The marine fisheries of Yemen with emphasis on the Red sea and cooperatives¹

Dawit Tesfamichael^{a,b}, Peter Rossing^a and Hesham Saeed^c

^a Sea Around Us, Fisheries Centre, University of British Columbia, 2202 Main Mall, Vancouver, BC, V6T 1Z4, Canada ^b Department of Marine Sciences, University of Asmara, Eritrea ^c Marine Research and Resource Center, Hodeidah, Yemen d.tesfamichael@fisheries.ubc.ca; p.rossing@fisheries.ubc.ca; alsaeed_co@yahoo.com

Abstract

The marine fisheries catches in the Exclusive Economic Zone (EEZ) of Yemen are reconstructed from 1950 to 2010 using published literature, local reports, databases and interviews, with emphasis on the Red Sea. Reported catches were first separated into the Red Sea and Gulf of Aden, then into different sectors, artisanal, subsistence and industrial, and further into taxonomic composition. In the Red Sea waters of Yemen, the only active fisheries were the artisanal and subsistence until 1970; then, the industrial fishery started. The total catch remained low (around 10,000 t·year⁻¹ in the 1950s) until the formation of fishery cooperatives and the availability of loans from the Agricultural Credit Bank in the mid-1970s, which allowed for the motorization of many vessels. The peak catch of about 90,000 t·year⁻¹ was achieved at the end of 1990s and then it declined to about 44,000 t·year⁻¹ by the end of 2000s. The industrial fishery picked up only in the mid-1990s, but its catches began to decline around 2003. The reconstructed catches were 1.9 times the Food and Agriculture Organization (FAO) catch data for the Red Sea part of Yemen.

In the Gulf of Aden, inshore pelagic fishes make up the largest amount of the total catch, while the catch of coral reef-associated fishes has declined. The demersal fish catch fluctuated, depending on access agreements for foreign trawlers to operate in Yemeni waters. The total catch was around 40,000 t·year⁻¹ in the 1950s, increased to about 175,000 t·year⁻¹ in the mid-1980s (mainly due to a trawling fishery which did not survive the re-unification of South and North Yemen in 1990) then massively increased, with peak catches of above 350,000 t·year⁻¹ in the 2000s. Overall, reconstructed catches were 2.1 times the FAO data for the Gulf of Aden part of Yemen. Although the total number of taxa in the catch is very high, 7 taxa accounted for more than 50% of the total catch in the Red Sea and 4 in the Gulf of Aden.

INTRODUCTION

The Republic of Yemen is situated on the southwest corner of the Arabian Peninsula, and is bordered by Saudi Arabia to the North, the Red Sea to the West, the Gulf of Aden and the Arabian Sea to the South and Oman to the East (Figure 1). Hence, Yemen has access to both the Red Sea and the Gulf of Aden. Prior to its (re)unification, in 1990, Yemen consisted of two entities, the Yemen Arabic Republic (YAR; or North Yemen) and the People's Democratic Republic of Yemen (PDRY, or South Yemen). The border between the two entities was where the Red Sea opens to the Gulf of Aden; hence, the Yemeni Red Sea coast was entirely part of the North Yemen (YAR) and the Gulf of Aden under South Yemen (PDRY). This research emphasizes the fisheries along the Red Sea coast of Yemen. All the fisheries, both by domestic fleets and foreign, are included. However, for completeness' sake, an account of the Gulf of Aden fisheries is also given in Appendix B. In the following, the waters off 'North Yemen' and the waters along the 'Red Sea coast of Yemen' are treated as synonymous, as are 'South Yemen' and 'Gulf of Aden waters of Yemen'.

Yemen is divided into governorates and three of these border the Red Sea, i.e., Hajja, Al Hodeidah and Ta'izz. Fish are landed at 31 locations along the Red Sea coast with the largest proportion occurring in the Al Hodeidah governorate (Akester 2007). The main ports where fishing is concentrated are Hodeidah, Al Khauka, Al Khoba and Mocha.



Figure 1. The Red Sea coast of Yemen with its shelf area and Exclusive Economic Zone (EEZ).

¹ Cite as: Tesfamichael, D., Rossing, P. and Saeed, H. (2012) The marine fisheries of Yemen with emphasis on the Red Sea and cooperatives. pp. 105-152. *In*: Tesfamichael, D. and Pauly, D. (eds.) Catch reconstruction for the Red Sea large marine ecosysytem by countries (1950-2010). Fisheries Centre Research Reports 20(1). Fisheries Centre, University of British Columbia [ISSN 1198-6727].

The waters off Yemen include a shelf area of 41,000 km² (FAO 2002a). Overall, these waters exhibit a high level of primary and secondary production, and hence the country is endowed with considerable fisheries resources. This is especially true for the Gulf of Aden, whose catches, as it will be shown below, were generally well above those from the Red Sea coast.

To date, over 600 commercial species of fish and invertebrates have been recorded from Yemen (see www.fishbase.org). Of these, 40 species (mainly pelagic) contribute the bulk of the Red Sea catch, notably sharks, jacks and tunas (Brodie *et al.* 1999). The fisheries are an important source of foreign exchange, generating an estimated 2–3% of Yemen's GDP in the mid-2000s (Koehn and Aklilu 1999; FAO 2002a).

The Yemeni Ministry of Fish Wealth (MoFW) is mandated with the management of fishery resources, and controls the licensing of boats and the collection of data, while the Marine Research and Resource Center (MRRC) is a government institute active in fisheries and environmental research. Both institutions collaborate when conducting fisheries research, which faces numerous human and financial constraints that have affected the data collection system. Their branch offices in Hodeidah are responsible for the Red Sea coast of Yemen. The fishing activities of Yemen can be broadly divided into (a) artisanal (small scale), (b) subsistence and (c) industrial (large scale). Recreational fishery does not exist in Yemen (Morgan 2006).

Artisanal

Yemen has a long history and tradition of artisanal fisheries. Yemeni fishers are the most experienced in the wider Red Sea, where they operate, legally or not, along the coasts of several countries. Yemeni fishers also venture into the Indian Ocean, and in their wide range of operation, they are similar to the Fante people of West Africa (Atta-Mills *et al.* 2004). They are also innovative, and were often the first to introduce new fishing practices and gears. Yemeni fishers also benefit from well-organized cooperatives, a financing system and an infrastructure unique among countries in the region, that includes a logistics system which provides them with all the basic necessities for their fishing trips such as fuel, food and gear. There are anecdotal evidences that Yemeni artisanal fishers venture out from the EEZ of Yemen and fish in neighboring countries waters.

Many coastal people of Yemen depend on fishing for their livelihood. In the Red Sea, the number of Yemeni fishers has increased from approximately 3,000–4,500 in the mid-1970s to over 37,000 in 2007, while the number of artisanal boats grew from approximately 1,000 to 7,600 (Walczak and Gudmundsson 1975; Agger 1976; MoFW 2008). The reported artisanal Red Sea landing, however, declined from its peak 51,247 t in 1993 to 28,641 t in 2007 and in 2010, it declined further, to 20,751 t (MoFW 2008, 2012) as many species have become over-exploited (Morgan 2006).

The artisanal or traditional fisheries are mainly restricted inshore, with fishing taking place close to the landing areas and targeting mostly pelagic species (PERSGA 2001). Catches are landed directly on the beach, or are brought beyond the surf line, on the back of porters (Bonfiglioli and Hariri 2004). The primary vessels used in artisanal fisheries are sambouk, a wooden vessel which can range from 12 to 20 m, with an inboard diesel engine, and houri, a smaller canoe like vessel of 7–12 m, fitted with outboard engine and/or sails (Sanders and Morgan 1989). In the 1970s, Yemen's artisanal fleet underwent massive technological changes; notably, sailing houris were motorized as fishers got access to loans from the Yemeni government and foreign aid agencies (Barraniya 1979). In the mid-1970s, the Agricultural Credit Bank was established and, together with the flourishing of fishery cooperatives, facilitated the growth of fisheries. This trend has continued and engines have become more powerful, enabling skippers to operate further away from shore with larger crew (Walczak and Gudmundsson 1975; Brodie *et al.* 1999). This, combined with the availability of ice has enabled fishing trips to last for several days (PERSGA 2001). Hook and line fishing (hand or troll); gillnetting (drifting or set) and purse seine are the most important types of gears used (Barraniya 1979). A small number of sambouks have, since the 1980s, also been equipped to trawl for shrimp (Sanders and Morgan 1989). Besides those gears, there are some minor fisheries in which artisanal fishers get involved, such as crabs, cuttlefish and sea cucumber fisheries for which diverse gears such as trap, skin and hookah diving, spears etc... are used.

Most of the artisanal catch is consumed locally; however, export of the higher value component of the catch of artisanal fisheries is growing. The low grade fish, such as Indian mackerel, are dried and sold all the way to the interior of Yemen. Yemeni society, especially along the coast, has a long tradition of seafood consumption. Fisheries are an important part of the socio-economic and cultural part of the community, and command strong political and financial support, partly due to the strength and success of the fishery unions, important in organizing and financing the fishery.

Subsistence

Subsistence fishing takes place at beaches free of rocks and coral reefs using beach seines to catch sardines, anchovy and other small pelagic species, locally referred to as '*wasif*' fishery (Walczak 1977). This is the least capital intensive fishery and solely for consumption by local communities; hence it is here categorized as a subsistence fishery. In addition to the small pelagic fishery, the subsistence fishery includes the catch of the artisanal fishery that is consumed by the crew and the catch that is freely given to family, friends and part of the communities who need such help. This portion can be as much as half of the total catch in the earlier years. Hence, it is important to explicitly represent this component in the catch reconstruction, even though it declined as the marketing of seafood grew.

Industrial

Prior to reunification, the PDRY and YAR sought to develop their fisheries in different ways. The government of South Yemen focused on the development of industrial foreign and state-owned fisheries in the 1970s and the early 1980s, while that of North Yemen aimed to develop its artisanal small scale fisheries, notably by offering loans to fishers to improve their boats and equipment (Koehn and Aklilu 1999). Thus, industrial fishing was extremely rare in the YAR, one of the exceptions being shrimp trawling by a Kuwaiti company operating along the Red Sea coast of Yemen from 1970 to 1978 (Walczak and Gudmundsson 1975; Sanders and Morgan 1989; Morgan 2006). However, following reunification, industrial vessels that had been operating in the Gulf of Aden were granted access to the Red Sea as well. From 1993 to 2010, most of the trawlers were from Egypt and a few from Lebanon. In 1998, there were 63 licensed boats in the Red Sea, catching a total of 4,200 t (FAO 2005). At present, the landings from industrial vessels consists mostly of shrimp, cuttlefish, emperor, snappers, lizardfish and threadfin fish. Estimates from Brodie *et al.* (1999) suggested that industrial vessels were typically 20–40 meter long, with motors of 500–800 hp, and caught 600–800 kg/day of shrimp, which is much higher than the 25 kg of shrimp caught daily by sambouks in the same period. The rapid growth of effort and the changes it induced in the last few decades have led to dramatic decline in catch rates, which could be a sign of overfishing in many areas and leading, among other things, to conflict between artisanal and industrial fisheries (Bonfiglioli and Hariri 2004).

While Yemen has introduced recent measures to better control industrial fishing, its limited capacity to effectively monitor existing regulations has limited the impact of these measures (Pramod *et al.* 2008). Compounding the overfishing issue, official catch statistics greatly misreport what is caught (Morgan 2006). Reported landings have historically not accounted for all species and have failed to include the recent drastic increase in the number of artisanal boats (Herrera and Lepere 2005). Official landing statistics have overlooked significant illegal, unregulated and unreported (IUU) catches, known to be substantial in Yemen's industrial fishing sector (Koehn and Aklilu 1999).

Thus, the aim of this study is to reconstruct Yemen's catch statistics from 1950 to 2010 in order to provide fisheries scientists and managers with more reliable information on which to base their fisheries policies. The main focus of this report is Yemen's fishery in the Red Sea. However, a brief description and catch reconstruction of the Gulf of Aden is also included, to obtain a comprehensive understanding of Yemeni fisheries and also to allow for comparison between Yemen's Red Sea and Gulf of Aden fisheries. Catches are reconstructed and presented by sectors and taxonomic composition of each sector. Further, the reconstructed catches are compared with the data Yemen reported to FAO.

MATERIALS AND METHODS

Separating the FAO data into Red Sea and Gulf of Aden

Yemen reports its catch annually to the FAO through one data set for the country which combines both the Red Sea and Gulf Aden, and thus needs to be split, as the two seas are here treated separately. For this, we used sources which reported the catch of the two seas separately, i.e., the catch ratios they provided were used to divide the total Yemen catch in the FAO records into their respective seas. Sanders and Morgan (1989), PERSGA (2001), (FAO 2002b), MoFW (2004) and MoFW (2008) provided reported total landings for both the Red Sea and the Gulf of Aden/Arabian Sea for the periods 1976–1986, 1986–1994, 1998, 2002–2003 and 2006–2007, respectively (Table 1). For 1986, data were obtained from Sanders and Morgan (1989) for the Red Sea and from (PERSGA 2001) for

the Gulf of Aden and Arabian Sea. We used the reported proportions to divide the FAO data into Gulf of Aden and Red Sea components for these years. Also, in absence of a better alternative, the estimated catch proportion for 1976 was used for the period 1950–1975. All other missing years were estimated using interpolation except for 2009 and 2010, where the average ratio from 2006 to 2008 was used (Table 1, Figure 2). This split was used as an initial value to compare the reconstructed values with the FAO data and to calculate the reconstructed catch as a proportion of the FAO data for the reconstruction of Yemeni catch in the Gulf of Aden (see below). The final FAO data for each sea, however, were calculated latter by taking into account the taxonomic breakdown information which caused the proportions to change slightly, so this first split is not necessarily representative of the final data set.



Figure 2. Marine fisheries catch of Yemen, 1950–2010, as reported to FAO by Yemen for both the Red Sea and the Gulf of Aden.

Catch reconstruction for the Red Sea waters of Yemen, 1950–2010

No catch statistics exist that present Yemen's F landings in the Red Sea as a complete time series from 1950 to 2010. Similarly, no published information was found that accounts for the unreported catches in Yemen. Catch time series were therefore estimated using a reconstruction method based on assumption-driven inferences (Pauly 1998; Zeller and Pauly 2007). Such an approach is justified, despite data uncertainties, given the less acceptable alternatives that users of official data will interpret non-reported or missing data components as zero catches (Pauly 1998; Pitcher et al. 2002; Tesfamichael and Pitcher 2007). Using data from published, gray literature and interview sources as anchor points, time series data can be reconstructed interpolation and extrapolation using (Tesfamichael and Pauly 2011). Anchor points included fishery surveys, national reported catch data, peer-reviewed literature, and field trip interviews and data collected in Yemen by the first author in 2007. We worked in close collaboration with local experts from Yemen's Ministry of Fish Wealth (MoFW) and Marine Research and Resource Center (MRRC) to get feedback, and update our results.

The Yemeni artisanal and industrial catches in the Red Sea (i.e., of pre-unification North Yemen) were estimated separately. For the artisanal fisheries, this involved reconstructing landings and unreported catch for the major fisheries targeting large pelagics and coral reefassociated fishes using *houri* and *sambouk*, which constitute the 'artisanal fisheries'. The same procedure was needed for the beach seine fishery (a subsistence fishery). Also reconstructed were the catches of the minor artisanal fisheries for sea cucumber, crabs, and cuttlefish. For the industrial fishery, the elements involved in the reconstruction included estimating reported landings, discards

Table 1. Sources used to split the total catch data submitted by Yemen
to FAO into Red Sea, and Gulf of Aden and Arabian Sea components from
1950 to 2010.

1950 10 2	2010.		
Period	Red Sea	Gulf of Aden	Source/Remarks
1950–75	0.20	0.80	Assumed 1976 value
1976	0.20	0.80	Sanders and Morgan (1989)
1977	0.21	0.79	Sanders and Morgan (1989)
1978	0.29	0.71	Sanders and Morgan (1989)
1979	0.26	0.74	Sanders and Morgan (1989)
1980	0.16	0.84	Sanders and Morgan (1989)
1981	0.17	0.83	Sanders and Morgan (1989)
1982	0.17	0.83	Sanders and Morgan (1989)
1983	0.20	0.80	Sanders and Morgan (1989)
1984	0.18	0.82	Sanders and Morgan (1989)
1985	0.19	0.81	Sanders and Morgan (1989)
1986	0.20	0.80	Sanders and Morgan (1989), PERSGA (2001)
1987	0.19	0.81	PERSGA (2001)
1988	0.24	0.76	PERSGA (2001)
1989	0.24	0.76	PERSGA (2001)
1990	0.35	0.65	PERSGA (2001)
1991	0.42	0.58	PERSGA (2001)
1992	0.46	0.54	PERSGA (2001)
1993	0.50	0.50	PERSGA (2001)
1994	0.54	0.46	PERSGA (2001)
1995	0.50	0.50	Interpolation
1996	0.47	0.53	Interpolation
1997	0.43	0.57	Interpolation
1998	0.39	0.61	FAO (2002)
1999	0.34	0.66	Interpolation
2000	0.29	0.71	Interpolation
2001	0.25	0.75	Interpolation
2002	0.20	0.80	MoFW (2004)
2003	0.15	0.85	MoFW (2004)
2004	0.14	0.86	Interpolation
2005	0.14	0.86	Interpolation
2006	0.14	0.86	MoFW (2008)
2007	0.17	0.83	MoFW (2008)
2008	0.24	0.76	MoFW (2012)
2009–10	0.18	0.82	Average of 2006–08

and unreported landings. The estimation of catch composition was mostly based on reports with reliable data and the database of the Ministry of Fish Wealth (MoFW), with interpolations for missing years. Last but not least, we also classified the reconstructed total catch into their taxonomic composition and ecological guilds.

