843		2,939		22	1
1983	**2,307**	44	69	548	9	760		851		26	
1984	**6,763**	222	81	868	62	1,029		4,496		5	
1985	**8,930**	2,367	4	953	33	2,033		3,515		16	9
1986	**6,510**	824	9	401	43	1,347		3,839		26	21
1987	**5,677**	519	36	520		1,277		3,315			10
1988	**6,642**	1,628		593	75	1,628		2,634	22		62
1989	**5,496**	667	12	563	21	1,252	262	2,273	446		
1990	**7,431**	695	13	1,276	22	1,569	273	3,118	465		
1991	**7,087**	771	14	651	24	1,601	303	3,207	516		
1992	**7,068**	748	13	1,324	23	1,615	294	2,551	500		
1993	**7,000**	804	14	1,707	25	504	316	3,092	538		
1994	**8,407**	804	14	2,291	25	1,164	316	3,255	538		
1995	**8,112**	800	15	2,204	20	1,226	300	3,047	500		
1996	**8,299**	800	88	1,887	20	1,183	300	3,521	500		
1997	**8,670**	840	90	1,970	20	1,240	310	3,680	520		
1998	**8,450**	820	90	1,920	20	1,210	300	3,580	510		
1999	**8,450**	820	90	1,920	20	1,210	300	3,580	510		
2000	**8,450**	820	90	1,920	20	1,210	300	3,580	510		
2001	**8,450**	820	90	1,920	20	1,210	300	3,580	510		
2002	**8,450**	820	90	1,920	20	1,210	300	3,580	510		
2003	**8,450**	820	90	1,920	20	1,210	300	3,580	510		

[23] IOTC Secretariat; sources are the FAO (1950-69; 1990 to date) and Yemen (1970-1989, data reported to the Indo-Pacific Tuna Program)

FAO FishStat database: Data recorded in the FAO database were previously input into the IOTC nominal catches database (FAO was the main source until the present review).

Fisheries sector review[24]: Data on total catches and/or catches per species in the Gulf of Aden and/or Red Sea are available for some years:

Gulf of Aden	Total catch	YFT
1991	N/A	N/A
1992	39,700	
1993	35,442	
1994	38,809	
1995	61,800	
1996	70,150	15,000
2004	146,232	N/A

Red Sea	Total catch	COM	TUN	KAW
1991	34,200	N/A		
1992	36,700			
1993	40,000			
1994	41,200			
1995	38,600			
1996	30,000	2,218	1,380	1,650
2004	21,960	N/A		

The above estimates were produced by using data from different sources, including trips to the field.

Yellowfin tuna catches during 2003-04 were estimated to be around 30,000 t[25].

Fisheries sector strategy note[26]: Estimates of the average catch per vessel are provided for two different periods in the 1980's:

- 1980-84: 90,000 kg per year per boat
- 1985-89: 104,000 kg per year per boat

Note, these values appear to be too high for artisanal vessels.

Data on exports of yellowfin tuna to the EC[27]: The amounts of yellowfin tuna exported annually from Yemen to EC markets are available for 2000-2004:

Year	Imports YFT EU (t)
2000	**828**
2001	**2,055**
2002	**5,300**
2004	**8,800**

No details on the type of fish processing (gilled and gutted, fish fillets, etc.) were provided and therefore it is impossible to estimate round weights out of these data. No information is available on the proportion of yellowfin that was exported from Yemen to the EC from the total harvested for the species during these years.

Estimation of catch and effort time series

Due to the paucity of information available, catch estimates have had to be derived by making numerous assumptions. While the new estimates are still highly uncertain, they are, arguably, much more realistic than before.

1. **Estimating number of crafts and catches for 1992-2004**[28]: The numbers of boats engaged in artisanal fishing is available for 1992, 1997 and 2004. Catches are also available for some years and species.

[24] Republic of Yemen: Fisheries Sector Review; McAllister, Elliot and partners, and *pers.com.*
[25] McAllister, Elliot and partners, and *pers.com*
[26] Republic of Yemen: Fisheries Sector Strategy Note (World Bank, June 14, 1999)
[27] Alain Fonteneau, *pers.com.*
[28] Republic of Yemen: Fisheries Sector Review; McAllister, Elliot and partners, and *pers.com*

a. **Red sea:** The number of vessels that operated between 1992 and 1997 and 1997 and 2004 was estimated by interpolation, assuming that craft numbers increased steadily during this time.

