Preliminary reconstruction of fisheries catches of Jordan and Israel in the inner Gulf of Aqaba, Red Sea, 1950-2010[1]

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Abstract

The fisheries catch taken within the small Exclusive Economic Zones (EEZ) of Jordan and Israel, in the inner Gulf of Aqaba, Red Sea, was reconstructed from a variety of government and non-government sources for the years 1950-2010, and compared with the catch these two countries report annually to the Food and Agriculture Organization of the United Nations (FAO). The different sectors of the fisheries in each country are treated separately and the composition of the catches estimated. There is a strong discrepancy between the reconstructed catch and FAO data, in part due to these countries' fleets having operated outside of their EEZ (Israel in what are now Eritrean waters, from 1958 to the early 1970s; Jordan in Saudi Arabian waters, from 1950 to 1984), and to an overall lack of interest in collecting data for what are rather small operations, with very low catch level. For Jordan, the catch was around 150 t·year^{-1} from 1950 to the mid-1960s. This catch then declined, due to conflicts in the area, and started to increase again in the mid-1980s, with some fluctuations. The highest catch of 330 t was achieved in 2009. Israel's total catch in its Red Sea EEZ was less than 100 t·year^{-1} in the early 1950s, then increased until it reached its peak of around 300 t·year^{-1} in the early 1980s, and it later decreased to around 100 t·year^{-1} in the late 2000s. Overall, the estimated reconstructed catch of Jordan from 1950 to 2010 was 1.7 times what is reported in the FAO database and for Israel it was 1.4 times. The reconstruction exercise, with its explicit stated procedures and assumptions, accounting all the sectors comprehensively, can be a good starting point to improve the quality of the data for these countries and for better management of resources, which are under continuous pressure from fishing and other developments in the region.

Introduction

The Hashemite Kingdom of Jordan and the State of Israel share the north-eastern tip of the Gulf of Aqaba, Red Sea, with small, quasi-Exclusive Economic Zones of about 95 and 29 km^2, respectively (MoE, 2002; Al Ouran, 2005) (Figure 1). This unique region harbors the world's northernmost coral reef ecosystem (Khalaf and Disi, 1997; MoE, 2002) and is characterized as hypersaline, with waters averaging 42 psu (Sneh and Friedman, 1985). This is in part due to its semi-enclosed nature (Hargreaves, 1981), which allows for a complete renewal of the water basin only once every 20 years (Lapidoth-Eschelbacher, 1982). These factors not only lead to a high degree of endemism in the region, but also increase the susceptibility to pollution, which, jointly with overfishing, affect the diversity and abundance of the fish stocks, as well as the health of the coral reefs (Tellawi, 2001). The two major settlements in the gulf are Aqaba and Eilat in Jordan and Israel, respectively. The two cities have major ports for their respective countries in the Red Sea. For Jordan, the only access to the sea is through the Red Sea, which makes the port of Aqaba its sole port. The fish landing site of Jordan is at Sidra, near the town of Aqaba, where fish are sold directly to merchants, hotels and restaurants based in Aqaba (PERSGA, 2002).