Artisanal fisheries

Reported landings

The first catch estimates for Yemen in the Red Sea were made in the 1970s by the staff of FAO field projects, based on surveys of the artisanal fisheries for the number of boats, number of fishing days and catch rates to derive yearly catches for the various boat types (Agger 1976; Campleman 1977; Walczak 1977; Barraniya 1979). They provided reliable estimates for Yemen's *houri* and *sambouk* catches for the 1970s, which are used as anchor points.

Barraniya (1979) presented two different sets of catch statistics covering 1970–1978: one based on the General Directorate of Hodeidah and another based on the Central Planning Agency of Yemen. The former data set was used because its data matched the results of an independent extensive survey for 1973 by Agger (1976). As these data did not pertain to a calendar year, but applied from June to May of the next year (Walczak 1977), they were adjusted to the calendar year using monthly catch ratios for 1975 (Barraniya 1979). This approach reconstructed only 6 months of the catches for 1970 and 1978. For those two years, total annual catch was calculated using the average proportions from 1971 to 1977. Since most of the catch by the artisanal fisheries was for local consumption, we assumed, to estimate the total catch from 1950 to 1969, that catches grew proportionally with Yemen's population. Hence, catches from 1950 to 1969 were estimated using 1970 as an anchor point and population sizes given in www .populstat.info/ (Table 2).

Brodie *et al.* (1999) reported landings were used for 1979–1982 and 1987– 1997. Landings provided by Sanders and Morgan (1989) were used, instead of the ones reported by Brodie *et al.* (1999), for the years 1983 – 1986, as these data had a better species breakdown. A dataset of the Ministry of Fish Wealth was used for the years 1998 – 2007 (MoFW 2004, 2008) and 2008 – 2010 (MoFW 2012). Table (2) summarizes the equations, assumptions and sources used to estimate the reported artisanal catch landings from 1950 to 2010.

Unreported catch

Table 2. Methods for estimating artisanal fisheries landings 1950 – 2010.

Year	Procedure	Source/Remarks
1950-69	(Pop_/Pop_1070)* Land_1070	Catches grew proportional to population size
	n = year 1950-1969	
1970-78	Adjusted reported landings	Barraniya (1979)
1979-82	Reported	Brodie (1999)
1983-86	Reported	Sanders and Morgan (1989)
1987-97	Reported	Brodie (1999)
1998-2007	Reported	MoFW (2004, 2008)
2008-10	Reported	MoFW (2012)
Dec I	Construction of the college of the construction	

Pop = population; Land = landings

Reported landings for Yemen's artisanal fisheries are believed to be severely underestimated (Chakraborty 1984; Koehn and Aklilu 1999; PERSGA 2001; Herrera and Lepere 2005; Morgan 2006; Pramod *et al.* 2008). In Yemen, fishers do not necessarily land their catches at landing sites where landings are recorded. Based on interviews with fishers, a sizeable fraction of the total catch is landed in areas remote from major landing sites, where it goes unreported (Tesfamichael *et al.* in press).

In the 1970s, reported landings were based on the number of boats multiplied by observed landings, based on observations for some landing places and some days of the year (Chakraborty 1984). Interviews with fishers who were active since the 1950s suggest that they graded their catch. Usually the high grade fish and the big size fish of the chosen fishes were sold in the formal market where fishery statistics were recorded, and the rest was sold in the informal markets. This is supported by the relatively small number of taxa reported in early statistics. Sanders and Morgan (1989) noted that grading was an issue in the artisanal fisheries. Species now landed, notably catfish, sharks and the smaller grunts, were not preferred in the past. So, we assumed, conservatively, the level of under-reporting, to have been 30% of the reported landing from 1950 to 1975.

In the mid-1970s, Yemen's catch statistics for the Red Sea improved considerably as a more comprehensive system of fisheries data collection was put in place (Sanders and Morgan 1989). The catch data we used from 1983 to 1986, provided by Sanders and Morgan (1989), were therefore considered quite reliable (Herrera and Lepere 2005). The level of underreporting was assumed to be 20% and 10% for 1976–1982 and 1983–1990, respectively. For about a decade after 1991, no reliable analysis of landings statistics, resource surveys or stock assessments were undertaken, due to the system for collecting fisheries statistics having broken down after the re-unification of Yemen. This resulted in gross underestimation of artisanal catches. Thus, for example, statistics were not adjusted for the growth of the artisanal

Table 3. Percentages used to estimate unreported catches of the artisanal fisheries in Yemeni Red Sea, 1950–2010.

Year	%
1950-75	30
1976-82	20
1983-90	10
1991-2001	20
2002-10	10

fishery, including the number of boats, failed to account for fish sold outside auctions and relied on historical prices to convert auction sales to weight (Koehn and Aklilu 1999; PERSGA 2001; Herrera and Lepere 2005; Morgan 2006). We assumed the level of unreported catch to be 20% for the period 1991–2001. Catch statistics after 2002 are believed to have improved, as Yemen took a number of steps to improve its fisheries management with external financial and technical assistance (Morgan 2006). Thus, 10% was assumed to be the level of unreported catch from 2001 to 2010. Table (3) summarizes the values used to estimate the unreported catches from 1950 to 2010.

Catch composition

Catch composition data for 1974–1976 were available in Walczak (1977), which were used to disaggregate our reconstructed total catch (reported and unreported) for the period 1950–1978. However, the constituents of a few groups were modified. Walczak (1977) reported catch ratio for 'jacks', a group we split into two, i.e., 'jacks' (Carangidae) and 'queen fish' (Scomberoides spp.), contributing 72% and 28%, respectively, based on the catch ratio of these species for the years 1979–1986. This was done as interviewed fishers indicated that they always historically caught queen fish. Similarly, snappers (Lutjanidae) and emperors (Letrinidae), which were reported together, were split in a similar way using data from 1979 to 1986, with relative contributions of 25% and 75%, respectively.

The average of the 1983–1986 catch composition reported by Sanders and Morgan (1989) was used to disaggregate total landings from 1979 to 1982. From 1983 to 2010, the data were already reported by taxonomic composition. We used Sanders and Morgan (1989) for 1983–1986, Brodie *et al.* (1999) for 1987–1997, MoFW (2004, 2008) for 1998–2007 and MoFW (2012) for 2008 – 2010 who reported catch compositions for the periods indicated (See Appendix Table A1).

Other minor artisanal fisheries

The relatively minor artisanal fisheries included in this group target sea cucumber (Holothuroidea), crabs (Brachyura) and cuttlefish (Sepiidae). Sea cucumbers have been harvested for many years, but have traditionally been omitted from the catch statistics (Bonfiglioli and Hariri 2004). Catch data for this fishery are therefore very sporadic. Walczak (1977) indicated that 20 t of sea cucumber were exported in 1975. Sea cucumber landings were also reported from 2000 to 2010 (MoFW 2012). As sea cucumber catches are reported in dry weight units we converted the reported catch data to wet weight by multiplying them by a factor of 9.54 based on Purcell *et al.* (2009). Based on qualitative information from interviews, we assumed that catches began in 1970 and used interpolations between anchor points to derive the missing years 1971–1974 and 1976–1999.

Records of the artisanal catches for crab and cuttlefish were only available for 2002–2003 (MoFW 2004) and for 2006 – 2010 (MoFW 2012). Based on interviews, these taxa are likely to have been caught in the past as well, but remained unrecorded, as is the case for the sea cucumber fishery. Catches for 1950–2001 were estimated by adjusting the catch from 2002 relative to estimated population size. The catches for 2004–2005 were interpolated between the landings of 2003 and 2006. Tables (4 and 5) summarize the equations, assumptions and sources used to estimate the reported artisanal landings of sea cucumber, cuttlefish and crabs from 1950 to 2010.

Subsistence fishery

Table 4. Methods used for estimating catches of sea cucumbers in Yemen (Red Sea), 1950–2010. Note all dry weights were converted to wet weight.

Remarks	
umbers were not prior to 1970	
(1977)	
changed steadily n anchor point year	ars
2012)	
umbers were prior to 1970 (1977) changed ste n anchor poin 2012)	adily

Table 5. Methods used for estimating landings of cuttlefishand crabs 1950 – 2010.

Year	Procedure	Source/Remarks
1950-2001	Pop,* Per capita catch ₂₀₀₂ ;	Catches grew proportionally
	i= 1950-2001	with population
2002-03	Reported catch	MoFW (2004)
2004-05	Interpolation between 2003-06	Catches changed steadily between anchor point years
2006-10	Reported catch	MoFW (2012)

The subsistence fishery includes beach seining for small pelagic fishes, which is considered an entirely subsistence fishery, and the catch of the artisanal fishery that is consumed by the crew and/or given to family, friends and people in the fishing communities who need help.

The beach seine fishery for sardines and anchovies was estimated to be 1,500 t in 1976 (Walczak 1977). Unfortunately, no other data point was available. However, based on interviews with fishers, it appeared that the fishery has been active for a long time at subsistence levels. The catch for the whole period 1950–2010 was calculated by assuming that it was directly proportional to Yemen's population size. This is reasonable, because the beach seine fishery catches were mainly subsistence and strongly affected by population size. However, an adjustment was applied to the population-related catches from 1976 to 2010, where a multiplier of 1 was used for 1976 and 0.5 for 2010 and the multipliers between the two points were interpolated. This was done to reflect the likely decrease in catch per unit effort of the fishery over its long period of operation and arrive at a conservative catch estimate.

The subsistence fishery catch that comes from the artisanal fishery was calculated from a ratio of the artisanal fishery catch (excluding the minor artisanal fishery described above). We assumed the subsistence catch to be 30% of the artisanal catch from 1950 to 1974. The ratio was reduced to 20% for 1975, when the motorization of the artisanal fleet was in full swing and the artisanal fishery started to become more commercialized, hence likely decreasing the proportion of the catch freely given to the community. The ratio was assumed to be 10% in 2010 and the ratios between 1975 and 2010 were interpolated. Based on interviews with fishers and the fishery administration in Yemen, fishers used to give up to 50% of their catch away, so these ratios are quite conservative.

Industrial fisheries

The industrial fisheries in the Yemeni Red Sea waters are operated by foreign vessels. Reported, unreported catches and discards were reconstructed as three separate components of industrial fisheries from 1950 to 2010 in Yemen's Red Sea. Industrial fishing in Yemen's Red Sea went through three distinct phases. First, there was a period of limited shrimp trawling in the 1970s (Agger 1976; Walczak 1977), followed by a period of no industrial fishing lasting from the 1980s to the early 1990s (Chakraborty 1984; PERSGA 2001), and lastly a period characterized by an in-flux of foreign bottom trawlers from 1992 to 2010 MoFW (2004, 2008, 2012).

Reported catch

Industrial fisheries did not begin in Yemen's Red Sea until the late 1960s. Agger (1976) indicated that the Greek Achilles Frangistas Co. had gained permission to trawl in the waters of Yemen's Red Sea, Saudi Arabia and Eritrea with at least two 86 m 2,000 HP factory trawlers from the period 1966/1967. As this operation was a form of exploratory fishing with very limited catches, it is not considered here.

Shrimp catches reported by the General Directorate of the Hodeidah from 1970/71 to 1977/78 were used as basis to reconstruct industrial catches for 1970 – 1978 (Barraniya 1979). The catches from 1970/71 to 1973/74 were identical to those reported for the United Fishing Company of Kuwait, or UFCK, formerly Gulf Fisheries. The company operated a total of 43 trawlers and two mother ships until it stopped in May 1974 due to declining catches (Walczak 1977). As the records were for the period lasting from June to May of the next year (Walczak 1977), the catches were recomputed for calendar year based on the assumption that monthly catches had the same distribution as observed in 1975 (Barraniya 1979). This gave an estimate of the industrial shrimp catches for 1970–1978. For 1970 and 1978, this approach only allocates half a year of catch data. These two years where raised to annual catches using seasonal average for 1971–1977.

We assumed industrial catches to be nil between 1979 and 1992, as no industrial fishing occurred in Yemen's Red Sea in the 1980s and the early 1990s (Chakraborty 1984; PERSGA 2001). It recommenced when Yemen, after reunification, changed its policy to allow foreign fishing fleets access to the Red Sea, beginning with two Lithuanian double-rigged shrimpers in 1993 (PERSGA 2001). The fishing was carried out mainly by Egyptian trawlers and to a less extent by Lebanese from 1993 to 2000, and from 2001 to 2010 by Egyptian only. In 1998, it was reported that 40–44 foreign industrial bottom trawlers caught 4,186 t of shrimp and fin fish (FAO 2002a). Total reported industrial landings for the Red Sea were also available for 2002 and 2003 (MoFW 2004) and 2006 and 2007 (MoFW 2008). These years were used as anchor points, and for the missing years 1993–1997; 1999–2001 and 2004–2005, catches were estimated by interpolation between these anchor points. The

Table 6. Reported landings of industrial fishingvessels in Yemen's Red Sea.

Year	Source/Remarks
1950-69	Zero catch Agger (1976)
1970-78	Barraniya (1979)
1979-92	Zero catch: Chakraborty (1984); PERSGA (2001)
1993-97	Interpolation
1998	FAO Fishstat (Year)
1999-2001	Interpolation
2002-03	MoFW (2004)
2004-05	Interpolation
2006-07	MoFW (2008)
2008-10	Using reconstructed/FAO ratio

total catch for 2008–2010 was estimated using the average ratio between reconstructed catch and FAO data for 2006 and 2007. The average total industrial reconstructed catch, including retained, unreported and discarded, for 2006 and 2007 was 47% of Yemen's FAO data for the Red Sea. The total was divided between retained and discard using the ratio 1:2, the ratio used from 1993 to 2007 (see discard calculation below). Table (6) summarizes the sources and procedures used to estimate the reported industrial landings from 1950 to 2010.

Unreported catch

The unreported catch refers to the catch that is landed but not recorded in the official statistics, while the discards (see below) refer to the catch that is not recorded nor landed. We added a conservative 10% to the reported landings for the industrial fleet from 1970 to 1978, as the catches of the United Fishing Company of Kuwait (UFCK) fleet were thought to be underreported (Walczak 1977). Yemen now requires observers onboard industrial vessels, but this has not solved the problem, because observer coverage is partial (Pramod *et al.* 2008), and the effectiveness of the limited onboard observation is also very questionable. Local experts estimate the unreported catch, in the Red

Table 7. Industrial fishing boats unreported landings in Yemen's Red Sea 1950–2010.

	,0	
Year	Procedure	Source/Remarks
1950-69	n/a	Zero catch Agger (1976)
1970- 78	Rep. landings, * 0.1;	Unreported landings were
	i=year 1970-78	10% of the reported landings.
		Zero catch Chakraborty
1979-92	n/a	(1984); PERSGA (2001)
1993-2007	Rep. landings, * 0.75;	Unreported landings were
	i=year 1993-2007	75% of the reported landings.
2008-10		Used reconstructed/FAO ratio

Sea, to be 75% of the total catch from 1993 to 2007. Table (7) summarizes the equations, assumptions and sources used to estimate the unreported industrial landings from 1950 to 2007. The unreported catch from 2008 to 2010 is calculated as part of the total industrial catch using the reconstructed catch to FAO ratio as described above.

Discards

Discards are catch that are not landed, hence not recorded as well. Discards from trawling, especially from shrimp, are substantial and must therefore be added as a component of industrial fisheries catch. However, data regarding Yemen's discard levels in the Red Sea were limited. Lisac (1971), while onboard a United Fishing Company of Kuwait trawler, observed discards from shrimping to be up to three times that of shrimp caught. Losse (1973) found that boats fishing for shrimp discarded approximately 4.4–5.6 t of fish for every tonne of shrimp caught. For 1950–1969, discards were zero as industrial fishing did not occur during these years. For the period 1970–1978, we assumed discards to be 75% of total catch (reported + unreported catch + discards) based on Lisac (1971). A reduced discard

rate of 67% was assumed from 1993 to 2007, as shrimp were no longer the only species retained. The discard amount from 2008 to 2010 was calculated as part of the total catch, using the average ratio of reconstructed catch (including retained, unreported and discard) to FAO data for 2006 and 2007, i.e., reconstructed catch was 47% of FAO data for the Red Sea. The discarded catch was 67% of the total industrial catch, the ratio used from 1993 to 2007. Table (8) summarizes the equations, assumptions and sources used to estimate industrial discards from 1950 to 2010. **Table 8.** Discards from industrial fishing boats fishing in Yemen's Red Sea 1950–2010.