Year	no Craft	Formula	Assumptions
1992	1,771		Number of crafts known
1993	1,863	$no_{92}+(no_{97}- no_{92})/5$	The number of crafts increased proportionally between 1997 and 2004 (this is consistent with various reports cited in this report)
1994	1,955	$no_{93}+(no_{97}- no_{92})/5$	
1995	2,046	$no_{94}+(no_{97}- no_{92})/5$	
1996	2,138	$no_{95}+(no_{97}- no_{92})/5$	
1997	2,230		Number of crafts known
1998	2,273	$no_{97}+(no_{04}- no_{97})/7$	The number of crafts increased steadily between 1997 and 2004(this is consistent with various reports cited in this report)
1999	2,315	$no_{98}+(no_{04}- no_{97})/7$	
2000	2,358	$no_{99}+(no_{04}- no_{97})/7$	
2001	2,401	$no_{00}+(no_{04}- no_{97})/7$	
2002	2,444	$no_{01}+(no_{04}- no_{97})/7$	
2003	2,486	$no_{02}+(no_{04}- no_{97})/7$	
2004	2,529		Number of crafts known

Total catches in the Red Sea are available for 1991-96 and 2004. Catches per species are only available for 1996. These were used to estimate total catches and catch by species for the period:

Year	no Craft	Fish Catch (Fc)	Formula	Assumptions
1991		34,200		Total Catch known
1992	1,771	36,700		
1993	1,863	40,000		
1994	1,955	41,200		
1995	2,046	38,600		
1996	2,138	30,000		
1997	2,230	28,995	$Fc_{96}+(Fc_{04}- Fc_{96})/8$	The catches decreased steadily between 1996 and 2004; catches per unit of effort have been decreasing in the Red Sea in recent times; it is not, however, clear if this decrease was steady
1998	2,273	27,990	$Fc_{97}+(Fc_{04}- Fc_{96})/8$	
1999	2,315	26,985	$Fc_{98}+(Fc_{04}- Fc_{96})/8$	
2000	2,358	25,980	$Fc_{99}+(Fc_{04}- Fc_{96})/8$	
2001	2,401	24,975	$Fc_{00}+(Fc_{04}- Fc_{96})/8$	
2002	2,444	23,970	$Fc_{01}+(Fc_{04}- Fc_{96})/8$	
2003	2,486	22,965	$Fc_{02}+(Fc_{04}- Fc_{96})/8$	
2004	2,529	21,960		Total Catch known

Catches per species for 1991-95 and 1996-2004 were estimated according to the species composition recorded in 1996 and total catches for each year. Only the catches of tuna and tuna-like species were estimated:

Year	Fish Catch (Fc)	COM	TUN	KAW	Formula	Assumptions
1991	34,200	2,529	1,573	1,881	$Fc_{91}* Csps_{96} / Fc_{96}$	The relationship between the catches of tunas and total catches of finfish are stable over time. Catch composition did not change for the period. The above is probably not true.
1992	36,700	2,713	1,688	2,019	$Fc_{92}* Csps_{96} / Fc_{96}$	
1993	40,000	2,957	1,840	2,200	$Fc_{93}* Csps_{96} / Fc_{96}$	
1994	41,200	3,046	1,895	2,266	$Fc_{94}* Csps_{96} / Fc_{96}$	
1995	38,600	2,854	1,776	2,123	$Fc_{95}* Csps_{96} / Fc_{96}$	
1996	30,000	2,218	1,380	1,650		Catches per species known
1997	28,995	2,144	1,334	1,595	$Fc_{97}* Csps_{96} / Fc_{96}$	The relationship between the catches of tunas and total catches of finfish are stable over time. Catch composition did not change for the period. The above is probably not true.
1998	27,990	2,069	1,288	1,539	$Fc_{98}* Csps_{96} / Fc_{96}$	
1999	26,985	1,995	1,241	1,484	$Fc_{99}* Csps_{96} / Fc_{96}$	
2000	25,980	1,921	1,195	1,429	$Fc_{00}* Csps_{96} / Fc_{96}$	
2001	24,975	1,846	1,149	1,374	$Fc_{01}* Csps_{96} / Fc_{96}$	
2002	23,970	1,772	1,103	1,318	$Fc_{02}* Csps_{96} / Fc_{96}$	
2003	22,965	1,698	1,056	1,263	$Fc_{03}* Csps_{96} / Fc_{96}$	
2004	21,960	1,624	1,010	1,208	$Fc_{04}* Csps_{96} / Fc_{96}$	

b. Gulf of Aden: The number of vessels that operated in the Gulf of Aden between 1992 and 1997 was estimated from the total catches and number of boats available for 1992 and 1997 respectively, and total catches and average catches per boat for 1993-1996, the latter was estimated through interpolation.