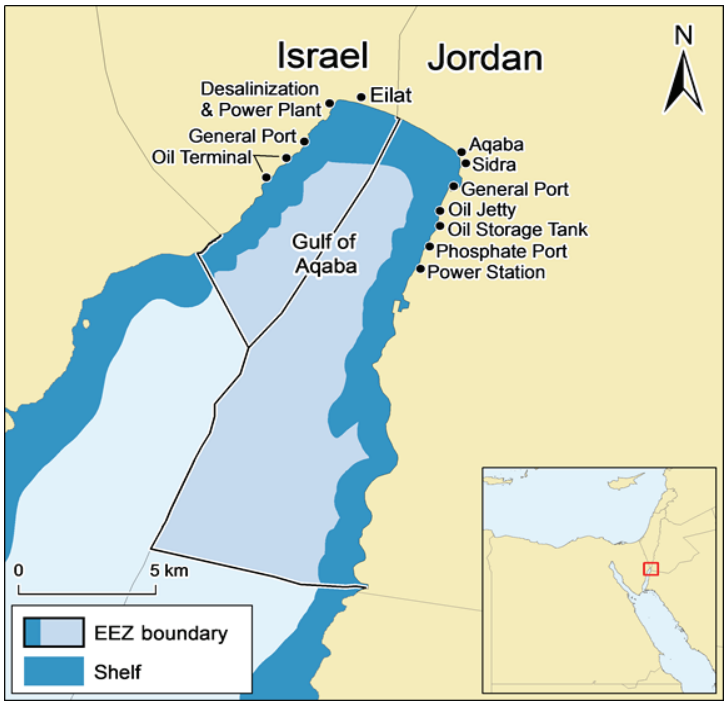

Figure 1. The Gulf of Aqaba, Red Sea, with shelf areas and Exclusive Economic Zones (EEZ) of Jordan and Israel.

In 1949, Israel conducted an experimental fishing expedition from the port of Eilat which confirmed the potential for a commercial fishery in the region, previously exploited by poorly-documented traditional fisheries. Due to the limited area available for fishing (Farid, 1984), the fisheries of both countries soon expanded beyond the inner Gulf of Aqaba. Jordanian fishers engaged in fishing along the coast of neighboring Saudi Arabia (PERSGA, 2002), while Israel ventured further south to Eritrea beginning in 1957 (Ben-Tuvia, 1968).

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The predominant gears utilized by fishers in Israel are beach seines, gill-nets, and trammel nets (Ben-Tuvia, 1968), and the fishing boats range in length from 7 to 11 m (Shapiro, 2007). In Jordan, beach seines, gill-nets, and trammel nets are also used, along with hand lines and longlines, various traps, and (illegally) spear guns and explosives. The main species targeted by the Jordanian fleet are snappers (Family Lutjanidae), groupers (Family Serranidae) and emperors (Family Lethrinidae), along with numerous incidental species (Khalaf and Disi, 1997). The catch, which is not iced, is landed from boats ranging from 5.5 to 11 meters (PERSGA, 2002), and sold immediately to merchants in the port of Aqaba.

In addition to fishing, several other anthropogenic factors have been linked to impact the Jordanian waters over the past few decades. Commercial fish farms, sewage overflow, and phosphate emissions from nearby industrial terminals have led to increasing levels of eutrophication (MoE, 2002; Al Ouran, 2005), which is having an adverse effect on the coral reefs. For example, in 1996, 70% of the coral were reported to be alive, yet in 2002 the reef was comprised of only 30% live coral in Jordan (MoE, 2002). These unfavorable marine conditions, coupled with fishing (Tellawi, 2001), are responsible for the increase of pressure on the ecosystem. The extent of the impact of these pressures needs to be studied and monitored. Some of the impacts are obvious, for example in 2006 half of all the Jordanian fishing boats were permanently anchored (IRIN, 2006).

The state of the fisheries in the inner Gulf of Aqaba cannot be assessed using only the catch data which Israel and Jordan submit to the Food and Agriculture Organization (FAO) of the United Nations (Pauly and Zeller, 2003). Rather, as for other countries and territories, it is necessary to 'reconstruct' historic catch trends to acquire a minimum understanding of the evolution of these fisheries (Zeller *et al.*, 2006; Zeller *et al.*, 2007).

Materials and Methods

The total marine catches by Jordan and Israel within their territorial waters in the Gulf of Aqaba were estimated by country for the period from 1950 to 2010. The required data were primarily obtained from government reports and the scientific literature. The fishery sectors in each country are treated separately, and for each country, the reconstructed total catch is divided into reported and unreported catch. Since the fisheries of the two countries are dominated by artisanal fisheries, which use selective gear (PERSGA, 2002), there is no discarded catch or, if it exists, it is negligible. Emphasis was given to 'hard' estimates of the catch of distinct fisheries, which were used as 'anchor points' (Zeller *et al.*, 2006; Zeller *et al.*, 2007) between which estimates for missing years could be obtained by interpolation.