Year	Procedure	Source/Remarks
1950-69	n/a	Zero catch Agger (1976)
1970-78	3 * (report. land, + unreport. land,) i=year 1970-78	Discards were 75% of total catch Lisac (1971)
1979-92	n/a	Zero catch Chakraborty (1984); PERSGA (2001)
1993-2007	2 * (report. land, + unreport. land,) i=year 1993-2007	Discards were 67% of total catch using Lisac (1971) as a base
2008-10		Used reconstructed/FAO ratio and discards were 67% of total catch

report. land = reported landing; unreport. land = unreported landing

Species composition

The species composition of industrial catches was estimated separately for total retained catches and for discards. For the retained catch, total catches from 1970 to 1978 were assumed to be shrimp only (Barraniya 1979), reflecting the nature of the fishery then. The earliest catch composition data available for Yemen since the industrial fishery started to retain non-shrimp taxa in 1993 were for 2002 and 2003 (MoFW 2004). For the years 1993–2001 we used the weighted average ratios of 2002 and 2003 to calculate the catch composition. Catch composition data were available for 2006 and 2007 (MoFW 2008) whose average values were used for 2004 and 2005. From 2008 to 2010, for which the total retained catch was calculated using the FAO to reconstructed catch ratio of the previous years, the composition was calculated using the weighted average of the ratios from 1998 to 2007. The data for 2002 and 2003 had more generalized categories for which 'deep water fishes' accounted for more than 85%. This was later subdivided to taxa using ratios from 2006 and 2007 (Table 9).

Table 9. Species composition (%) of total industrial landings in Yemen's Red Sea 1950–2010.

Year	Penaeidae	Brachyura	Sepiidae	Nemipterus spp.	Synodontidae	Lethrinidae	Lutjanidae	Sources/Remarks
1970-78	100.00	0	0	0	0	0	0	Barraniya (1979)
1993-2001	7.00	0.64	4.90	27.49	49.98	6.25	3.75	Weighted average of 2002-03
2002	2.49	0.52	2.08	29.83	54.23	6.78	4.07	MoFW (2004)
2003	11.30	0.74	7.58	25.26	45.92	5.74	3.44	MoFW (2004)
2004-05	3.12	0.05	20.86	23.88	43.41	5.43	3.26	Weighted average of 2006-07
2006	2.70	0.08	29.38	21.32	38.77	4.85	2.91	MoFW (2008)
2007	3.96	0.00	3.64	29.04	52.80	6.60	3.96	MoFW (2008)
2008-10	5.47	0.40	10.40	26.32	47.85	5.98	3.59	Weighted average of 1998-2007

Surveys estimating the species composition of trawlers' discards were available from the FAO research vessel R/V Orion from 1974 to 1977 (Walczak 1977). These percentages were used in unaltered form to breakdown discard totals by species from 1970 to 1978. However, in recent years, many species previously discarded are retained, as the most sought-after species are getting scarcer. Thus, these were removed from the survey, and the total of the ratio of the remaining discarded species was scaled up to 100% to divide the discard into its composition from 1993 to 2010 (Table 10).

Comparing reconstructed catches with FAO data

The catch composition of each sector was compared with the taxonomic composition of the data Yemen reported to FAO (www.fao.org/fishery/statistics/software/fishstat/en). Only the artisanal and industrial sectors were compared with the FAO data, as the subsistence and discarded catches are not reported to FAO. A few taxa were reported to the FAO, but were not in our reconstructed catch composition. They were allocated to the appropriate sector in the reconstruction. Their amount in the reconstructed catch. The amounts were later deducted from the 'others' of the sector to which they were allocated. For each sector, for the years the group 'others' was higher than 10% it was reduced to 10% and the rest distributed to the taxa already identified according to their proportion in each sector.

Table 10. Species composition (%) of the discards of the industrial fishery in Yemen's Red Sea. Main source was Walczak (1977).

Тахор	1070 79	1002 2010
TaxUII	1970-78	1993-2010
Pony fish	31.0	62
Malabar jacks	15.0	0
Lizard fish	14.0	0
Threadfin bream	12.0	0
Grunts	4.5	0
Grunters	3.5	7
Mojarra	2.0	4
Cutlass fish	2.0	4
Ariid catfish	2.0	0
Other jacks	1.0	0
Flatheads	1.0	2
Puffers	1.0	2
Soles	1.0	2
Barracudas	1.0	0
Jack pomfret	1.0	2
Blue swimming crab	1.0	2
Sardines, anchovies	0.5	1
Goatfish	0.5	1
Mantis shrimp	0.5	1
Cuttlefish	0.5	0
Other fish	5.0	10

After the reconstructed and the corresponding FAO catch by taxa were tabulated, comparison was done at the taxonomic level. The part of the reconstructed catch that is accounted in the FAO data is referred as 'reported catch' in our result. If the value of a taxon in the reconstructed catch was higher than its value in the FAO data, then the difference was labeled as 'unreported catch'. If the FAO value for a taxon was higher than the reconstructed catch, the difference is over-reported catch in the EEZ of Yemen into the Red Sea. At this stage, each sector had a more detailed catch composition than it started with in the catch composition methods presented above. Since, the comparison of the reconstructed catch what is reported in the methodological tables given in the above, including Table (1) that has the ratios to divide the FAO data between the Red Sea and Gulf of Aden. This procedure was done for the Gulf of Aden as well, which his presented in Appendix B.

Results

The total catch in Yemen's EEZ in the Red Sea (both by domestic and foreign fleets) was low, and started to increase in the early 1970s (Figure 3, Appendix Table A2). It reached its peak at the end of 1990s. The majority of Yemen's catch in its Red Sea EEZ is generated by the artisanal fisheries (66%).

The artisanal catch went through different phases: relatively low level until the beginning of the 1970s, a slow increase until the mid-1980s, followed by a rapid increase until a peak was reached in 1993 and a phase of rapid decline since (Figure 3). The rapid increase was due to motorization of boats. The decline could be caused by a conflict with Eritrea over the Hanish Islands, in the southern part of the Red Sea, which prevented Yemeni from accessing some major fishing grounds. The unreported catch of the artisanal fishery accounted for 40% of the total artisanal catch from 1950 to 2010.



Figure 3. Reconstructed catch in Yemeni Red Sea waters from 1950 to 2010 by sectors compared to the total supplied to FAO.

For the period 1993–2007, when the industrial fishery was active, the artisanal catch was on average 58% of the total catch. The contribution of industrial fisheries increased only after 1990, the year of Yemen's re-unification, when industrial fishing was encouraged, and permission was given to foreign fleets to operate in the Red Sea waters. Overall, the industrial sector accounted for 18% of the reconstructed catch with only 6% being retained. The subsistence catch, third in its contribution (16%), follows the trend of the artisanal fishery, because its main component is computed as a proportion of the artisanal catch. Discards accounted for 12% of the total catch (all from the industrial sector) and appeared mainly after the 1990s with the resumption of industrial fishery.

The category 'reported' in Figure (4) and Table (A3) is the amount of the reconstructed catch reported in the FAO data for Yemen for its EEZ in the Red Sea, while the unreported catch is the difference between our reconstructed catch and the FAO data. The reported catch and unreported landings each accounted for 44% of the total catch. Unreported landed catches existed throughout the whole period and had more stable values than the other components. The discarded catch appeared in the latter period when the industrial fishery was active (Figure 3). Both the unreported catch and discards are not recorded in the official statistics, the main difference is that the unreported catches are landed while discards are not. The artisanal fisheries use selective gear; hence, almost all the catch is retained. However, not all their catch is reported.



Figure 4. Reconstructed catch in Yemeni Red Sea waters from 1950 to 2010 by components. Reported catch refers to the part of reconstructed catch accounted in the FAO data.

The number of taxa in the catch of the artisanal fishery is quite high. The dominant taxa are Indian mackerel (*Rastrelliger kanagurta*), narrow-barred Spanish mackerel (*Scomberomorus commerson*), emperors (Lethrinidae), and sharks (Carcharhinidae) (Figure 5). The taxa represented in Figure (5) are only the dominant ones; a detailed catch composition is given in Appendix Table (A4). Most of the dominant species are caught by gillnet, the major gear for artisanal fishers of Yemen in the Red Sea. The number of taxa increased in later years, because, based on interviews with fishers, the species that were very important in the earlier years started to decrease and fishing effort switched to previously non-targeted taxa.

The total catch of the minor artisanal fisheries for sea cucumber, cuttlefish and crabs is very low, compared to the major artisanal fishery or other sectors. Sea cucumbers were the largest component of the total catch, and hence, their catch time series shapes the pattern of the total catch of the minor artisanal fisheries (Figure 6, Table A5). The sea cucumber fishery started only in the 1970s. Before 1970, the catch of cuttlefish and crabs was very low, but then increased.

The subsistence beach seine fishery for small pelagic fish is not detailed in the fishery statistics of Yemen. Although, its economic value may not be as important compared to the other fisheries, the amounts caught are quite significant and their contribution to food security are very important, as beach seining is a fishery whose catch is fully consumed and distributed within all of Yemen. In the absence of other data, it is reasonable to assume that the total catch of this fishery changes with population size. Accordingly, the catch was low, around 1,200 t-year-1, until the 1980s and then started to increase continuously even after we have assumed the catch per capita in 2010 to be only half of that of 1975, which we believe is a very conservative estimate (Figure 7).

The other subsistence fishery catch (i.e., the fraction of the artisanal catch that is given away) has relatively less difference in its amount from 1950 to 2010 compared to the other fisheries, with the exception of a sharp increase in the 1990s (Figure 8), during which time the artisanal fishery – the main source of subsistence catch – achieved its peak. Even for the 1990s, however, the change is gentler for subsistence than artisanal fishery as can be seen by comparing Figures (5 and 8). This is a realistic representation for a subsistence fishery, as it is not thought to be strongly affected by market fluctuations. A more detailed catch composition of the subsistence fishery is given in Table (A6).

Industrial fisheries played an important role in the Red Sea part of Yemen only since the mid-1990s. Prior to this, in the 1970s, it was relatively small, and caught only shrimps. After the reunification in 1992, the industrial fishery became more important, targeting shrimp and a wide variety of finfish. Since the fishery uses non-selective trawling gear, a huge proportion of the catch is thrown overboard. The highest peak of the industrial fishery occurred in 2003, when a large number of foreign vessels were given permits to fish along Yemen's Red Sea coast. However, the number of licences was reduced after 2003, because the government wanted to restrict this fishery (Akester 2007), hence the decline in total catch (Figure 9). According to our catch reconstruction, from 1950 to 2010, reported catch, unreported catch and discards accounted for 22%, 11% and 67% of the total catch, respectively.

Euthynnus affinis Lutianidae Scomberoides spp Scombridae Chrysoblephus spp 50 Serranidae Trachurus spp. Nemipterus spp Catch (10³ t) Sphyraenidae Carcharhinidae Lethrinidae 25 Scomberomorus commersor Rastrelliger kanagurta 1960 1980 1950 1970 1990 2010 2000 Year

Figure 5. Taxonomic composition of the reconstructed catch of the artisanal fishery of Yemen in the Red Sea from 1950 to 2010.



Figure 6. Reconstructed catch of the minor artisanal fisheries of Yemen in the Red Sea from 1950 to 2010.



Figure 7. Reconstructed catch of beach seine fishery of Yemen in the Red Sea from 1950 to 2010.

Lizard fish and threadfin bream, with a combined 73%, are the dominant taxa that are retained by the industrial fishery. There are a number of other taxa that appear in the retained catch, but their contribution is limited (Figure 10 and Table A7). The main target of the industrial fishery was and still is shrimp, which accounts for less than 10% of the total hauled catch. Some of the taxa that are not the prime target are retained (Figure 10), but the majority, mainly demersal species, are discarded. The number of taxa in the discarded catch is quite large and they are usually discarded because they lack economic value (Figure 11 and Table A8 for more details). The dominant group in the discards is ponyfishes (Leiognathidae) with 61%.

With regard to the taxonomic composition of the total catch in Yemeni Red Sea EEZ, Indian mackerel (Rastrelliger kanagurta) and kingfish (Scomberomorus commerson) are dominant at the species level (Figure 12), with 17% and 9%, respectively. They are so dominant that they are represented individually in Yemeni fisheries statistics, while other taxa are usually lumped together at family level. A total of 43 taxa make up 94% of the total catch in the Red Sea, while the rest are taxa with minor contributions. Only the major taxa are shown in Figure (12), the rest were added to the group 'others'. Ponyfish (Leiognathidae), a discarded group in the bottom trawl fishery, started to increase since the early 1990s, when the industrial fishery increased its effort. A more detailed catch composition is given in Table (A9).

When the total catch is broken into ecological groups (Table 11), the pelagic (predominantly inshore taxa) group was dominant and more or less stable throughout the entire period (Figure 13). This is the group targeted by the gillnet fishery of the artisanal sector-which, unlike the industrial fishery is rather stable. The coral reef-associated species group increased its contribution to the total catch starting in the mid-1980s, but declined drastically at the end of the 1990s. The contribution of the demersal fish targeted by the industrial fishery was high starting in the early 1990s. Sharks and rays also contributed significantly to the total catches in the 1990s. The classification of the taxa into ecological groups is based on the dominant behavior they exhibit in relation to the fishery and gear used to catch them. Otherwise, some of them could inhabit different habitats. The group 'others' includes all the minor taxa and



Figure 8. Taxonomic composition of the reconstructed subsistence catch (part of the artisanal fishery given away freely) of Yemen in the Red Sea from 1950 to 2010.



Figure 9. Components of the industrial fishery catch in Yemeni Red Sea from 1950 to 2010.

hence cannot be put to any ecological group. The coral reef-associated group, which shows the least fluctuation, has been fished for a long time and plays an important role in domestic food security (Figures 14 - 17).

DISCUSSION

Lack of a structured data recording system is a serious hindrance for assessing the catch of Yemen in the Red Sea by different gears and taxonomic compositions. Although such data do not exist continuously for the whole period from 1950 to 2010, pieces of information exist from different periods reported by various authors and institutions in Yemen. In this report, the total catch in the Red Sea EEZ of Yemen is reconstructed from 1950 to 2010; the catch is divided into artisanal, subsistence and industrial sectors and, as well, into the taxa that compose the catch. Assumptions were made to fill in some of the data gaps. These assumptions are made based on the best knowledge available to us about the fisheries at the time of the research. The artisanal sector is more important in the Yemeni Red Sea than the industrial sector. The artisanal fishery is locally owned and operated while the industrial fishery is almost exclusively foreign and its operation is sporadic. The artisanal fishery is the main livelihood for many coastal communities, and hence also the source of subsistence catches.



Figure 10. Taxonomic composition of the retained industrial fishery catch in Yemeni Red Sea from 1950 to 2010.

Yemen's artisanal fishery is one of the best established in the Red Sea. It has a large number of boats and fishers, a strong cooperative system, a relatively smoothly working financing system, and an effective marketing system that meets a high demand. Yemen has a long and strong fishing tradition and Yemeni's fishers are found throughout the Red Sea and Indian Ocean, actively spreading their fishing skills to neighboring countries (Tesfamichael and Pitcher 2006). For example, Yemeni fisheries were active in the small pelagic fishing industry in Eritrea, where they fished in the EEZ of Eritrea and sold their catches to the fish meal processing plants within Eritrea in the 1950s and 1960s (Tesfamichael and Mohamud 2012).

The increase in total catch of the artisanal fishery in the mid-1970s, from its near constant value of around 10,000 t-year-1 to more than 20,000 t·year⁻¹ in the 1980s is due to the strengthening of the sector by the formation of fishery cooperatives and the establishment of the Agricultural Credit Bank of Yemen. These two institutes allowed the availability of loans for the fishers to buy new boats and more importantly motorization of the boats. Although, the Agricultural Credit Bank was established in 1976 and opened the door for fishers requiring loans for motorization, it took several years for the fishers to adopt the new technology. The momentum increased and major motorization occurred at the end of the 1970s (Barraniya 1979), which further increased the number of artisanal fishers. The number of boats and fishers increased significantly at the end of the 1980s resulting in a rapid increase of total catch (Brodie et al. 1999). Although fishers reported a decline in their catch rates, the larger number of boats combined with bigger engines and availability of ice, which allowed the fishers to stay longer at sea and go to further fishing grounds, resulting in higher total catch.



Figure 11. Taxonomic composition of the discarded industrial fishery catch in Yemeni Red Sea from 1950 to 2010.



Figure 12. Reconstructed total catch by major taxa in the Red Sea EEZ of Yemen from 1950 to 2010.

Table 11.	Ecological	l groups of	the major	taxa in the	catch of Y	emen in the Red Sea.
-----------	------------	-------------	-----------	-------------	------------	----------------------

Pelagic	Coral reef-associated	Demersal	Sharks and rays
Atule mate	Lethrinidae	Leiognathidae	Carcharhinidae
Carangidae	Lutjanidae	Synodontidae	Dasyatidae
Carangoides malabaricus	Nemipterus spp.	Holothuroidea	Rhinobatidae
Clupeidae	Priacanthidae	Penaeidae	
Rastrelliger kanagurta	Rachycentron canadum	Sepiidae	
Scomberoides spp.	Scaridae	Ariidae	
Scomberomorus commerson	Serranidae	Mugilidae	
Scombridae	<i>Terapon</i> spp.	Gerreidae	
Sphyraenidae	Haemulidae	Trichiuridae	
Trachurus spp.	Chrysoblephus spp.	<i>Epigonus</i> spp.	
Euthynnus affinis		Parastromateus niger	
Thunnus tonggol		Platycephalidae	
		Portunus pelagicus	
		Soleidae	
		Tetraodontidae	
		Brachyura	
		Mullidae	
		Stomatopoda	

As far as the industrial fishery is concerned, its contribution to the total catch was considerable during the years it was given permission to operate. The official reports of the industrial fishery do not account for the discards that can be up to 90% of the total catch. This omission can be misleading in any fishery management decision-making process. It is helpful to present the discards clearly so that by-catch mitigation strategies can be investigated. This can be either by spatial allocation of trawling, by designating mesh size or by-catch excluding devices. On the other hand, if the discard information is not presented at all, as is currently the case, there will not be any urgency to deal with the real problem that it represents.