Year	no Craft	Total Catch	Average Catch (t)	Formula	Assumptions
1991		42,550			Total catch known
1992	2,543	39,700	16		Total catch and number of crafts known
1993	2,326	35,442	15	TC_{92} / AvC_{92}	Total catches are known. Trend in average catches changes steadily according to 1992 and 1997 recorded average catches.
1994	2,612	38,809	15	TC_{93} / AvC_{93}	
1995	4,266	61,800	14	TC_{94} / AvC_{94}	
1996	4,972	70,150	14	TC_{95} / AvC_{95}	
1997	5,800	79,660	14		Number of crafts known. Total catch estimated

The number of vessels that operated between 1997 and 2004 was estimated by interpolation, assuming that craft numbers increased steadily during this time.

Year	no Craft	Total Catch	Formula	Assumptions
1997	5,800	79,660		Number of crafts known
1998	6,136	89,171	$no_{97}+(no_{04}- no_{97})/7$	The number of crafts increased proportionally between 1997 and 2004. This was probably the case being so stated in different reports
1999	6,472	98,681	$no_{98}+(no_{04}- no_{97})/7$	
2000	6,808	108,191	$no_{99}+(no_{04}- no_{97})/7$	
2001	7,145	117,701	$No_{00}+(no_{04}- no_{97})/7$	
2002	7,481	127,212	$No_{01}+(no_{04}- no_{97})/7$	
2003	7,817	136,722	$No_{02}+(no_{04}- no_{97})/7$	
2004	8,153	146,232		Number of crafts known

Total catches in the Gulf of Aden are available for 1991-96 and 2004. Catches of yellowfin tuna are only available for 1996. No catches are available for other tuna or tuna like species. Catches for 1997-2003 were estimated by interpolation being yellowfin tuna catches estimated from the proportion between total catches and catches of yellowfin tuna in 1996:

Year	Fish Catch (Fc)	YFT	Formula (Fc)	Formula (YFTc)	Assumptions
1991	42,550				Total catches known; the relationship between the catches of tunas and total catches of YFT are stable over time.
1992	39,700	8,489		Fc_{92}* $YFTc_{96}$ / Fc_{96}	
1993	35,442	7,578		Fc_{93}* $YFTc_{96}$ / Fc_{96}	
1994	38,809	8,298		Fc_{94}* $YFTc_{96}$ / Fc_{96}	
1995	61,800	13,215		Fc_{95}* $YFTc_{96}$ / Fc_{96}	
1996	70,150	15,000			Catches per species known
1997	79,660	17,034	$Fc_{96}+(Fc_{04}- Fc_{96})/8$	Fc_{97}* $YFTc_{96}$ / Fc_{96}	Total catches increased steadily between 1996 and 2004. The relationship between the catches of tunas and total catches of YFT is stable over time.
1998	89,171	19,067	$Fc_{97}+(Fc_{04}- Fc_{96})/8$	Fc_{98}* $YFTc_{96}$ / Fc_{96}	
1999	98,681	21,101	$Fc_{98}+(Fc_{04}- Fc_{96})/8$	Fc_{99}* $YFTc_{96}$ / Fc_{96}	
2000	108,191	23,134	$Fc_{99}+(Fc_{04}- Fc_{96})/8$	Fc_{00}* $YFTc_{96}$ / Fc_{96}	
2001	117,701	25,168	$Fc_{00}+(Fc_{04}- Fc_{96})/8$	Fc_{01}* $YFTc_{96}$ / Fc_{96}	
2002	127,212	27,201	$Fc_{01}+(Fc_{04}- Fc_{96})/8$	Fc_{02}* $YFTc_{96}$ / Fc_{96}	
2003	136,722	29,235	$Fc_{02}+(Fc_{04}- Fc_{96})/8$	Fc_{03}* $YFTc_{96}$ / Fc_{96}	
2004	146,232	31,268		Fc_{04}* $YFTc_{96}$ / Fc_{96}	

Catches estimated per species are only considered complete for yellowfin tuna as YFT catches in the Red Sea are thought to be negligible..

2. **Estimating catches per species for 1950-2004**: Total catches of tunas and catches per species are only available from the FAO for years before 1992. According to several reports, data collection and processing have been poor since the early 1990's due mainly to the collapse of the existing data systems after the unification of South and North Yemen. Catches estimated before 1990 might, for this reason, be

more accurate than those after 1990. Notwithstanding this, the catch series is, however, thought to be incomplete in the early years when only catches of narrow-barred Spanish mackerel were recorded.

a. **Yellowfin tuna (YFT):** YFT catches were estimated for three different periods:

i. **1992-2004**: The catches estimated in the Gulf of Aden are used as total catches for Yemen. Catches of yellowfin in the Red Sea are probably negligible. Total catches estimated in recent years agree with catch trends for this species according to the information in the available reports.