Pelagic fish contributed the largest proportion throughout the whole period and did not exhibit any considerable decline, as compared to demersal and reef-associated fish. The high fluctuation of the trawl fishery is due to whether or not permits were given to the foreign vessels. An interesting case is the difference between the catch of pelagic and reef fish. They are both generated by artisanal fisheries; however, reef fishes exhibit a sharper increase and later decrease than pelagic fishes, which may be due to the migrations which pelagic fish undertake. The southern part of the Red Sea gets replenishment of migratory pelagic species from the more productive Gulf of Aden; hence, it can sustain a larger fishery. On the other hand, reef-associated fish are territorial and hence their biomass will be strongly affected by localized effort increases.

Overall, the reconstructed catch is higher than the catch that Yemen reported to the FAO. This is critical information for future plans in Yemen. Due attention to the reconstructed catch can prevent some serious mistakes in the assumption on the status of the resources (Tesfamichael 2012). The fact that the total catch is declining should alert the decision makers to initiate ways of managing effort before the resources get too depleted.



Figure 13. Reconstructed catch by major ecological groups of the fisheries in the Red Sea EEZ of Yemen from 1950 to 2010.



Figure 14. Taxonomic composition of pelagic fishes caught in the Red Sea EEZ of Yemen from 1950 to 2010.





Figure 16. Taxonomic composition of the demersal fishes caught in the Red Sea EEZ of Yemen from 1950 to 2010.

Figure 15. Taxonomic composition of coral reef-associated fishes caught in the Red Sea EEZ of Yemen from 1950 to 2010.



Figure 17. Taxonomic composition of the sharks and rays caught in the Red Sea EEZ of Yemen from 1950 to 2010.

ACKNOWLEDGEMENTS

We would like to thank the personnel of the Marine Research and Resource Center in Hodeidah, especially to Fahad Shooi Zabaan for his help with interviews and data acquisition, and Aref for helping in the arrangement of this work and for hospitality. We also thank the personnel of the Ministry of Fish Wealth, especially Khalid Hezaam Al Makrami. Margaret North's inputs after proof reading the first draft are appreciated. This research was supported by Sea Around Us, a scientific collaboration between the University of British Columbia and The Pew Charitable Trusts.

References

Agger P (1976) Yemen Arab Republic–Stock Assessment FI: DP YEM/74/003/3, FAO, Rome. 1-42 p.

Akester S (2007) Yemen's fisheries: the need for management. The British-Yemeni Society, Vol. 15.

- Atta-Mills J, Alder J and Sumaila UR (2004) The decline of a regional fishing nation: The case of Ghana and West Africa. Natural Resources Forum 28(1): 13-21.
- Barraniya AA (1979) Socioeconomic aspects of the Red Sea fisheries in the Yemen Arab Republic. FAO/UNDP Proj. for Development of Fisheries in Areas of the Red Sea and Gulf of Aden, Rome.
- Bonfiglioli A and Hariri KI (2004) Small-scale fisheies in Yemen: Social assessment and development prospects. FAO, The World Bank. 11 p.
- Brodie J, M., Al-Sorimi and Turak E (1999) Fish and fisheries of Yemen's Red Sea. *In* DouAbul A, Rouphael TS and Marchant R (eds.), Ecosystems of the Red Sea coast of Yemen. Protection of Marine Ecosystems of the Red Sea Coast of Yemen. Hassell & Assoc., AMSAT and UNOPS.
- Campleman G (1977) Fisheries and Marketing in YAR FAO, Rome.
- Chakraborty D (1984) Fishery Statistics in Yemen Arab Republic–An Expanded Plan of Development. FAO/UNDP, SUEZ (EGYPT). 1-48 p.
- FAO (2002a) Fishery Country Profile-The Republic of Yemen. www.fao.org.
- FAO (2002b) Information on Fisheries Management in the Republic of Yemen, February 2002. www.fao.org
- FAO (2005) The FAO Yearbook of Fishery Statistics–Capture production 2003. FAO Fishery Information, Data and Statistics Unit, Rome.
- Herrera M and Lepere L (2005) Revised catch estimates for tuna and tuna-like species caught by artisinal boats in Yemen Indian Ocean Tuna Commitee (IOTC) 15 p.
- Koehn D and Aklilu P (1999) Republic of Yemen-Fisheries Sector Strategy Note World Bank. 1-23 p.
- Lisac H (1971) Report to travel to Yemen Arabic and the People's Republic of Southern Yemen, (16 January–1 February 1972) FAO Fish. Travel Aide Mem., FAO, Rome.
- Losse G (1973) Marine resources of the Yemen Arabic Republic. A report prepared for the the UNEP/FAO Food and Nutrition programme 1973.
- MoFW (2004) Fisheries Statistics Book. Ministry of Fish Wealth, General Department for Planning and Statistic. 224 p.
- MoFW (2008) Catch Statistics Yemen 1990-2007. Ministry of Fish Wealth, General Department for Planning and Statistic.
- MoFW (2012) Catch Statistics Yemen 2008-2010. Ministry of Fish Wealth, General Department for Planning and Statistic.
- Morgan G (2006) Country Review: Yemen. p. 458 *In* De Young C (ed.), Review of the state of world marine capture fisheries management: Indian Ocean. FAO Fisheries Technical Paper. No. 488. FAO, Rome.
- Pauly D (1998) Rationale for reconstructing catch time series. Bulletin. EC Fisheries Cooperation/Bulletin. CE Cooperation Peche. Brussels 11(2): 4-10.
- PERSGA (2001) Strategic action programme for the Red Sea and Gulf of Aden. Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), Jeddah, Saudi Arabia. 149-180 p.
- Pitcher TJ, Watson R, Forrest R, Valtysson HP and Guenette S (2002) Estimating illegal and unreported catches from marine ecosystems: a basis for change. Fish and Fisheries 3(4): 317-339.
- Pramod G, Pitcher TJ, Pearce J and Agnew D (2008) Sources of information supporting estimates of unreported fishery catches (IUU) for 59 countries and the high seas fisheries. Fish. Cent. Res. Rep. Vol. 16, No. 14, Vancouver. 243 p.
- Purcell SW, Gossuin H and Agudo NS (2009) Changes in weight and length of sea cucumbers during conversion to processed beche-de-mer: Filling gaps for some exploited tropical species. SPC Beche-de-mer Information Bulletin 29: 3–6.
- Sanders MJ and Morgan GR (1989) Review of the fisheries resources of the Red Sea and Gulf of Aden. FAO, Rome. 138 p.
- Tesfamichael D (2012) Assessment of the Red Sea ecosystem with emphasis on fisheries. PhD, University of British Columbia, Resource Management and Environmental Studies, Vancouver. 241 p.
- Tesfamichael D and Mohamud S (2012) Reconstructing Red Sea fisheries of Eritrea: A case study of the relationship between political stability and fisheries development. *In:* Tesfamichael D and Pauly D (eds.), Catch reconstruction for the Red Sea large marine ecosystem by countries (1950 2010). Fisheries Centre Research Reports, Vol. 20 (1), Vancouver.

- Tesfamichael D and Pauly D (2011) Learning from the Past for Future Policy: Approaches to Time-series Catch Data Reconstruction. Western Indian Ocean J. Mar. Sci. 10(2): 99-106.
- Tesfamichael D and Pitcher TJ (2006) Multidisciplinary evaluation of the sustainability of Red Sea fisheries using Rapfish. Fisheries Research 78(2-3): 227-235.
- Tesfamichael D and Pitcher TJ (2007) Estimating the unreported catch of Eritrean Red Sea fisheries. African Journal of Marine Science 29(1): 55-63.
- Tesfamichael D, Pitcher TJ and Pauly D (in press) Assessing changes in fisheries using fishers' knowledge to generate long time series of catch rates: a case study from the Red Sea. Ecology and society.
- Walczak P (1977) The Yemen Arab Republic. A study of the marine resources of the Yemen ArabRepublic. A report prepared for the Fisheries Development Project. FAO, Rome. 67 p.
- Walczak P and Gudmundsson J (1975) Yemen Arab Republic–Summary of fish stock assessment work. FAO, Rome. 14 p.
- Zeller D and Pauly D (2007) Reconstruction of marine fisheries catches for key countries and regions (1950-2005). Fisheries Centre Research Report. Volume 15 (2), Vancouver. 163 p.

Year 1 2 3 4 5 6 7 8 9 10 11 12 13 14 1950-82 46 19 5 5 6 3 0 0 0 2 3 2 0 1983 38 15 10 6 7 3 5 2 0 4 0 0 0 0 0 10 1983 38 15 10 4 2 6 3 0 4 2 0 4 1 1985 11 12 11 7 7 6 6 6 4 3 0 4 1 1986 23 9 9 5 3 4 4 6 11 2 3 3 3 3 3 3 3 1 1 1988 2 10 9 7 </th <th>Appendi</th> <th>IX TAD</th> <th colspan="10">Appendix Table A1. Percentages and sources used to disaggregate the catch of artisanal insienes by taxa.</th> <th></th>	Appendi	IX TAD	Appendix Table A1. Percentages and sources used to disaggregate the catch of artisanal insienes by taxa.												
1950-78 46 19 5 5 6 3 0 0 0 0 2 3 2 0 1979-82 24 14 10 6 7 3 5 2 0 4 2 0 3 1 1983 38 15 10 6 7 3 5 2 0 4 0 0 0 1 1984 23 17 10 4 2 6 3 0 0 4 2 0 4 1 1985 21 11 5 5 5 4 6 11 2 2 1 4 1 1986 22 10 9 6 2 5 5 9 9 3 3 3 3 1 1988 22 10 9 7 2 6 5 9 9 1 5 4 4 0 1999 2 6 9 <t< th=""><th>Year</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th></t<>	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1979-82 24 14 10 6 6 5 5 0 2 4 2 0 3 1 1983 38 15 10 6 7 3 5 2 0 4 0 0 0 0 1984 23 17 10 4 2 6 6 6 4 2 0 4 1 1985 11 12 11 7 7 7 6 6 6 1 3 0 4 2 1986 22 10 9 4 4 6 11 2 3 1 4 1 1988 23 9 9 5 3 4 4 6 11 2 3 3 3 3 1 1989 22 10 9 7 2 6 5 4 5 9 3 3 4 4 0 1992 2 10 8 <td< td=""><td>1950-78</td><td>46</td><td>19</td><td>5</td><td>5</td><td>6</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>3</td><td>2</td><td>0</td></td<>	1950-78	46	19	5	5	6	3	0	0	0	0	2	3	2	0
1983 38 15 10 6 7 3 5 2 0 4 0 0 0 4 1 1984 23 17 10 4 2 6 3 0 0 4 2 0 4 1 1985 11 12 11 7 7 7 6 6 4 3 0 4 2 1986 22 12 11 5 5 5 4 4 12 2 2 1 4 1 1987 25 10 9 6 2 5 5 9 9 3 3 3 1 1 1989 22 10 9 7 2 6 5 6 7 4 4 0 1 <t< td=""><td>1979-82</td><td>24</td><td>14</td><td>10</td><td>6</td><td>6</td><td>5</td><td>5</td><td>0</td><td>2</td><td>4</td><td>2</td><td>0</td><td>3</td><td>1</td></t<>	1979-82	24	14	10	6	6	5	5	0	2	4	2	0	3	1
1984 23 17 10 4 2 6 3 0 0 4 2 0 4 1 1985 11 12 11 7 7 7 6 6 6 4 3 0 4 2 1986 22 12 11 7 7 5 5 4 5 6 11 3 0 4 2 1987 25 10 9 4 4 5 4 4 6 11 2 3 1 4 1 1988 23 9 9 5 3 4 4 6 11 2 3 1 4 1 1989 22 10 9 7 2 6 5 6 7 4 4 0 1991 19 8 9 8 14 6 5 8 8 3 3 4 4 0 1992 3 7 9 </td <td>1983</td> <td>38</td> <td>15</td> <td>10</td> <td>6</td> <td>7</td> <td>3</td> <td>5</td> <td>2</td> <td>0</td> <td>4</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td>	1983	38	15	10	6	7	3	5	2	0	4	0	0	0	0
198511121177666430421986221211555456130421987251094454412221411988239953446112314119892210962559933331199022109726567445211991198987545915440199237981465883344019932696135507563421994269610550756342199527981055075634119989797106580113062001141410859 <t< td=""><td>1984</td><td>23</td><td>17</td><td>10</td><td>4</td><td>2</td><td>6</td><td>3</td><td>0</td><td>0</td><td>4</td><td>2</td><td>0</td><td>4</td><td>1</td></t<>	1984	23	17	10	4	2	6	3	0	0	4	2	0	4	1
198622121155545613042198725109445441222141198823995344611231411988221096255993333119902210972656744521199119898754591544019923798146588334401993269613550756342199527961055075634219962797115508573411998979106560453011999389912658068301199938991265<	1985	11	12	11	7	7	7	6	6	6	4	3	0	4	2
1987 25 10 9 4 4 5 4 4 12 2 2 1 4 1 1988 23 9 9 5 3 4 4 6 11 2 3 1 4 1 1988 22 10 9 6 2 5 5 9 9 3 3 3 3 1 1990 22 10 9 7 2 6 5 6 7 4 4 0 1991 19 8 9 8 7 5 4 5 9 1 5 4 4 0 1992 3 7 9 8 14 6 5 8 8 3 3 4 4 0 1993 2 6 9 6 13 5 5 0 7 5 6 3 4 2 1995 2 7 9 7 11	1986	22	12	11	5	5	5	4	5	6	1	3	0	4	2
1988 23 9 9 5 3 4 4 6 11 2 3 1 4 1 1989 22 10 9 6 2 5 5 9 9 3 3 3 3 1 1990 22 10 9 7 2 6 5 6 7 4 4 5 2 1 1991 19 8 9 8 7 5 4 5 9 1 5 4 4 0 1992 3 7 9 8 14 6 5 8 8 3 3 4 4 0 1993 2 6 9 6 13 5 5 0 7 5 6 3 4 2 1995 2 7 9 7 11 5 5 0 7 5 6 3 4 2 1997 2 7 9	1987	25	10	9	4	4	5	4	4	12	2	2	1	4	1
198922109625599333311990221097265674452119911989875459154401992379814658833440199326961365011321711994269613550756342199527961055075634219962797115507563411998979710656045301199938991265806830119993899126580113062001141410856101214052004221398385<	1988	23	9	9	5	3	4	4	6	11	2	3	1	4	1
1990221097265674445211991198987545915440199237981465883344019932696135501132171199426961055075634219952796105507563421996279711550756341199897971065604530119993899126580683011999389912610802140620011414108561080113062003341198386601221420052016985	1989	22	10	9	6	2	5	5	9	9	3	3	3	3	1
1991 19 8 9 8 7 5 4 5 9 1 5 4 4 0 1992 3 7 9 8 14 6 5 8 8 3 3 4 4 0 1993 2 6 9 6 13 5 5 0 91 5 5 2 5 1 1994 2 6 9 6 13 5 5 0 9 5 5 2 5 1 1995 2 7 9 6 10 5 5 0 7 5 6 3 4 2 1996 2 7 9 7 10 6 5 0 8 5 7 3 4 1 1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6	1990	22	10	9	7	2	6	5	6	7	4	4	5	2	1
1992 3 7 9 8 14 6 5 8 8 3 3 4 4 0 1993 2 6 9 6 13 6 5 0 11 3 2 1 7 1 1994 2 6 9 6 13 5 5 0 9 5 5 2 5 1 1995 2 7 9 6 10 5 5 0 7 5 6 3 4 2 1996 2 7 9 6 10 5 5 0 7 5 6 3 4 2 1996 2 7 9 7 11 5 5 0 7 5 6 3 4 2 1996 2 7 9 7 10 6 5 0 8 5 7 3 4 1 1998 9 7 9 7 10 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 1 1 3 0 6 2001 14 10 8 5 6 10 8 0 1 2 2 1 4 2003 34 11 9 8 3 8 6 6 </td <td>1991</td> <td>19</td> <td>8</td> <td>9</td> <td>8</td> <td>7</td> <td>5</td> <td>4</td> <td>5</td> <td>9</td> <td>1</td> <td>5</td> <td>4</td> <td>4</td> <td>0</td>	1991	19	8	9	8	7	5	4	5	9	1	5	4	4	0
1993 2 6 9 6 13 6 5 0 11 3 2 1 7 1 1994 2 6 9 6 13 5 5 0 9 5 5 2 5 1 1995 2 7 9 6 10 5 5 0 7 5 6 3 4 2 1996 2 7 9 7 11 5 5 0 7 5 6 3 4 1 1997 2 7 9 8 10 5 5 0 8 5 7 3 4 1 1998 9 7 9 7 10 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 10 8	1992	3	7	9	8	14	6	5	8	8	3	3	4	4	0
1994 2 6 9 6 13 5 5 0 9 5 5 2 5 1 1995 2 7 9 6 10 5 5 0 7 5 6 3 4 2 1996 2 7 9 7 11 5 5 0 7 5 6 3 4 1 1997 2 7 9 8 10 5 5 0 8 5 7 3 4 1 1998 9 7 9 7 10 6 5 6 0 4 5 3 0 1 1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 1 1 3 0 6 2001 14 10 8	1993	2	6	9	6	13	6	5	0	11	3	2	1	7	1
1995 2 7 9 6 10 5 5 0 7 5 6 3 4 2 1996 2 7 9 7 11 5 5 0 7 5 6 3 4 2 1997 2 7 9 8 10 5 5 0 8 5 7 3 4 1 1998 9 7 9 7 10 6 5 6 0 4 5 3 0 1 1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 14 10 8 5 6 10 8 0 1 1 3 0 6 2002 24 13 8	1994	2	6	9	6	13	5	5	0	9	5	5	2	5	1
1996 2 7 9 7 11 5 5 0 7 5 6 3 4 1 1997 2 7 9 8 10 5 5 0 8 5 7 3 4 1 1998 9 7 9 7 10 6 5 6 0 4 5 3 0 1 1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 14 10 8 5 6 10 8 0 1 1 3 0 6 2002 24 13 8 8 1 5 9 8 0 1 2 2 1 4 2004 22 13 9	1995	2	7	9	6	10	5	5	0	7	5	6	3	4	2
1997 2 7 9 8 10 5 5 0 8 5 7 3 4 1 1998 9 7 9 7 10 6 5 6 0 4 5 3 0 1 1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 14 10 8 5 6 10 8 0 2 1 4 0 6 2002 24 13 8 8 1 5 9 8 0 1 1 3 0 6 2003 34 11 9 8 3 8 6 6 0 1 2 2 1 4 2004 22 13 9	1996	2	7	9	7	11	5	5	0	7	5	6	3	4	2
1998 9 7 9 7 10 6 5 6 0 4 5 3 0 1 1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 14 10 8 5 6 10 8 0 2 1 4 0 6 2002 24 13 8 8 1 5 9 8 0 1 1 3 0 6 2003 34 11 9 8 3 8 5 6 0 1 2 2 1 4 2004 22 13 9 8 5 8 8 4 0 1 2 2 1 4 2005 20 16 9 <td>1997</td> <td>2</td> <td>7</td> <td>9</td> <td>8</td> <td>10</td> <td>5</td> <td>5</td> <td>0</td> <td>8</td> <td>5</td> <td>7</td> <td>3</td> <td>4</td> <td>1</td>	1997	2	7	9	8	10	5	5	0	8	5	7	3	4	1
1999 3 8 9 9 12 6 5 8 0 6 8 3 0 1 2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 14 10 8 5 6 10 8 0 2 1 4 0 6 2002 24 13 8 8 1 5 9 8 0 1 1 3 0 6 2003 34 11 9 8 3 8 5 6 0 1 2 4 0 5 2004 22 13 9 8 3 8 6 6 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 2 6 2006 22 12 10 </td <td>1998</td> <td>9</td> <td>7</td> <td>9</td> <td>7</td> <td>10</td> <td>6</td> <td>5</td> <td>6</td> <td>0</td> <td>4</td> <td>5</td> <td>3</td> <td>0</td> <td>1</td>	1998	9	7	9	7	10	6	5	6	0	4	5	3	0	1
2000 12 14 6 7 7 4 13 6 0 5 1 6 0 7 2001 14 14 10 8 5 6 10 8 0 2 1 4 0 6 2002 24 13 8 8 1 5 9 8 0 1 1 3 0 6 2003 34 11 9 8 3 8 5 6 0 1 2 4 0 5 2004 22 13 9 8 3 8 6 6 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 1 4 2006 22 12 10 7 5 8 8 4 0 1 2 3 1 5 2007 21 14 9<	1999	3	8	9	9	12	6	5	8	0	6	8	3	0	1
2001 14 14 10 8 5 6 10 8 0 2 1 4 0 6 2002 24 13 8 8 1 5 9 8 0 1 1 3 0 6 2003 34 11 9 8 3 8 5 6 0 1 2 4 0 5 2004 22 13 9 8 3 8 6 6 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 2 6 2006 22 12 10 7 5 8 8 4 0 1 2 3 1 5 2008 29 3 6 <td>2000</td> <td>12</td> <td>14</td> <td>6</td> <td>7</td> <td>7</td> <td>4</td> <td>13</td> <td>6</td> <td>0</td> <td>5</td> <td>1</td> <td>6</td> <td>0</td> <td>7</td>	2000	12	14	6	7	7	4	13	6	0	5	1	6	0	7
2002 24 13 8 8 1 5 9 8 0 1 1 3 0 6 2003 34 11 9 8 3 8 5 6 0 1 2 4 0 5 2004 22 13 9 8 3 8 6 6 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 2 6 2006 22 12 10 7 5 8 8 4 0 1 2 2 2 6 2007 21 14 9 7 5 8 8 4 0 1 2 3 1 5 2008 29 3 6	2001	14	14	10	8	5	6	10	8	0	2	1	4	0	6
2003 34 11 9 8 3 8 5 6 0 1 2 4 0 5 2004 22 13 9 8 3 8 6 6 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 2 6 2006 22 12 10 7 5 8 8 4 0 1 2 2 2 6 2007 21 14 9 7 5 8 8 4 0 1 2 3 1 5 2008 29 3 6 5 6 8 6 1 0 9 1 5 3 3 2009 25 0 5	2002	24	13	8	8	1	5	9	8	0	1	1	3	0	6
2004 22 13 9 8 3 8 6 6 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 2 1 4 2005 20 16 9 8 5 8 8 4 0 1 2 3 0 5 2006 22 12 10 7 5 8 8 4 0 1 2 2 2 6 2007 21 14 9 7 5 8 8 4 0 1 2 3 1 5 2008 29 3 6 5 6 8 6 1 0 9 1 5 3 3 2009 25 0 5 16 6 2 2 1 0 5 0 5 3 5 2010 30 3 8	2003	34	11	9	8	3	8	5	6	0	1	2	4	0	5
2005 20 16 9 8 5 8 8 4 0 1 2 3 0 5 2006 22 12 10 7 5 8 8 4 0 1 2 2 2 6 2007 21 14 9 7 5 8 8 4 0 1 2 2 2 6 2008 29 3 6 5 6 8 6 1 0 9 1 5 3 3 2009 25 0 5 16 6 2 2 1 0 5 0 5 3 5 2010 30 3 8 12 5 2 3 1 0 5 0 3 3 2	2004	22	13	9	8	3	8	6	6	0	1	2	2	1	4
2006221210758840122262007211497588401231520082936568610915332009250516622105053520103038125231050332	2005	20	16	9	8	5	8	8	4	0	1	2	3	0	5
2007211497588401231520082936568610915332009250516622105053520103038125231050332	2006	22	12	10	7	5	8	8	4	0	1	2	2	2	6
2008 29 3 6 5 6 8 6 1 0 9 1 5 3 3 2009 25 0 5 16 6 2 2 1 0 5 0 5 3 5 2010 30 3 8 12 5 2 3 1 0 5 0 3 3 2	2007	21	14	9	7	5	8	8	4	0	1	2	3	1	5
2009 25 0 5 16 6 2 2 1 0 5 0 5 3 5 2010 30 3 8 12 5 2 3 1 0 5 0 3 3 2	2008	29	3	6	5	6	8	6	1	0	9	1	5	3	3
<u>2010 30 3 8 12 5 2 3 1 0 5 0 3 3 2</u>	2009	25	0	5	16	6	2	2	1	0	5	0	5	3	5
	2010	30	3	8	12	5	2	3	1	0	5	0	3	3	2

Appendix Table A1. Percentages and sources used to disaggregate the catch of artisanal fisheries by taxa

1: Rastrelliger kanagurta; 2: Scomberomorus commerson; 3: Lethrinidae; 4: Carangidae; 5: Carcharhinidae; 6: Sphyraenidae; 7: Serranidae; 8: Nemipterus spp.; 9: Chrysoblephus spp.; 10: Scombridae; 11: Scomberoides spp.; 12: Euthynnus affinis; 13: Lutjanidae; 14: Penaeidae

APPENDIX A

Table A1 continued

Year	15	16	17	18	19	20	21	22	23	24	25	26	Source/remark
1950-78	1	0	0	0	2	0	0	3	0	0	2	2	Walczak (1977)
1979-82	2	0	3	0	0	1	0	0	0	0	0	12	Average of 1983-1986
1983	0	0	1	0	0	0	0	0	0	0	0	9	Sanders and Morgan (1989)
1984	1	0	5	0	0	3	0	0	0	0	0	16	Sanders and Morgan (1989)
1985	5	1	2	0	0	2	0	0	0	0	0	4	Sanders and Morgan (1989)
1986	3	1	6	2	0	2	0	0	0	0	0	2	Sanders and Morgan (1989)
1987	2	0	0	2	0	0	0	0	0	0	0	11	Brodie (1999)
1988	1	0	0	2	0	0	0	0	0	0	0	11	Brodie (1999)
1989	1	0	0	1	0	0	0	0	0	0	0	6	Brodie (1999)
1990	1	0	0	1	0	0	0	0	0	0	0	7	Brodie (1999)
1991	1	1	0	1	0	0	0	0	0	0	0	8	Brodie (1999)
1992	2	1	0	3	0	0	0	0	0	0	0	11	Brodie (1999)
1993	2	1	0	3	0	0	0	0	0	0	0	22	Brodie (1999)
1994	3	2	0	2	0	0	0	0	0	0	0	20	Brodie (1999)
1995	2	4	0	4	0	0	0	0	0	0	0	18	Brodie (1999)
1996	3	4	0	0	0	0	0	0	0	0	0	19	Brodie (1999)
1997	3	4	0	0	0	0	0	0	0	0	0	19	Brodie (1999)
1998	3	7	3	2	0	0	0	0	0	0	0	12	MoFW (2004, 2008)
1999	3	5	2	1	0	0	0	0	0	0	0	12	MoFW (2004, 2008)
2000	1	0	1	1	0	0	0	0	0	0	0	8	MoFW (2004, 2008)
2001	4	0	2	1	0	0	0	0	0	0	0	4	MoFW (2004, 2008)
2002	0	1	2	1	0	0	0	0	0	0	0	9	MoFW (2004, 2008)
2003	0	0	1	0	0	0	0	0	0	0	0	2	MoFW (2004, 2008)
2004	0	1	1	1	0	0	4	0	0	0	0	8	MoFW (2004, 2008)
2005	1	1	2	0	0	0	0	0	0	0	0	9	MoFW (2004, 2008)
2006	1	1	1	1	0	0	0	0	0	0	0	8	MoFW (2004, 2008)
2007	1	1	1	0	0	0	0	0	0	0	0	8	MoFW (2004, 2008)
2008	0	2	1	1	2	0	1	0	1	0	0	6	MoFW (2012)
2009	1	1	1	0	3	0	0	0	1	0	0	17	MoFW (2012)
2010	0	5	1	0	2	0	0	0	1	0	0	13	MoFW (2012)

15: Rachycentridae; 16: Haemulidae; 17: Mugilidae; 18: Ariidae; 19: *Thunnus tonggol*; 20: Priacanthidae; 21: Synodontidae; 22: Dasyatidae; 23: *Atule mate*; 24: Scaridae; 25: Rhinobatidae; 26: Others

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Discards
1950	4,111	11,500	0	8,140	3,320	0
1951	4,135	11,600	0	8,260	3,370	0
1952	4,934	11,800	0	8,410	3,430	0
1953	4,953	12,100	0	8,570	3,500	0
1954	4,990	12,300	0	8,750	3,570	0
1955	5,900	11,900	0	8,470	3,460	0
1956	4,065	12,200	0	8,690	3,550	0
1957	4.019	12.500	0	8.910	3.640	0
1958	3,964	12,900	0	9,130	3,730	0
1959	4,299	13,200	0	9.350	3.820	0
1960	4 055	13 500	0	9 5 9 0	3 910	0
1961	4 020	13,800		9,830	4 010	0
1962	4.061	14 200		10.080	1,010	0
1963	4,001	14,200		10,330	4,120	0
1967	4,101	14,000		10,550	4,220	0
1065	4,055	15 200		10,500	4,320	0
1066	5 210	15,200	0	11 020	4,410	0
1067	3,210	15,500	0	11,020	4,300	0
1060	4,705	16,100	0	11,230	4,380	0
1900	4,921	16,100	0	11,420	4,000	0
1909	6,291	10,400		11,620	4,740	2 004
1970	5,730	20,500	965	11,820	4,830	2,894
1971	6,253	20,400	912	11,860	4,850	2,736
1972	6,608	19,700	657	12,110	4,940	1,971
1973	7,149	19,500	326	13,010	5,220	978
1974	8,467	21,400	224	14,720	5,760	673
1975	10,100	22,800	137	17,360	4,870	412
1976	10,939	24,400	150	18,720	5,100	449
1977	11,887	27,100	208	20,790	5,460	625
1978	13,633	28,600	330	21,760	5,570	990
1979	17,622	28,000	0	22,380	5,630	0
1980	15,830	27,500	0	21,990	5,540	0
1981	16,725	31,500	0	25,290	6,220	0
1982	17,991	34,200	0	27,660	6,560	0
1983	17,024	27,800	0	22,330	5,520	0
1984	21,105	27,100	0	21,730	5,340	0
1985	17,539	29,700	0	24,000	5,650	0
1986	17,125	32,500	0	26,500	6,030	0
1987	26,669	33,900	0	27,700	6,160	0
1988	28,803	37,000	0	30,530	6,510	0
1989	27,756	42,400	0	35,240	7,190	0
1990	29,657	42,900	0	35,690	7,170	0
1991	40,482	59,000	0	49,690	9,330	0
1992	41,241	63,500	0	53 <i>,</i> 700	9,840	0
1993	48,027	79,400	1,221	64,450	11,270	2,442
1994	48,325	81,400	2,442	63,170	10,910	4,884
1995	52,063	78,500	3,663	57,450	10,070	7,326
1996	38,659	66,000	4,884	43,370	7,950	9,767
1997	43,128	88,000	6,105	59,680	10,050	12,209
1998	41,620	89,500	7,326	57,870	9,650	14,651
1999	37,946	89,900	8,918	54,170	9,000	17,835
2000	23,462	69,800	10,510	32,220	6,020	21,019
2001	22,433	69,700	12,102	27,620	5,780	24,203
2002	32,767	78,400	13,694	31,160	6,160	27,388
2003	32,286	80,400	14,352	31,620	5,720	28,704
2004	41,324	76,300	11,770	35,310	5,700	23,540
2005	41.007	64.900	9,188	31,620	5,750	18,376
2006	44,334	58,900	6,606	33,210	5,850	13,213
2007	36.785	48.900	3.269	33.190	5.880	6.538
2008	34.510	49.800	4,770	29.850	5,590	9.539
2009	40 983	46 700	4 564	27 760	5 280	9 1 2 8
2010	44,992	44.400	5,486	23,140	4,760	10.971

Appendix Table A3. Reconstructed catch (in tonnes) in Yemeni Red Sea waters from 1950 to 2010 by components. Reported catch refers to the part of reconstructed catch accounted in the FAO data.