Species	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
YFT	8,489	7,578	8,298	13,215	15,000	17,034	19,067	21,101	23,134	25,168	27,201	29,235	31,268

ii. **1950-1982:** There is little catch information for YFT recorded in the database for this period. It is presumed that catches of the species occurred during this period but they were not recorded as YFT. The narrow-barred Spanish mackerel (COM) is the only species for which catches are recorded since the beginning of the fishery. Catches of yellowfin tuna are available since 1980 although it is likely that catches for some years include those of industrial vessels from foreign countries operating within the Yemen Economic Exclusive Zone. The catches of swordfish reported for 1980-86 indicates that industrial vessels were operating as SWO is not usually caught by artisanal fleets.

The catches of YFT were estimated on the basis of the proportion that they make out of the catches of COM for 1989-93, this assumes that catch trends for both species were similar over this forty years period. This is probably not true because YFT and COM are usually fished in different areas.

The table below shows the proportion that the catches of YFT make out of the catches of COM for 1989-93 (IOTC Database);:

Year	Total	COM	YFT
1989	2,940	2,273	667
1990	3,813	3,118	695
1991	3,978	3,207	771
1992	3,299	2,551	748
1993	3,896	3,092	804
Total	17,926	14,241	3,685
Proportion	**1.00**	**0.79**	**0.21**

Catches of YFT estimated for 1950-88 are shown in the table below:

$$C_{YFT} = 0.21 * C_{COMy1950...1988} / 0.79$$

Year	COM	YFT
1950	800	207
1951	800	207
1952	1,000	259
1953	1,000	259
1954	1,000	259
1955	1,000	259
1956	800	207
1957	800	207
1958	800	207

Year	COM	YFT
1959	1,000	259
1960	800	207
1961	800	207
1962	800	207
1963	800	207
1964	800	207
1965	900	233
1966	900	233
1967	1,000	259

Year	COM	YFT
1968	1,000	259
1969	1,000	259
1970	800	207
1971	900	233
1972	1,000	259
1973	1,100	285
1974	2,604	674
1975	3,066	793
1976	3,465	897

Year	COM	YFT
1977	3,675	951
1978	4,000	1,035
1979	3,700	957
1980	4,073	1,054
1981	3,271	846
1982	2,939	760

iii. **1983-1991:** Catches of YFT estimated through interpolation on the basis of 1982 and 1992 recorded catches. Thus, the trend of catches for the species is presumed to be steady for the period.

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
YFT	760	1,533	2,306	3,079	3,852	4,625	5,397	6,170	6,943	7,716	8,489
Formula		$YFTc_{Y1982...1990} + (YFTc_{92} - YFTc_{82}) / 10$									

b. **Narrow-barred Spanish mackerel (COM):** Catches estimated for two different periods:

i. 1950-1995: Catches as recorded in the IOTC database (from the FAO). There is no other information available on catches of the species for 1950-91 and only catches in the Red Sea for 1992-95.

Year	COM
1950	800
1951	800
1952	1,000
1953	1,000
1954	1,000
1955	1,000
1956	800
1957	800
1958	800
1959	1,000

Year	COM
1960	800
1961	800
1962	800
1963	800
1964	800
1965	900
1966	900
1967	1,000
1968	1,000
1969	1,000

Year	COM
1970	800
1971	900
1972	1,000
1973	1,100
1974	2,604
1975	3,066
1976	3,465
1977	3,675
1978	4,000
1979	3,700

Year	COM
1980	4,073
1981	3,271
1982	2,939
1983	851
1984	4,496
1985	3,515
1986	3,839
1987	3,315
1988	2,634
1989	2,273

Year	COM
1990	3,118
1991	3,207
1992	2,551
1993	3,092
1994	3,255
1995	3,047

ii. **1996-2004:** Catches of COM have been repeated in the FAO FishStat database since 1997. Catches are mostly from the Red Sea were a decreasing trend has been observed during the last decade due to overfishing. The estimation was conducted as follows:

1. Catches of COM in the Gulf of Aden for 1991-95: Estimated by subtracting total catches of COM recorded in the FAO FishStat database from the catches estimated in the Red Sea for the same period:

Year	Total	Red Sea	Gulf of Aden
1991	3,207	2,529	678
1992	2,551	2,713	0
1993	3,092	2,957	135
1994	3,255	3,046	209
1995	3,047	2,854	193
Total	**15,314**	**14,099**	**1,215**
Proportion	**1.00**	**0.92**	**0.08**