Year	Reported	Unreported	Discards
1950	3,530	7,930	0
1951	3,560	8,070	0
1952	4,100	7,740	0
1953	4,120	7,950	0
1954	4,160	8,150	0
1955	4.690	7.240	0
1956	3.390	8.850	0
1957	3 460	9 080	0
1958	3 420	9 4 3 0	0
1959	3,420	9 550	0
1960	3,520	9 980	0
1061	3,320	10 350	0
1062	2 5 4 0	10,550	0
1062	2,540	10,000	0
1064	3,380	10,970	0
1065	4,030	10,870	0
1905	5,810	11,420	0
1966	4,890	10,630	0
1967	4,250	11,560	0
1968	4,390	11,700	U
1969	5,700	10,660	0
1970	5,070	12,540	2,894
1971	5,570	12,050	2,736
1972	5,790	11,920	1,971
1973	6,300	12,260	978
1974	7,160	13,540	673
1975	8,570	13,800	412
1976	9,260	14,700	449
1977	10,110	16,350	625
1978	11,430	16,220	990
1979	13,310	14,710	0
1980	12,010	15,520	0
1981	13,440	18,070	0
1982	14,370	19,850	0
1983	13,250	14,600	0
1984	17,580	9,480	0
1985	15,590	14,060	0
1986	15,560	16,970	0
1987	21,870	12,000	0
1988	24,330	12,710	0
1989	23,650	18,780	0
1990	26.820	16.040	0
1991	37.050	21,960	0
1992	36.830	26.710	0
1993	42.020	34.930	2.442
1994	42.680	33,840	4.884
1995	43 450	27 730	7 326
1996	34 570	21,730	9 767
1997	10 880	3/ 9/0	12 209
1008	38 380	36 470	14 651
1000	25 400	26 500	17 925
7000	33,430 20 040	20,030	11,000
2000	20,040 10 510	25 000	21,019
2001	72'2TO	20,990	24,203
2002	23,870	20,150	21,300
2003	22,000	29,030	28,704
2004	27,070	25,/10	23,540
2005	25,830	20,730	18,376
2006	26,700	18,950	13,213
2007	25,400	16,950	6,538
2008	27,210	13,010	9,539
2009	27,820	9,780	9,128
2010	25.720	7.670	10.971

124

Appendix Table A4. Taxonomic composition of the reconstructed catch (in tonnes) of the artisanal fishery of Yemen in the Red Sea from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1950	3,700	1,530	362	483	242	288	0	0	158	0	0	242	121	118
1951	3,760	1,550	368	490	245	292	0	0	160	0	0	245	123	120
1952	3,830	1,580	374	499	250	297	0	0	163	0	0	250	125	122
1953	3,900	1,610	382	509	254	303	0	0	166	0	0	254	127	124
1954	3,980	1,640	389	519	260	309	0	0	170	0	0	260	130	127
1955	3,860	1,590	377	503	252	300	0	0	164	0	0	252	126	123
1956	3,960	1,630	387	516	258	307	0	0	169	0	0	258	129	126
1957	4,050	1,670	397	529	264	315	0	0	173	0	0	264	132	129
1958	4.150	1.720	406	542	271	323	0	0	177	0	0	271	135	132
1959	4.260	1.760	416	555	278	331	0	0	181	0	0	278	139	136
1960	4.360	1.800	427	569	285	339	0	0	186	0	0	285	142	139
1961	4.470	1.850	438	584	292	348	0	0	191	0	0	292	146	143
1962	4,590	1,900	449	599	299	357	0	0	196	0	0	299	150	146
1963	4.700	1.940	460	614	307	365	0	0	200	0	0	307	153	150
1964	4.820	1.990	471	628	314	374	0	0	205	0	0	314	157	154
1965	4.920	2.030	481	642	321	382	0	0	210	0	0	321	160	157
1966	5.020	2.070	491	655	327	390	0	0	214	0	0	327	164	160
1967	5,110	2.110	500	667	333	397	0	0	218	0	0	333	167	163
1968	5 200	2 150	509	678	339	404	0	0	222	0	0	339	170	166
1969	5 290	2 180	517	690	345	411	0	0	225	0 0	0	345	172	169
1970	5 380	2,220	527	702	351	418	0	0	229	0 0	0	351	176	172
1971	5 380	2 220	527	702	351	418	0	0	229	0	0	351	176	172
1972	5 480	2,220	536	714	357	425	0	0	223	0	0	357	179	175
1973	5,400	2,200	574	766	383	456	0	0	250	0	0	383	191	187
1977	6.640	2,420	650	866	/33	516	0	0	230	0	0	133	217	212
1975	7 830	2,740	766	1 022	511	608	0	0	205	0	0	511	255	250
1976	8 390	3,240	821	1 095	547	652	0	0	358	0	0	547	255	250
1977	9 280	3,470	9021	1 211	605	721	0	0	396	0	0	605	2/4	200
1078	9,200	3,030	908	1,211	630	721	0	0	/12	0	0	630	215	208
1979	5,000	3,550	2 260	1 227	1 17/	864	1 0/15	/191	283	855	0	0.00	603	355
1020	5,220	2 070	2,200	1,227	1 1/5	004 010	1,045	491	27/	027	0	0	500	276
1001	5,090	3,070	2,204	1,190	1,145	042	1,019	470	574 420	054	0	0	500	200
1002	5,850	2,250	2,334	1,570	1 / 20	1 059	1,172	601	430	1 0 4 9	0	0	720	121
1002	7 020	2,000	2,700	1,303	1,430 571	1,038	1,200	001	470	706	200	0	/39	270
1001	1,950	3,070	2,092	1,497 EDE	1 275	502	1,040 645	0	207	790	560	0	705	220
1904	4,940 2,470	3,030	2,050	525 1 E 4 0	1,575	1 064	1 262	1 415	722	195	1 206	0	795	427
1905	2,470 E 420	2,590	2,495	1,540	1,525	1,004 0E1	1,505	1,415	755	924	1,200	0	995	437 251
1900	5,420	2,940	2,099	1,155	1,157	700	1 0092	2,470	/24	202	1,550	250	904	207
1907	0,450	2,470	2,597	1,000	1,294	1 021	1,000	3,099	452	595	1 957	207	974	422
1988	0,540	2,530	2,000	759	1,224	1,031	1,140	3,233	942	400	1,809	1 021	1,120	423
1969	7,290	5,140 2,420	3,039	600	1,000	1,424	1,515	5,070	1,117	900	3,110	1,051	1,015	565
1990	7,100	5,45U 2,940	5,007	2 2 2 2 2	1,957	1,005	1,741	2,404	2 4 4 4	1,411 642	2,092	1,727	1 717	1 1 2 4
1991	0,750	5,640 2,400	4,547	3,202	2,250	2,702	1,050	4,049	2,444	1 6 1 7	2,577	1,952	1,/1/	1,134
1992	1,340	3,490	4,738	7,280	3,219	2,855	2,474	3,943	1,098	1,017	4,310	1,950	2,187	1,172
1993	1,200	4,280	0,000	8,994	4,528	2,857	3,452	7,503	1,499	2,378	0	1 566	4,921	1,173
1994	1,400	4,370	0,219	0,000 F 001	3,027	2,803	3,223	3,8//	3,155	3,080	0	1,500	3,542	1,151
1995	1,270	4,030	5,521	5,901	3,110	2,487	2,996	4,223	3,610	2,921	0	1,620	2,640	1,021
1996	950	2,950	4,098	4,732	2,396	2,349	2,326	3,231	2,804	2,208	0	1,188	1,922	964
1997	1,550	4,200	5,759	6,267	3,134	3,346	3,163	4,705	4,221	3,155	0	2,100	2,609	1,374
1998	5,190	4,020	5,212	5,322	3,200	2,703	2,985	0	2,721	2,178	3,511	1,634	0	1,110
1999	1,520	4,060	4,549	0,321	3,043	3,225	2,528	0	4,051	3,043	4,061	1,763	0	1,324
2000	3,400	4,000	1,610	2,075	1,216	1,379	3,649	0	265	1,513	1,647	1,747	0	566
2001	3,720	3,640	2,627	1,327	1,657	1,454	2,678	0	359	606	2,185	1,091	0	597
2002	7,420	4,080	2,359	414	1,570	1,633	2,620	0	387	372	2,426	/90	144	6/0
2003	9,290	3,140	2,355	/62	2,200	1,586	1,283	0	546	255	1,644	992	5	651
2004	6,240	3,600	2,427	869	2,305	1,497	1,593	0	452	261	1,740	443	234	615
2005	5,800	4,530	2,589	1,309	2,345	1,612	2,183	0	442	234	1,083	1,008	3	662
2006	6,570	3,700	2,898	1,434	2,363	1,459	2,378	0	684	421	1,255	674	527	599
2007	6,520	4,410	2,894	1,449	2,496	1,637	2,409	0	584	338	1,231	910	254	672
2008	8,430	890	1,823	1,876	2,339	1,009	1,868	0	167	2,565	228	1,468	1,028	414
2009	7,260	20	1,403	1,680	449	3,210	494	0	110	1,500	344	1,452	946	1,318
2010	6.760	580	1 793	1 076	550	1 927	747	0	86	1 1 4 8	270	685	742	791

1: Rastrelliger kanagurta; 2: Scomberomorus commerson; 3: Lethrinidae; 4: Carcharhinidae; 5: Sphyraenidae; 6: Trachurus spp.; 7: Serranidae; 8: Chrysoblephus spp.; 9: Scomberoides spp.; 10: Scombridae; 11: Nemipterus spp.; 12: Euthynnus affinis; 13: Lutjanidae; 14: Carangidae

Table A4	continued

Veer	45	10	47	10	10	- 20	21			24	25	20	27	20
rear	12	10	^	18	19	20	21					20		28
1950	0	81	0	0	0	242	161	161	0	0	0	0	0	161
1951	0	82	0	0	0	245	163	163	0	0	0	0	0	163
1952	0	83	0	0	0	250	166	166	0	0	0	0	0	166
1953	0	85	0	0	0	254	170	170	0	0	0	0	0	170
1954	0	87	0	0	0	260	173	173	0	0	0	0	0	173
1955	0	84	0	0	0	252	168	168	0	0	0	0	0	168
1956	0	86	0	0	0	258	172	172	0	0	0	0	0	172
1957	0	88	0	0	0	264	176	176	0	0	0	0	0	176
1958	0	90	0	0	0	271	181	181	0	0	0	0	0	181
1959	0	93	0	0	0	278	185	185	0	0	0	0	0	185
1960	0	95	0	0	0	285	190	190	0	0	0	0	0	190
1961	0	97	0	0	0	292	195	195	0	0	0	0	0	195
1962	0	100	0	0	0	299	200	200	0	0	0	0	0	200
1963	0	102	0	0	0	307	205	205	0	0	0	0	0	205
1964	0	105	0	0	0	314	209	209	0	0	0	0	0	209
1965	0	107	0	0	0	321	214	214	0	0	0	0	0	214
1966	0	109	0	0	0	327	218	218	0	0	0	0	0	218
1967	0	111	0	0	0	333	222	222	0	0	0	0	0	222
1968	0	113	0	0	0	339	226	226	0	0	0	0	0	226
1969	0	115	0	0	0	3/15	220	220	0	0	0	0	0	220
1070	0	117	0	0	0	251	230	230	0	0	0	0	0	230
1071	0	117	0	0	0	251	234	234	0	0	0	0	0	234
1072	0	117	0	0	0	257	234	234	0	0	0	0	0	234
1972	0	119	0	0	0	202	250	250	0	0	0	0	0	200
1973	0	128	0	0	0	383	200	200	0	0	0	0	0	200
1974	0	144	0	0	0	433	289	289	0	0	0	0	0	289
1975	0	1/0	0	0	0	511	341	341	0	0	0	0	0	341
1976	0	182	0	0	0	547	365	365	0	0	0	0	0	365
1977	0	202	0	0	0	605	404	404	0	0	0	0	0	404
1978	0	210	0	0	0	630	420	420	0	0	0	0	0	420
1979	220	455	64	52	599	0	0	0	0	322	0	0	0	2,148
1980	214	443	62	51	584	0	0	0	0	314	0	0	0	2,095
1981	246	510	72	58	672	0	0	0	0	361	0	0	0	2,409
1982	269	557	78	64	734	0	0	0	0	394	0	0	0	2,631
1983	19	47	0	87	212	0	0	0	0	0	0	0	0	1,813
1984	280	215	0	0	1,074	0	0	0	0	546	0	0	0	2,009
1985	352	1,063	185	63	508	0	0	0	0	416	0	0	0	793
1986	475	627	168	603	1,470	0	0	0	0	482	0	0	0	471
1987	237	451	19	555	0	0	0	0	0	0	0	0	0	2,563
1988	303	411	74	458	0	0	0	0	0	0	0	0	0	2,831
1989	256	424	83	373	0	0	0	0	0	0	0	0	0	1,995
1990	166	380	82	224	0	0	0	0	0	0	0	0	0	2,291
1991	217	659	379	635	0	0	0	0	0	0	0	0	0	3,988
1992	104	1,096	681	1,645	0	0	0	0	0	0	0	0	0	5,089
1993	490	1,711	1,038	1,951	0	0	0	0	0	0	0	0	0	6,150
1994	678	1,682	1,534	1,396	0	0	0	0	0	0	0	0	0	6,006
1995	1,296	1,488	2,392	2,233	0	0	0	0	0	0	0	0	0	5,417
1996	881	1,213	1,747	0	0	0	0	0	0	0	0	0	0	3,995
1997	713	1,571	2,628	0	0	0	0	0	0	0	0	0	0	5,611
1998	734	1.634	3.812	1.073	1.634	0	0	0	0	0	0	0	0	5.416
1999	694	1 521	2 544	257	771	0	0	0	0	0	0	0	0	5 031
2000	2 078	181	51	364	268	0	0	0	0	0	0	0	0	2 202
2001	1 667	1 109	17	286	656	0	0	n	376	n	0	0	28	671
2002	1 788	75	170	200	504	0	0	0	122	0	1	0	70	2 225
2002	1 /65	101	E0 T\0	126	304 2⊑1	0	0	0	455	0	о Т	0	<i>פו</i> רכ	100
2003	1 100	101	30 105	267	221	10	0	0	457	0	U 1 1 1 0	0	22 25	1 0 2 0
2004	1,192	δ1 100	192	110	524 453	12	0	0	490	0	122	0	33	1,020
2005	1,423	199	220	170	452	80	0	U	405	0	112	0	92	2,073
2006	1,702	330	347	1/8	221	83	U	U	5//	U	113	0	69	1,846
2007	1,6/2	2//	298	149	369	86	0	0	596	0	131	0	86	2,041
2008	843	105	695	379	312	20	/00	0	331	0	204	325	133	1,319
2009	1,395	431	309	16	241	23	834	0	504	0	135	333	100	2,723

 2010
 516
 33
 1,177
 0
 149
 18
 458
 0
 597
 0
 106
 261
 63
 2,257

 15: Penaeidae; 16: Rachycentridae; 17: Haemulidae; 18: Ariidae; 19: Mugilidae; 20: Dasyatidae; 21: Thunnus tonggol; 22: Rhinobatidae; 23: Epigonus spp.;
 24: Priacanthidae; 25: Synodontidae; 26: Atule mate; 27: Scaridae; 28: Others

Vear	Holothuroidea	Seniidae	Brachyura
1950	0	65	21
1051	0	65	21
1052	0	67	21
1052	0	69	21
1955	0	70	22
1954	0	70	22
1955	0	67	22
1956	0	69	22
1957	0	/1	23
1958	0	/3	23
1959	0	74	24
1960	0	76	24
1961	0	78	25
1962	0	80	26
1963	0	82	26
1964	0	84	27
1965	0	86	27
1966	0	88	28
1967	0	89	29
1968	0	91	29
1969	0	93	30
1970	0	94	30
1971	38	96	31
1972	76	98	31
1973	115	100	32
1974	153	102	33
1975	191	105	33
1976	330	107	34
1977	469	110	35
1978	608	113	36
1979	747	117	37
1980	886	123	39
1981	1,025	138	44
1982	1,163	141	45
1983	1,302	144	46
1984	1,441	147	47
1985	1,580	150	48
1986	1,719	156	50
1987	1,858	161	51
1988	1,997	163	52
1989	2,136	168	54
1990	2,275	174	56
1991	2,414	188	60
1992	2,553	197	63
1993	2,692	202	64
1994	2,831	208	66
1995	2,970	229	73
1996	3,109	237	76
1997	3,248	241	77
1998	3,387	249	80
1999	3,526	256	82
2000	3,664	263	84
2001	506	271	87
2002	401	279	89
2003	3,206	914	107
2004	6,232	1,070	92
2005	1.269	1.227	77
2006	1.269	1.383	62
2007	1.269	390	29
2008	102	239	42
2009	144	231	154
2010	44	202	101

Appendix Table A5. Reconstructed catch (in tonnes) of the minor artisanal fisheries of Yemen in the Red Sea from 1950 to 2010.

Yemen - Tesfamichael et al.

Appendix Table A6. Taxonomic composition of the reconstructed subsistence catch (in tonnes), part of the artisanal fishery given away freely, of Yemen in the Red Sea from 1950 to 2010.

127

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1950	906	1,111	459	109	145	72	86	0	0	47	72	36	0	0
1951	920	1,128	466	110	147	74	88	0	0	48	74	37	0	0
1952	936	1,148	474	112	150	75	89	0	0	49	75	37	0	0
1953	955	1.170	483	114	153	76	91	0	0	50	76	38	0	0
1954	974	1.194	493	117	156	78	93	0	0	51	78	39	0	0
1955	944	1.157	478	113	151	75	90	0	0	49	75	38	0	0
1956	968	1.187	490	116	155	77	92	0	0	51	77	39	0	0
1957	992	1,216	502	119	159	79	94	0	0	52	79	40	0	0
1958	1.016	1,246	515	122	163	81	97	0	0	53	81	41	0	0
1959	1 042	1 277	528	125	167	83	99	0	0	54	83	42	0	0
1960	1 068	1 309	541	128	171	85	102	0	0	56	85	43	0	0
1961	1 095	1 342	554	131	175	88	102	0	0	57	88	45	0	0
1962	1 1 2 3	1 377	569	135	180	90	107	0	0	59	90	45	0	0
1062	1 1 5 1	1 /11	583	128	184	02	110	0	0	60	02	45	0	0
106/	1 1 7 9	1 // 5	505	1/1	188	92	112	0	0	62	92	40	0	0
1965	1,170	1,445	610	141	100	94	112	0	0	63	94	47	0	0
1965	1,204	1,470	622	144	195	90	117	0	0	64	90	40	0	0
1067	1,220	1 5 2 2	622	147	200	100	110	0	0	65	100	4J 50	0	0
1060	1,230	1,555	614	150	200	100	121	0	0	66	100	50	0	0
1060	1,272	1,500	655	155	203	102	121	0	0	69	102	52	0	0
1070	1,234	1,307	667	155	207	105	125	0	0	60	105	52	0	0
1970	1,517	1,015	667	150	211	105	125	0	0	60	105	22	0	0
1072	1,541	1,015	670	100	211	105	120	0	0	70	105	55	0	0
1972	1,307	1,043	0/9 727	101	214	107	128	0	0	70	107	54	0	0
1973	1,394	1,701	/2/	1/2	230	115	157	0	0	75	115	57	0	0
1974	1,430	1,992	823 647	195	200	100	100	0	0	65 67	100	05 F1	0	0
1975	1,404	1,507	047	103	204	102	122	0	0	70	102	51	0	0
1976	1,500	1,054	583	162	210	108	129	0	0	70	108	54	0	0
1977	1,536	1,804	745	1/6	235	118	140	0	0	77	118	59	0	0
1978	1,551	1,849	764	181	241	121	144	107	0	79	121	60	0	0
1979	1,583	983	594	426	231	221	163	197	93	72	0	114	161	0
1980	1,647	944	570	409	222	213	156	189	89	69	0	109	155	0
1981	1,813	1,069	646	463	252	241	1//	214	101	/9	0	124	1/5	0
1982	1,823	1,150	694	498	270	259	190	230	108	85	0	133	189	0
1983	1,832	1,405	543	371	265	101	160	185	0	0	0	0	141	67
1984	1,839	861	636	358	92	240	97	112	0	69	0	139	139	0
1985	1,846	424	443	428	265	261	182	234	243	126	0	170	158	220
1986	1,885	914	496	455	191	195	144	150	248	122	0	162	57	225
1987	1,914	1,066	410	397	167	214	116	167	514	75	58	161	65	155
1988	1,897	1,064	412	433	124	199	168	186	527	153	50	182	76	304
1989	1,927	1,167	503	486	124	266	228	242	491	179	165	162	154	499
1990	1,958	1,129	539	482	108	304	265	274	387	184	271	118	222	329
1991	2,073	1,346	593	671	506	345	426	256	625	377	298	265	99	367
1992	2,130	202	529	717	1,103	487	432	375	597	257	295	331	245	653
1993	2,137	187	636	974	1,336	673	424	513	1,124	223	104	731	353	0
1994	2,163	213	636	906	1,266	529	408	470	856	460	228	516	450	0
1995	2,332	181	576	789	843	444	355	428	603	516	231	377	417	0
1996	2,359	133	412	574	663	336	329	326	452	393	166	269	309	0
1997	2,352	213	576	790	860	430	459	434	645	579	288	358	433	0
1998	2,376	697	540	700	715	439	363	401	0	365	219	0	292	471
1999	2,386	200	534	598	831	400	424	332	0	532	232	0	400	534
2000	2,393	437	514	207	267	156	177	469	0	34	225	0	195	212
2001	2,415	468	457	330	167	208	183	337	0	45	137	0	76	275
2002	2,424	912	501	290	51	193	201	322	0	48	97	18	46	298
2003	2,428	1,115	377	283	91	264	190	154	0	66	119	1	31	197
2004	2,430	731	422	284	102	270	175	187	0	53	52	27	31	204
2005	2,428	663	517	296	150	268	184	250	0	50	115	0	27	124
2006	2,448	732	413	323	160	263	163	265	0	76	75	59	47	140
2007	2,463	708	479	314	157	271	178	262	0	63	99	28	37	134
2008	2,473	891	94	193	198	247	107	198	0	18	155	109	271	24
2009	2,479	747	2	144	173	46	330	51	0	11	149	97	154	35
2010	2,480	676	58	179	108	55	193	75	0	9	69	74	115	27

1: Clupeidae; 2: Rastrelliger kanagurta; 3: Scomberomorus commerson; 4: Lethrinidae; 5: Carcharhinidae; 6: Sphyraenidae; 7: Trachurus spp.; 8: Serranidae; 9: Chrysoblephus spp.; 10: Scomberoides spp.; 11: Euthynnus affinis; 12: Lutjanidae; 13: Scombridae; 14: Nemipterus spp.

128													
Table	A6 con	tinued											
Year	15	16	17	18	19	20	21	22	23	24	25	26	27
1950	35	24	0	0	72	0	48	48	0	0	0	0	0
1951	36	25	0	0	74	0	49	49	0	0	0	0	0
1952	37	25	0	0	75	0	50	50	0	0	0	0	0
1953	37	25	0	0	76	0	51	51	0	0	0	0	0
1954	38	26	0	0	78	0	52	52	0	0	0	0	0
1955	37	25	0	0	75	0	50	50	0	0	0	0	0
1956	38	26	0	0	77	0	52	52	0	0	0	0	0
1957	39	26	0	0	79	0	53	53	0	0	0	0	0
1958	40	27	0	0	81	0	54	54	0	0	0	0	0
1959	41	28	0	0	83	0	56	56	0	0	0	0	0
1960	42	28	0	0	85	0	57	57	0	0	0	0	0
1961	43	29	0	0	88	0	58	58	0	0	0	0	0
1962	44	30	0	0	90	0	60	60	0	0	0	0	0
1963	45	31 21	0	0	92	0	61	61	0	0	0	0	0
1964	40	31	0	0	94	0	03 64	63	0	0	0	0	0
1905	47	52 22	0	0	90	0	65	65	0	0	0	0	0
1900	40 70	33	0	0	100	0	67	67	0	0	0	0	0
1968		34	0	0	100	0	68	68	0	0	0	0	0
1969	51	34	0	0	102	0	69	69	0	0	0	0	0
1970	51	35	0	0	105	0	70	70	0	0	0	0	0
1971	51	35	0	0	105	0	70	70	0	0	0	0	0
1972	52	36	0	0	107	0	71	71	0	0	0	0	0
1973	56	38	0	0	115	0	77	77	0	0	0	0	0
1974	64	43	0	0	130	0	87	87	0	0	0	0	0
1975	50	34	0	0	102	0	68	68	0	0	0	0	0
1976	53	36	0	0	108	0	72	72	0	0	0	0	0
1977	58	39	0	0	118	0	78	78	0	0	0	0	0
1978	59	40	0	0	121	0	80	80	0	0	0	0	0
1979	67	86	41	12	0	10	0	0	113	0	61	0	0
1980	64	82	40	12	0	9	0	0	109	0	58	0	0
1981	73	93	45	13	0	11	0	0	123	0	66	0	0
1982	78	100	48	14	0	11	0	0	132	0	71	0	0
1983	66	8	3	0	0	15	0	0	38	0	0	0	0
1984	40	37	49	0	0	0	0	0	187	0	95	0	0
1985	75	182	60	32	0	11	0	0	87	0	71	0	0
1986	59	106	80	28	0	102	0	0	248	0	81	0	0
1987	48	75	39	3	0	92	0	0	0	0	0	0	0
1988	69	67	49	12	0	/5	0	0	0	0	0	0	0
1989	94	68	41	13	0	60	0	0	0	0	0	0	0
1990	109	60	26	13	0	35	0	0	0	0	0	0	0
1991	175	102	33	102	0	98	0	0	0	0	0	0	0
1992	174	100	10	103	0	249	0	0	0	0	0	0	0
1993	1/4	254	73	154	0	290	0	0	0	0	0	0	0
1994	146	245	99 195	224	0	205	0	0	0	0	0	0	0
1006	125	215 170	100	54Z	0	0 212	0	0	0	0	0	0	0
1990	188	215	02	240	0	0	0	0	0	0	0	0	0
1998	149	215	90	512	n	144	0	0	219	0	0	0	0
1999	174	200	91	334	0	34	0	0	101	0	0	0	0
2000	73	200	267	7	n	47	0	0	34	0	0	0	0
2001	75	139	210	2	0	36	0	0	82	47	0	0	0

15: Carangidae; 16: Rachycentridae; 17: Penaeidae; 18: Haemulidae; 19: Dasyatidae; 20: Ariidae; 21: Thunnus tonggol; 22: Rhinobatidae; 23: Mugilidae; 24: Epigonus spp.; 25: Priacanthidae; 26: Synodontidae; 27: Atule mate; 28: Scaridae; 29: Others

Appendix Table A7. Taxonomic composition of the retained industrial fishery catch (in tonnes) in Yemeni Red Sea from 1950 to 2010.

Year	Synodontidae	Nemipterus spp.	Sepiidae	Penaeidae	Lethrinidae	Lutjanidae	Brachyura
1950	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0
1970	0	0	0	965	0	0	0
1971	0	0	0	912	0	0	0
1972	0	0	0	657	0	0	0
1973	0	0	0	326	0	0	0
1974	0	0	0	220	0	0	0
1975	0	0	0	137	0	0	0
1976	0	0	0	150	0	0	0
1977	0	0	0	208	0	0	0
1978	0	0	0	330	0	0	0
1979	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0
1001	0	0	0	0	0	0	0
1082	0	0	0	0	0	0	0
1082	0	0	0	0	0	0	0
108/	0	0	0	0	0	0	0
1005	0	0	0	0	0	0	0
1006	0	0	0	0	0	0	0
1007	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0
1002	0	0	0	0	0	0	0
1002	610	226	60	0 95	76	16	0
1004	1 220	550	120	171	152	40	0 16
1994	1,220	1 007	120	171	155	92 127	10
1995	1,051	1,007	179	230	229	192	25
1007	2,441	1,542	239	342 427	201	220	20
1000	3,031	2,078	255	427 E12	760	225	39
1990	3,001	2,014	427	515	438	273	47
2000	4,437	2,451	457	726	557	204	57
2000	5,255	2,005	513	217	756	394 AEA	07
2001	0,040	3,321	252	047	010	434	77 72
2002	7,420 6 501	4,U84 2 625	200	541 1 622	520 971	327	107
2003	0,591	3,025	1,089	1,022	824	494	101
2004	2,110	2,810	2,455	30/	039	383	р Г
2005	3,989	2,194	1,910	28/	499	299	5
2006	2,501	1,409	1,941	1/9	320	192	5
2007	1,726	949	119	130	210	129	0
2008	2,282	1,255	496	201	285	1/1	19
2009	2,184	1,201	4/5	250	2/3	104	22
2010	2.025	1.444	5/0	500	5/X	197	//

Year 1,514 3,028 4,542 6,056 7,570 9,084 1,026 11,058 1,248 13,032 1,471 15,006 1,694 16,980 1,917 1,096 1,096 17,796 2,009 1,148 1,148 14,595 1,648 11,393 1,286 8,192 4,054 5,914

Appendix Table A8. Taxonomic composition of the discarded industrial fishery catch (in tonnes) in Yemeni Red Sea from 1950 to 2010.

1: Leiognathidae; 2: *Terapon* spp.; 3: Gerreidae; 4: Trichiuridae; 5: *Parastromateus niger*; 6: Platycephalidae; 7: *Portunus pelagicus*; 8: Soleidae; 9: Tetraodontidae; 10: Clupeidae

5,660

6.802

Table A8 continued

Year	11	12	13	14	15	16	17	18	19	20	21
1950	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0
1062	0	0	0	0	0	0	0	0	0	0	0
1062	0	0	0	0	0	0	0	0	0	0	0
1064	0	0	0	0	0	0	0	0	0	0	0
1065	0	0	0	0	0	0	0	0	0	0	0
1905	0	0	0	0	0	0	0	0	0	0	0
1900	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0
1970	14	14	434	405	347	130	58	29	29	14	145
1971	14	14	410	383	328	123	55	27	27	14	137
1972	10	10	296	276	237	89	39	20	20	10	99
1973	5	5	147	137	117	44	20	10	10	5	49
1974	3	3	101	94	81	30	13	7	7	3	34
1975	2	2	62	58	49	19	8	4	4	2	21
1976	2	2	67	63	54	20	9	4	4	2	22
1977	3	3	94	88	75	28	13	6	6	3	31
1978	5	5	149	139	119	45	20	10	10	5	50
1979	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0
1993	24	24	0	0	0	0	0	0	0	0	244
1994	49	49	0	0	0	0	0	0	0	0	488
1995	73	73	0	0	0	0	0	0	0	0	733
1996	98	98	0	0	0	0	0	0	0	0	977
1997	122	122	0	0	0	0	0	0	0	0	1.221
1998	147	147	0	0	0	0	0	0	0	0	1.465
1999	178	178	0	0	0	0	0	0	0	0	1.784
2000	210	210	0	0	0	0	0	0	0	0	2 102
2000	242	2/2	0	0	0	0	0	0	0	0	2 / 20
2001	274 271	272	0	0	0	0	0	0	0	0	2,720
2002	2/4	2/4	0	0	0	0	0	0	0	0	2,735
2003	207 225	207	0	0	0	0	0	0	0	0	2,070
2004	∠>> 104	200	0	0	0	0	0	0	0	0	2,304 1 020
2005	122	104	0	0	0	0	0	0	0	0	1 2 2 1
2006	132	132	U	U	U	U	U	U	0	0	1,321
2007	65	65	U	0	U	0	U	U	U	U	654
2008	95	95	0	0	U	0	U	U	0	0	954
2009	91	91	0	0	0	0	U	0	0	0	913
2010	110	110	0	0	0	0	0	0	0	0	1.097

 2010
 110
 0
 0
 0
 0
 0
 0
 0
 1,097

 11: Mullidae; 12: Stomatopoda; 13: Carangoides malabaricus; 14: Synodontidae; 15: Nemipterus spp.; 16: Haemulidae; 17: Ariidae; 18: Carangidae; 19: Sphyraenidae; 20: Sepiidae; 21: Others
 16: Haemulidae; 16: Haemulidae; 16: Haemulidae; 17: Ariidae; 17: Ariidae; 18: Carangidae; 19: Sphyraenidae; 20: Sepiidae; 21: Others

132 Appendix Table A9. Reconstructed total catch (in tonnes) by major taxa in the Red Sea EEZ of Yemen from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1950	4,815	1,989	0	471	628	906	314	0	374	0	0	0	0	205
1951	4,887	2,019	0	478	637	920	319	0	380	0	0	0	0	208
1952	4.975	2.055	0	487	649	936	324	0	386	0	0	0	0	212
1953	5.071	2.095	0	496	661	955	331	0	394	0	0	0	0	216
1954	5 175	2 137	0	506	675	974	337	0	402	0	0	0	0	220
1955	5 014	2 071	0	491	654	944	327	0	389	0	0	0	0	214
1956	5,014	2,071	0	503	671	968	225	0	300	0	0	0	0	214
1057	5,145	2,127	0	505	699	002	244	0	100	0	0	0	0	215
1050	5,271	2,177	0	510	704	1 016	2544	0	409	0	0	0	0	225
1950	5,400	2,251	0	520	704	1,010	202	0	419	0	0	0	0	250
1959	5,554	2,200	0	541	722	1,042	270	0	450	0	0	0	0	250
1960	5,072	2,343	0	555	740	1,008	370	0	441	0	0	0	0	242
1901	5,810	2,402	0	509	759	1,095	379	0	452	0	0	0	0	248
1962	5,967	2,465	0	584	7/8	1,123	389	0	463	0	0	0	0	254
1963	6,115	2,526	0	598	/98	1,151	399	0	475	0	0	0	0	261
1964	6,260	2,586	0	612	817	1,178	408	0	486	0	0	0	0	267
1965	6,398	2,642	0	626	834	1,204	41/	0	497	0	0	0	0	2/3
1966	6,524	2,695	0	638	851	1,228	425	0	507	0	0	0	0	278
1967	6,643	2,744	0	650	866	1,250	433	0	516	0	0	0	0	283
1968	6,759	2,792	0	661	882	1,272	441	0	525	0	0	0	0	288
1969	6,875	2,840	0	673	897	1,294	448	0	534	0	0	0	0	293
1970	6,997	2,890	897	684	913	1,331	485	347	543	0	405	0	0	298
1971	6,997	2,890	848	684	913	1,355	484	328	543	0	383	38	0	298
1972	7,120	2,941	611	697	929	1,377	484	237	553	0	276	76	0	303
1973	7,632	3,152	303	747	996	1,398	508	117	593	0	137	115	0	325
1974	8,632	3,565	209	844	1,126	1,433	570	81	671	0	94	153	0	368
1975	9,400	3,883	128	920	1,226	1,466	617	49	730	0	58	191	0	401
1976	10,047	4,150	139	983	1,310	1,502	660	54	780	0	63	330	0	428
1977	11,087	4,579	194	1,085	1,446	1,539	729	75	861	0	88	469	0	472
1978	11,509	4,754	307	1,126	1,501	1,556	761	119	894	0	139	608	0	490
1979	6,199	3,743	0	2,686	1,458	1,583	1,396	0	1,027	1,242	0	747	583	456
1980	6,030	3,640	0	2,613	1,418	1,647	1,358	0	999	1,208	0	886	567	443
1981	6,917	4,176	0	2,997	1,627	1,813	1,557	0	1,146	1,386	0	1,025	651	509
1982	7.538	4.551	0	3.266	1.773	1.823	1.697	0	1.248	1.511	0	1.163	709	554
1983	9.337	3.610	0	2.463	1.762	1.832	672	447	1.062	1.231	0	1.302	0	0
1984	5.801	4.288	0	2.415	617	1.839	1.615	0	656	757	0	1.441	0	467
1985	2 894	3 029	0	2 922	1 813	1 846	1 786	1 506	1 247	1 597	0	1 580	1 657	858
1986	6 336	3 436	0	3 1 5 4	1 324	1 885	1 352	1 561	998	1 042	0	1 719	1 717	846
1987	7/97	2 883	0	2 79/	1 175	1 91/	1 508	1 092	816	1 175	0	1 858	3 613	527
1088	7 600	2,005	0	2,754	283	1 807	1 / 22	2 172	1 100	1 2 2 6	0	1 007	3,013	1 005
1020	2,000 8,462	2,959	0	3,031	000	1 0 2 7	1 0 2 5	2,175	1,190	1,520	0	2 1 2 6	3,701	1 206
1000	0,402 0 210	2 069	0	2 5/0	700	1,927	2 2 4 2	2 4 2 1	1,052	2 015	0	2,130	2 951	1 251
1001	10.072	3,300	0	5,545	2 7 9 0	1,950	2,242	2,421	2,550	2,013	0	2,275	2,031	1,551
1991	1 5 2 0	4,435	0	5,017	3,789	2,073	2,581	2,744	3,189	1,914	0	2,414	4,074	2,821
1992	1,359	4,025	1 5 1 4	5,455 7,607	0,009	2,150	5,700	4,905	3,200	2,049	610	2,555	4,540	1,900
1993	1,442	4,910	1,514	7,007	10,331	2,102	5,201	330	3,282	3,905	1 220	2,092	8,080 C 722	1,722
1994	1,678	5,004	3,028	7,277	9,953	2,211	4,150	1 007	3,211	3,693	1,220	2,831	0,733	3,614
1995	1,449	4,606	4,542	6,539	6,744	2,405	3,554	1,007	2,842	3,424	1,831	2,970	4,826	4,125
1996	1,085	3,358	6,056	4,977	5,395	2,457	2,732	1,342	2,678	2,651	2,441	3,109	3,684	3,197
1997	1,/6/	4,///	7,570	6,930	/,12/	2,474	3,564	1,678	3,805	3,597	3,051	3,248	5,350	4,800
1998	5,884	4,565	9,084	6,369	6,036	2,523	3,705	5,996	3,067	3,386	3,661	3,387	0	3,086
1999	1,721	4,594	11,058	5,703	7,152	2,565	3,443	7,046	3,649	2,860	4,457	3,526	0	4,583
2000	3,838	4,509	13,032	2,474	2,341	2,603	1,373	4,747	1,556	4,118	5,253	3,664	0	299
2001	4,191	4,094	15,006	3,714	1,494	2,658	1,866	5,786	1,637	3,015	6,048	506	0	404
2002	8,337	4,576	16,980	3,577	465	2,697	1,763	6,808	1,834	2,942	7,427	401	0	435
2003	10,409	3,519	17,796	3,462	853	2,715	2,464	5,466	1,777	1,437	6,591	3,206	0	611
2004	6,967	4,022	14,595	3,350	970	2,665	2,575	4,754	1,673	1,780	6,358	6,232	0	505
2005	6,462	5,045	11,393	3,383	1,459	2,612	2,613	3,400	1,796	2,433	4,136	1,269	0	492
2006	7,299	4,115	8,192	3,541	1,594	2,580	2,626	2,803	1,621	2,643	2,687	1,269	0	760
2007	7,226	4,887	4,054	3,424	1,606	2,528	2,767	2,314	1,815	2,671	1,872	1,269	0	648
2008	9,324	981	5,914	2,300	2,074	2,568	2,586	1,507	1,116	2,066	2,507	102	0	185
2009	8,007	18	5,660	1,821	1,853	2,570	495	1,581	3,540	545	2,332	144	0	122
2010	7,438	640	6,802	2,301	1,184	2,590	605	1,740	2,120	821	2,741	44	0	95