2. Catches of COM in the Gulf of Aden for 1996-04: Estimated from the proportion that the catches of COM in the Red Sea made up of the catches in the Gulf of Aden overall for the period 1991-95.

$$C_{GA} = 0.08 * C_{RS} / 0.92$$

Year	Red Sea	Gulf of Aden	Total
1996	2,218	191	2,409
1997	2,144	185	2,329
1998	2,069	178	2,247
1999	1,995	172	2,167

Year	Red Sea	Gulf of Aden	Total
2001	1,846	159	2,005
2002	1,772	153	1,925
2003	1,698	146	1,844
2004	1,624	140	1,764

Year	Red Sea	Gulf of Aden	Total
2000	1,921	166	2,087

Year	Red Sea	Gulf of Aden	Total

3. Total catches of COM for 1996-2004 input as catches estimated in the Red Sea plus catches in the Gulf of Aden (above table).

The previous assumption might be wrong due to the different catch trends in the Red Sea and Gulf of Aden descending and ascending, respectively. Catches of COM in the area, however, have shown a decreasing trend in countries other than Yemen.

c. Other species: Estimated catches of yellowfin tuna or catches of narrow-barred Spanish mackerel were used to estimate the catches of other tuna and tuna-like species.

i. **Indian mackerel (GUT):** Catches previously recorded under KGX (seerfish not elsewhere included) where assigned to GUT. Although the catches under KGX may include some catches of wahoo (WAH) or streaked seerfish (STS) it is thought that the majority refers to GUT. The catches were estimated as follows:

1. **1950-1988**: Catches of KGX are not recorded in the FAO database. It is, however, likely that catches occurred during this period. The catches of GUT were estimated on the basis of the proportion that they made up out of the catches of COM for 1989-93 (IOTC database), this assuming that the catch trends of GUT and COM were the same over the forty years.

The table below shows the proportion that the catches of GUT made up out of the total catches of GUT and COM for 1989-93:

Year	Total	COM	GUT
1989	2,719	2,273	446
1990	3,583	3,118	465
1991	3,723	3,207	516
1992	3,051	2,551	500
1993	3,630	3,092	538
Total	16,706	14,241	2,465
Proportion	**1.00**	**0.85**	**0.15**

Catches estimated for 1950-88 are shown in the table below:

$$C_{GUT} = 0.15 * C_{COMy1950...1988} / 0.85$$

Year	COM	GUT
1950	800	138
1951	800	138
1952	1,000	173
1953	1,000	173
1954	1,000	173
1955	1,000	173
1956	800	138
1957	800	138
1958	800	138
1959	1,000	173

Year	COM	GUT
1960	800	138
1961	800	138
1962	800	138
1963	800	138
1964	800	138
1965	900	156
1966	900	156
1967	1,000	173
1968	1,000	173
1969	1,000	173

Year	COM	GUT
1970	800	138
1971	900	156
1972	1,000	173
1973	1,100	190
1974	2,604	451
1975	3,066	531
1976	3,465	600
1977	3,675	636
1978	4,000	692
1979	3,700	640

Year	COM	GUT
1980	4,073	705
1981	3,271	566
1982	2,939	509
1983	851	147
1984	4,496	778
1985	3,515	608
1986	3,839	664
1987	3,315	574
1988	2,634	456

2. **1989-1995**: Previous catches of KGX in the IOTC database were assigned to GUT.

Species	1989	1990	1991	1992	1993	1994	1995
GUT	446	465	516	500	538	538	500

3. **1996-2004**: The catches of GUT were estimated on the basis of the proportion that they make out of the catches of COM in 1995, this assuming that GUT and COM catch rates were similar over the nine years.

   The table below shows the proportion that the catches of GUT made out of the total catches of GUT and COM during 1995:

Year	Total	COM	GUT
1995	3,547	3,047	500
Proportion	**1.00**	**0.86**	**0.14**

   Catches estimated for 1996-2004 are shown in the table below:

   $C_{GUT} = 0.14 * C_{COMy1996...2004} / 0.86$

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004
COM	2,409	2,328	2,248	2,167	2,086	2,006	1,925	1,844	1,764
GUT	395	382	369	356	342	329	316	303	289

ii. **Longtail tuna (LOT), Skipjack tuna (SKJ), Kawakawa (KAW), Frigate tuna (FRI) and tunas not elsewhere included (TUN):** The proportion between estimated catches of yellowfin tuna or narrow-barred Spanish mackerel and the catches of each of the above species for 1989-1995 were used to estimate catches of these species, depending on the year:.