1: Rastrelliger kanagurta; 2: Scomberomorus commerson; 3: Leiognathidae; 4: Lethrinidae; 5: Carcharhinidae; 6: Clupeidae; 7: Sphyraenidae; 8: Nemipterus spp.; 9: Trachurus spp.; 10: Serranidae; 11: Synodontidae; 12: Holothuroidea; 13: Chrysoblephus spp.; 14: Scomberoides spp.

Yemen - Tesfamichael et al.
Table A9 continued

Table		unucu													
Year	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1950	157	0	314	0	154	105	65	0	0	0	0	314	0	0	209
1951	159	0	319	0	156	106	66	0	0	0	0	319	0	0	212
1052	160	0	224	0	150	100	67	0	0	0	0	224	0	0	216
1952	102	0	524	0	139	108	07	0	0	0	0	524	0	0	210
1953	165	0	331	0	162	110	68	0	0	0	0	331	0	0	220
1954	169	0	337	0	165	112	70	0	0	0	0	337	0	0	225
1955	164	0	327	0	160	109	67	0	0	0	0	327	0	0	218
1956	168	0	335	0	164	112	69	0	0	0	0	335	0	0	224
1057	170	0	244	0	104	115	71	0	0	0	0	244	0	0	224
1957	172	0	344	0	108	115	/1	0	0	0	0	344	0	0	229
1958	1/6	0	352	0	1/2	11/	/3	0	0	0	0	352	0	0	235
1959	180	0	361	0	176	120	74	0	0	0	0	361	0	0	241
1960	185	0	370	0	181	123	76	0	0	0	0	370	0	0	247
1961	190	0	379	0	185	126	78	0	0	0	0	379	0	0	253
1062	105	0	200	0	100	120	20	0	0	0	0	200	0	0	250
1902	195	0	200	0	190	100	00	0	0	0	0	202	0	0	255
1963	199	0	399	0	195	133	82	0	0	0	0	399	0	0	266
1964	204	0	408	0	200	136	84	0	0	0	0	408	0	0	272
1965	209	0	417	0	204	139	86	0	0	0	0	417	0	0	278
1966	213	0	425	0	208	142	88	0	0	0	0	425	0	0	284
1067	217	0	/22	0	212	144	80	0	0	0	0	122	0	0	200
1907	217	0	455	0	212	144	05	0	0	0	0	455	0	0	205
1968	220	0	441	0	216	147	91	0	0	0	0	441	0	0	294
1969	224	0	448	0	219	149	93	0	0	0	0	448	0	0	299
1970	228	0	456	965	252	152	109	130	101	58	0	456	58	58	304
1971	228	0	456	912	250	152	110	123	96	55	0	456	55	55	304
1072	220	0	150	657	247	102	100	20	60	20	0	100	20	20	210
1972	252	0	404	057	247	155	100	09	09	59	0	404	59	59	210
1973	249	0	498	326	253	166	105	44	34	20	0	498	20	20	332
1974	281	0	563	224	282	188	106	30	24	13	0	563	13	13	375
1975	307	0	613	137	304	204	107	19	14	8	0	613	8	8	409
1976	328	0	655	150	325	218	110	20	16	9	0	655	9	9	437
1077	262	0	722	200	260	241	112	20	22	10	0	722	10	12	107
1977	502	0	725	200	500	241	115	20	22	15	0	725	15	15	402
1978	375	0	751	330	377	250	118	45	35	20	0	751	20	20	500
1979	717	1,017	0	261	422	540	117	76	0	62	712	0	0	0	0
1980	697	989	0	254	410	526	123	74	0	60	693	0	0	0	0
1981	800	1 1 3 4	0	291	470	603	138	85	0	69	795	0	0	0	0
1001	000	1 226	0	210	-10 F10	657	1 4 1	03	0	75	000	0	0	0	0
1962	0/2	1,250	0	510	515	057	141	95	0	/5	000	0	0	0	0
1983	0	937	0	22	436	56	144	0	0	102	250	0	0	0	0
1984	933	933	0	329	269	252	147	0	0	0	1,261	0	0	0	0
1985	1,164	1,082	0	412	512	1,245	150	216	0	73	595	0	0	0	0
1986	1 1 2 6	395	0	555	410	733	156	197	0	704	1 717	0	0	0	0
1007	1 1 2 0	450	400	270	225	535	1.01	107	0	C 4 7	1,717	0	0	0	0
1987	1,130	458	409	276	335	526	101	22	0	647	0	0	0	0	0
1988	1,302	542	357	352	492	478	163	86	0	533	0	0	0	0	0
1989	1,175	1,120	1,196	296	678	491	168	97	0	433	0	0	0	0	0
1990	870	1,633	1,998	193	800	440	174	95	0	259	0	0	0	0	0
1991	1 982	741	2 230	250	1 309	760	188	438	0	733	0	0	0	0	0
1002	2 E 1 0	1 060	2,230	110	1 240	1 262	107	70/	0	1 00E	0	0	0	0	0
1992	2,510	1,002	2,245	119	1,549	1,202	197	/04	0	1,095	0	0	0	0	0
1993	5,698	2,/31	803	648	1,347	1,965	262	1,193	1/1	2,241	0	0	98	98	0
1994	4,149	3,536	1,794	948	1,318	1,927	328	1,757	342	1,599	0	0	195	195	0
1995	3,155	3,338	1,852	1,738	1,167	1,700	409	2,734	513	2,552	0	0	293	293	0
1996	2 375	2 517	1 354	1 346	1 099	1 383	476	1 991	684	0	0	0	391	391	0
1007	2,070	2,517	2,001	1 220	1 560	1 706	E 4 0	2,000	000	0	0	0	100	100	0
1997	3,190	3,388	2,388	1,238	1,502	1,780	540	2,988	600	0	0	0	488	400	0
1998	275	2,470	1,854	1,345	1,259	1,854	608	4,324	1,026	1,217	1,854	0	586	586	0
1999	334	3,443	1,995	1,409	1,498	1,721	693	2,878	1,248	291	873	0	713	713	0
2000	394	1.708	1.972	3.081	639	204	777	58	1.471	411	302	0	841	841	0
2001	454	683	1 228	2 72/	672	1 2/18	864	10	1 69/	222	738	0	968	968	0
2001	710	410	1,220	2,724	752	1,240	504	200	1 017	251	750	0	1 000	1 000	0
2002	119	418	887	2,349	/53	84	504	200	1,91/	251	500	U	т,096	т,096	U
2003	500	285	1,111	3,263	729	113	2,003	64	2,009	153	281	0	1,148	1,148	0
2004	645	291	495	1,698	687	90	3,525	218	1,648	410	362	13	942	942	0
2005	303	261	1.123	1.873	737	222	3.143	252	1.286	122	503	90	735	735	0
2006	777	162	750	2 1 2 7	666	272	2 2 2 1	286	025	102	216	07	520	520	0 0
2000	111	400	1 000	2,137		2/2	5,524	200	525	130	240	52	323	323	0
2007	411	3/5	1,009	т,983	745	307	509	330	458	105	409	96	262	262	U
2008	1,307	2,836	1,623	1,193	458	117	735	768	668	419	345	23	382	382	774
2009	1,207	1,654	1,602	1,788	1,453	475	705	341	639	17	266	25	365	365	920
<u>20</u> 10	1,013	<u>1,2</u> 62	754	<u>8</u> 68	870	36	773	<u>1,</u> 295	768	0	<u>1</u> 64	20	439	439	504

 2010
 1,013
 1,262
 754
 868
 870
 36
 773
 1,295
 768
 0
 164
 20
 439
 439

 15: Lutjanidae; 16: Scombridae; 17: Euthynnus affinis; 18: Penaeidae; 19: Carangidae; 20: Rachycentridae; 21: Sepiidae; 22: Haemulidae; 23: Terapon spp.;
 24: Ariidae; 25: Mugilidae; 26: Dasyatidae; 27: Gerreidae; 28: Trichiuridae; 29: Thunnus tonggol
 164
 20
 439
 439

134

Table Ao	continued
10010119	continucu

Year	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1950	209	0	0	0	0	0	0	21	0	0	0	0	0	0	209
1950	205	0	0	0	0	0	0	21	0	0	0	0	0	0	203
1052	212	0	0	0	0	0	0	21	0	0	0	0	0	0	212
1952	210	0	0	0	0	0	0	21	0	0	0	0	0	0	210
1953	220	0	0	0	0	0	0	22	0	0	0	0	0	0	220
1954	225	0	0	0	0	0	0	22	0	0	0	0	0	0	225
1955	218	0	0	0	0	0	0	22	0	0	0	0	0	0	218
1956	224	0	0	0	0	0	0	22	0	0	0	0	0	0	224
1957	229	0	0	0	0	0	0	23	0	0	0	0	0	0	229
1958	235	0	0	0	0	0	0	23	0	0	0	0	0	0	235
1959	241	0	0	0	0	0	0	24	0	0	0	0	0	0	241
1960	247	0	0	0	0	0	0	24	0	0	0	0	0	0	247
1961	253	0	0	0	0	0	0	25	0	0	0	0	0	0	253
1962	259	0	0	0	0	0	0	26	0	0	0	0	0	0	259
1963	266	0	0	0	0	0	0	26	0	0	0	0	0	0	266
1964	272	0	0	0	0	0	0	27	0	0	0	0	0	0	272
1965	278	0	0	0	0	0	0	27	0	0	0	0	0	0	278
1966	284	0	0	0	0	0	0	28	0	0	0	0	0	0	284
1967	289	0	0	0	0	0	0	29	0	0	0	0	0	0	289
1068	205	0	0	0	0	0	0	20	0	0	0	0	0	0	205
1060	200	0	0	0	0	0	0	20	0	0	0	0	0	0	204
1969	299	0	20	20	20	20	20	30	0	14	14	124	0	0	299
1970	304	0	29	29	29	29	29	30	0	14	14	434	0	0	449
1971	304	0	27	27	27	27	27	31	0	14	14	410	0	0	441
1972	310	0	20	20	20	20	20	31	0	10	10	296	0	0	408
1973	332	0	10	10	10	10	10	32	0	5	5	147	0	0	381
1974	375	0	7	7	7	7	7	33	0	3	3	101	0	0	409
1975	409	0	4	4	4	4	4	33	0	2	2	62	0	0	429
1976	437	0	4	4	4	4	4	34	0	2	2	67	0	0	459
1977	482	0	6	6	6	6	6	35	0	3	3	94	0	0	513
1978	500	0	10	10	10	10	10	36	0	5	5	149	0	0	550
1979	0	0	0	0	0	0	0	37	383	0	0	0	0	0	2,553
1980	0	0	0	0	0	0	0	39	372	0	0	0	0	0	2,484
1981	0	0	0	0	0	0	0	44	427	0	0	0	0	0	2.849
1982	0	0	0	0	0	0	0	45	465	0	0	0	0	0	3 105
1983	0	0	0	0	0	0	0	46	0	0	0	0	0	0	2 135
108/	0	0	0	0	0	0	0	40	6/1	0	0	0	0	0	2,155
1005	0	0	0	0	0	0	0	47	197	0	0	0	0	0	2,333
1965	0	0	0	0	0	0	0	40	407	0	0	0	0	0	929
1986	0	0	0	0	0	0	0	50	563	0	0	0	0	0	551
1987	0	0	0	0	0	0	0	51	0	0	0	0	0	0	2,988
1988	0	0	0	0	0	0	0	52	0	0	0	0	0	0	3,292
1989	0	0	0	0	0	0	0	54	0	0	0	0	0	0	2,314
1990	0	0	0	0	0	0	0	56	0	0	0	0	0	0	2,651
1991	0	0	0	0	0	0	0	60	0	0	0	0	0	0	4,603
1992	0	0	0	0	0	0	0	63	0	0	0	0	0	0	5,860
1993	0	0	49	49	49	49	49	72	0	24	24	0	0	0	7,307
1994	0	0	98	98	98	98	98	82	0	49	49	0	0	0	7,370
1995	0	0	147	147	147	147	147	96	0	73	73	0	0	0	6,924
1996	0	0	195	195	195	195	195	107	0	98	98	0	0	0	5,531
1997	0	0	244	244	244	244	244	116	0	122	122	0	0	0	7,602
1998	0	0	293	293	293	293	293	126	0	147	147	0	0	0	7.608
1999	0	0	357	357	357	357	357	138	0	178	178	0	0	0	7.475
2000	0	0	420	420	420	420	420	151	0	210	210	0	0	0	4 587
2001	0	423	484	484	484	484	484	164	0	242	242	n	0	21	3 176
2001	0	125	5/12	5/12	5/12	5/12	5/12	161	0	272	27/	0	0	20	5 727
2002	0	-+0U E11	540	540	540 E74	540	540	214	0	2/4	207	0	0	0 <i>5</i>	2 001
2003	0	211	5/4	5/4 474	5/4	5/4	5/4	214	0	287	20/	0	0	25	3,084
2004	U	555	4/1	4/1	4/1	4/1	4/1	98	0	235	235	0	U	39	4,387
2005	0	518	368	368	368	368	368	82	0	184	184	0	0	102	4,147
2006	0	641	264	264	264	264	264	67	0	132	132	0	0	17	3,373
2007	0	660	131	131	131	131	131	29	0	65	65	0	0	96	2,917
2008	0	366	191	191	191	191	191	61	0	95	95	0	360	148	2,412
2009	0	556	183	183	183	183	183	172	0	91	91	0	367	111	3,916
2010	0	657	219	219	219	219	219	123	0	110	110	0	287	69	3,580

30: Rhinobatidae; 31: *Epigonus* spp.; 32: *Parastromateus niger*; 33: Platycephalidae; 34: *Portunus pelagicus*; 35: Soleidae; 36: Tetraodontidae; 37: Brachyura; 38: Priacanthidae; 39: Mullidae; 40: Stomatopoda; 41: *Carangoides malabaricus*; 42: *Atule mate*; 43: Scaridae; 44: Others