1. **1950-1988**: Catches of LOT, SKJ, KAW, FRI and TUN are not always recorded in the FAO database. The catches of these species in years for which data are not available were estimated on the basis of the proportion that they make out of the catches of COM for 1989-93 (IOTC database), this assumes that catch rates were similar over this forty years period. Catches in the IOTC database were kept for years in which they were available.

   The table below shows the proportion that the catches of LOT, SKJ, KAW, FRI and TUN make out of the catches of each species plus the catches of COM for 1989-93:

Year	COM	GUT	TUN	KAW	FRI	LOT	SKJ
1989	2,273	446	262	1,252	21	563	12
1990	3,118	465	273	1,569	22	1,276	13
1991	3,207	516	303	1,601	24	651	14
1992	2,551	500	294	1,615	23	1,324	13
1993	3,092	538	316	504	25	1,707	14
Total	14,241	2,465	1,448	6,541	115	5,521	66
Proportion	**1.00**	**0.17**	**0.10**	**0.46**	**0.01**	**0.39**	**0.00**

   Catches estimated for 1950-88 are shown in the table below:

   TUN: Catches estimated for the entire period

   KAW: Catches estimated for 1950-73; 1974-88 catches as recorded in the IOTC database.

   FRI-LOT-SKJ: Catches estimated for 1950-83; 1983-88 catches as recorded in the IOTC database.

   $C_{SPS} = Prop_{SPS89-93} * C_{COMy1950...1988}$

Year	COM	TUN	KAW	FRI	LOT	SKJ
1950	800	81	367	6	310	4
1951	800	81	367	6	310	4
1952	1,000	102	459	8	388	5
1953	1,000	102	459	8	388	5
1954	1,000	102	459	8	388	5
1955	1,000	102	459	8	388	5
1956	800	81	367	6	310	4
1957	800	81	367	6	310	4
1958	800	81	367	6	310	4
1959	1,000	102	459	8	388	5
1960	800	81	367	6	310	4
1961	800	81	367	6	310	4
1962	800	81	367	6	310	4
1963	800	81	367	6	310	4
1964	800	81	367	6	310	4
1965	900	92	413	7	349	4
1966	900	92	413	7	349	4
1967	1,000	102	459	8	388	5
1968	1,000	102	459	8	388	5
1969	1,000	102	459	8	388	5

Year	COM	TUN	KAW	FRI	LOT	SKJ
1970	800	81	367	6	310	4
1971	900	92	413	7	349	4
1972	1,000	102	459	8	388	5
1973	1,100	112	505	9	426	5
1974	2,604	265	372	21	1,010	12
1975	3,066	312	438	25	1,189	14
1976	3,465	352	495	28	1,343	16
1977	3,675	374	525	30	1,425	17
1978	4,000	407	577	32	1,551	19
1979	3,700	376	500	30	1,434	17
1980	4,073	414	1,713	33	1,579	19
1981	3,271	333	875	26	1,268	15
1982	2,939	299	843	24	1,139	14
1983	851	87	760	7	330	4
1984	4,496	457	1,029	62	868	81
1985	3,515	357	2,033	33	953	4
1986	3,839	390	1,347	43	401	9
1987	3,315	337	1,277		520	36
1988	2,634	268	1,628	75	593	

2. **1989-1995**: Catches as recorded in the IOTC database for all species.

Species	1989	1990	1991	1992	1993	1994	1995
TUN	262	273	303	294	316	316	300
KAW	1,252	1,569	1,601	1,615	504	1,164	1,226
FRI	21	22	24	23	25	25	20
LOT	563	1,276	651	1,324	1,707	2,291	2,204
SKJ	12	13	14	13	14	14	15

3. **1996-2004**: The catches of LOT, SKJ, KAW, FRI and TUN were estimated on the basis of the proportion that they make out of the catches of YFT in 1995, this assumes equal proportions of catches for yellowfin tuna and other species over time. The latter is probably not completely true because, according to the information available, catch rates of yellowfin tuna have been increasing over the last decade as targeting of YFT increases. Whether the catches of other species have increased proportionally to yellowfin catches is not known.

   The table below shows the proportion that the catches of LOT, SKJ, KAW, FRI and TUN made out of the catches of YFT in 1995:

Year	YFT	TUN	KAW	FRI	LOT	SKJ
1995	13,215	300	1226	20	2204	15
Proportion	**1.00**	**0.02**	**0.09**	**0.00**	**0.17**	**0.00**

   Catches estimated for 1996-2004 are shown in the table below:

   $C_{SPS} = Prop_{SPS95} * C_{YFTy1996...2004}$

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004
TUN	341	387	433	479	525	571	618	664	710
KAW	1,392	1,580	1,769	1,958	2,146	2,335	2,524	2,712	2,901
FRI	23	26	29	32	35	38	41	44	47
LOT	2,502	2,841	3,180	3,519	3,858	4,198	4,537	4,876	5,215
SKJ	17	19	22	24	26	29	31	33	35

iii. **Other species (swordfish and Indo-Pacific bonito)**: Data on SWO catches from 1980 - 86 are presumed to come from foreign longline ships instead of domestic boats. SWO is not usually caught by artisanal vessels and it is known that foreign longliners were licensed to operate off Yemen during the 1980s. It is presumed that, as it has been the case with other countries, the catch data represents both domestic (artisanal) and foreign (industrial) crafts operating in Yemen combined. The much higher catches of YFT recorded for some years would confirm this.

Catches of Indo-Pacific bonito (BIP) are available for 1980-88 but were removed from the database as BIP is not an IOTC species.

Revised catch estimates

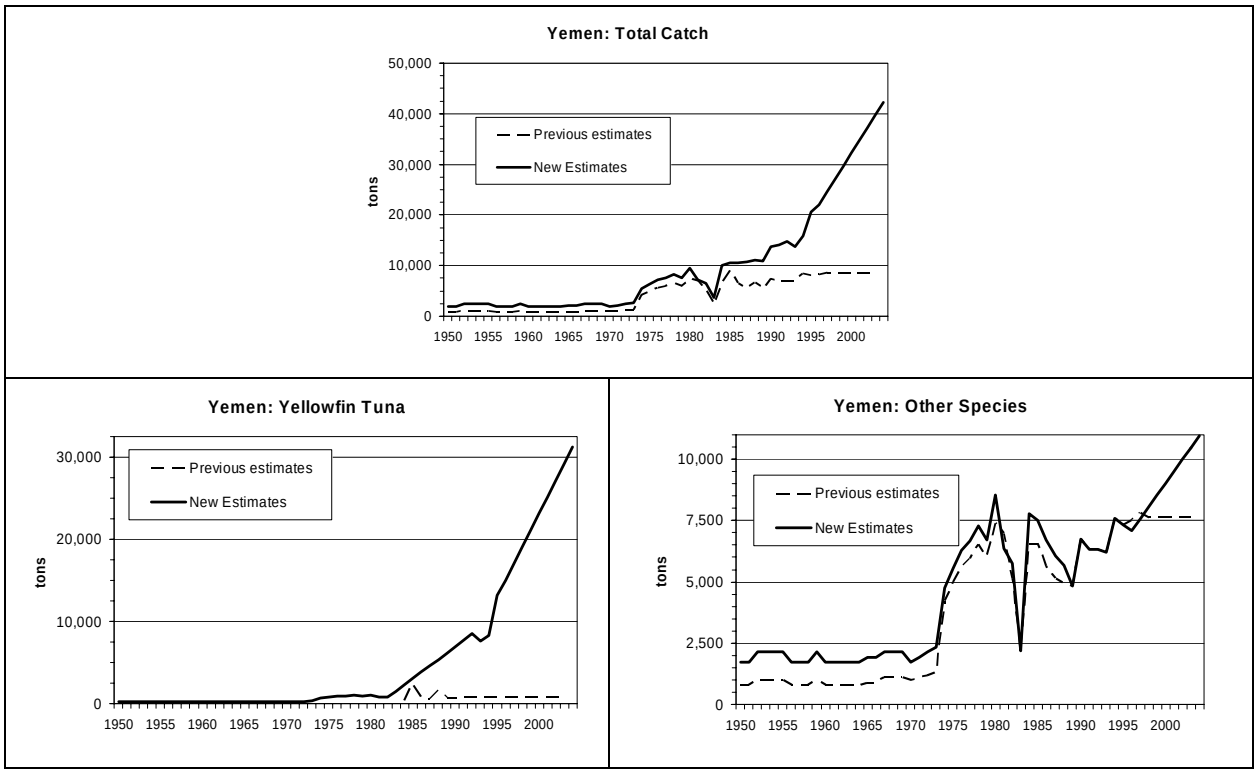
The revised catches and number of crafts estimated for Yemen are shown in the table below:

Year	no Craft	TOTAL	YFT	COM	GUT	TUN	KAW	FRI	LOT	SKJ
1950		**1,913**	207	800	138	81	367	6	310	4
1951		**1,913**	207	800	138	81	367	6	310	4
1952		**2,394**	259	1,000	173	102	459	8	388	5
1953		**2,394**	259	1,000	173	102	459	8	388	5
1954		**2,394**	259	1,000	173	102	459	8	388	5
1955		**2,394**	259	1,000	173	102	459	8	388	5
1956		**1,913**	207	800	138	81	367	6	310	4
1957		**1,913**	207	800	138	81	367	6	310	4
1958		**1,913**	207	800	138	81	367	6	310	4
1959		**2,394**	259	1,000	173	102	459	8	388	5
1960		**1,913**	207	800	138	81	367	6	310	4
1961		**1,913**	207	800	138	81	367	6	310	4
1962		**1,913**	207	800	138	81	367	6	310	4
1963		**1,913**	207	800	138	81	367	6	310	4
1964		**1,913**	207	800	138	81	367	6	310	4
1965		**2,154**	233	900	156	92	413	7	349	4
1966		**2,154**	233	900	156	92	413	7	349	4
1967		**2,394**	259	1,000	173	102	459	8	388	5
1968		**2,394**	259	1,000	173	102	459	8	388	5
1969		**2,394**	259	1,000	173	102	459	8	388	5
1970		**1,913**	207	800	138	81	367	6	310	4
1971		**2,154**	233	900	156	92	413	7	349	4
1972		**2,394**	259	1,000	173	102	459	8	388	5
1973		**2,632**	285	1,100	190	112	505	9	426	5
1974		**5,409**	674	2,604	451	265	372	21	1,010	12
1975		**6,368**	793	3,066	531	312	438	25	1,189	14
1976		**7,196**	897	3,465	600	352	495	28	1,343	16
1977		**7,633**	951	3,675	636	374	525	30	1,425	17
1978		**8,313**	1,035	4,000	692	407	577	32	1,551	19
1979		**7,654**	957	3,700	640	376	500	30	1,434	17
1980		**9,590**	1,054	4,073	705	414	1,713	33	1,579	19
1981		**7,200**	846	3,271	566	333	875	26	1,268	15
1982		**6,527**	760	2,939	509	299	843	24	1,139	14
1983		**3,719**	1,533	851	147	87	760	7	330	4
1984		**10,077**	2,306	4,496	778	457	1,029	62	868	81

Year	no Craft	TOTAL	YFT	COM	GUT	TUN	KAW	FRI	LOT	SKJ
1985		**10,582**	3,079	3,515	608	357	2,033	33	953	4
1986	2,093	**10,545**	3,852	3,839	664	390	1,347	43	401	9
1987		**10,684**	4,625	3,315	574	337	1,277		520	36
1988		**11,051**	5,397	2,634	456	268	1,628	75	593	
1989		**10,999**	6,170	2,273	446	262	1,252	21	563	12
1990		**13,679**	6,943	3,118	465	273	1,569	22	1,276	13
1991		**14,032**	7,716	3,207	516	303	1,601	24	651	14
1992	4,314	**14,809**	8,489	2,551	500	294	1,615	23	1,324	13
1993	4,189	**13,774**	7,578	3,092	538	316	504	25	1,707	14
1994	4,566	**15,901**	8,298	3,255	538	316	1,164	25	2,291	14
1995	6,313	**20,527**	13,215	3,047	500	300	1,226	20	2,204	15
1996	7,110	**22,079**	15,000	2,409	395	341	1,392	23	2,502	17
1997	8,030	**24,597**	17,034	2,328	382	387	1,580	26	2,841	19
1998	8,409	**27,117**	19,067	2,248	369	433	1,769	29	3,180	22
1999	8,788	**29,636**	21,101	2,167	356	479	1,958	32	3,519	24
2000	9,167	**32,152**	23,134	2,086	342	525	2,146	35	3,858	26
2001	9,545	**34,674**	25,168	2,006	329	571	2,335	38	4,198	29
2002	9,924	**37,193**	27,201	1,925	316	618	2,524	41	4,537	31
2003	10,303	**39,711**	29,235	1,844	303	664	2,712	44	4,876	33
2004	10,682	**42,230**	31,268	1,764	289	710	2,901	47	5,215	35

Although the revised estimates are likely to be more realistic than those recorded before in the IOTC database, they remain highly uncertain due to the paucity of available information and the numerous assumptions that had to be made to derive them. Data quality was, for this reason set to 'poor' for all strata.

The following figures show the differences between revised and previous catches estimated for Yemen:



Finally, it is important to note that the strengthening of fisheries resources management in Yemen is one of the main components of a World Bank Project that is due to start by the end of 2005. The IOTC/OFCF[29] Project will be sending a mission to Yemen in the future in order to obtain more information on the type of activities implemented and expected outcome.

[29] Overseas Fisheries Cooperation Foundation of Japan