Jordan

Artisanal fishery

For some years, the Jordanian Red Sea fisheries data were obtained from peer-reviewed articles, government reports and grey literature (Table 1). The catch estimates for years without sources were derived by interpolation between years with known catch. Also, the 1965 value was carried back to 1950, as the fishing fleet and environmental conditions have experienced few changes from 1950 to 1964 (Barrania, 1979). After 1985, the fishery statistical reporting ceased and the catch values available were based on researchers from Jordanian universities (PERSGA, 2002). These values match what are available in the FAO database for the later years. Thus, the FAO values were used from 1998 to 2010.

The landings in the Jordanian port of Aqaba prior to 1985 included both catches in Jordanian waters and catches from Saudi Arabian waters up to 300 km south of Aqaba. In 1985, access to these southern fishing grounds ceased, as did the collection of fisheries statistics by the government (PERSGA, 2002). Until 1984, approximately half of the catch was obtained in Saudi Arabian waters (Barrania, 1979) and thus only half of the reconstructed catch was applied to the Jordanian catch. The other half, which was caught in Saudi waters was accounted in the Saudi Arabia's catch reconstruction in its Red Sea EEZ (see Tesfamichael and Rossing, 2012 this volume).

In addition to fishing in foreign waters, there are mentions of high spoilage rates due to low handling standards and insufficient amount of ice to preserve the catch. Estimated rates of spoilage ranged from 0.4 to 54% (Table 2) (Barrania, 1979). The values from 1972 to 1978 included spoilage, whereas the data for the previous years did not. A conservative estimate of 19%, calculated by taking the average spoilage values from 1972 to 1976, was added to the catch in all years prior to 1972.

Table 1. Sources for estimating the Jordanian marine catch in the Gulf of Aqaba.

Year	Catch (t)	Source
1965	180	Barrania (1979)
1966	180	Ben-Tuvia (1968)
1972	143	Barrania (1979)
1973	93	Barrania (1979)
1974	103	Barrania (1979)
1975	90	Barrania (1979)
1976	49	Barrania (1979)
1977	31	Barrania (1979)
1978	31	Barrania (1979)
1983	100	Chakraborty (1984)
1985	125	Chesrown (2004)
1993	103	FAO (2003)
1995	150	FAO (2003)
1998	120	FAO[a], PERGSA (2002)
1999	160	FAO
2000	150	FAO
2001	170	FAO
2002	176	FAO
2003	131	FAO
2004	144	FAO
2005	160	FAO
2006	147	FAO
2007	156	FAO
2008	150	FAO
2009	219	FAO
2010	136	FAO

[a] http://www.fao.org/fishery/topic/16072/en

Table 2. Percentage of spoiled fish in the Jordanian catch.

Year	%
1972	54.1
1973	1.7
1974	10.8
1975	27.9
1976	1.1
1977	n.a.
1978	0.4

Finally, the reconstructed catch was disaggregated into major taxa. There were two sources of catch composition data, one for the early period (Barrania, 1979) and for the later period (1998 – 2010) from the FAO database. The Jordan fishery in the Gulf of Aqaba had two distinct periods before and after 1985. This coincides with the time the fishers were allowed to operate in the waters of neighboring countries, mainly in Saudi waters, or not. When they fished outside their waters, most of the local fishing sector was focused on inshore and coral reef fishes (Barrania, 1979). Once they were prevented from fishing outside of Jordanian waters, in 1985, most of their catch focused on pelagic fishes (PERSGA, 2002). Accordingly, the composition from 1950 to 1984 was calculated based on the data from Barrania (1979). Only local names were available in the report and their corresponding scientific and English common names were obtained from Tesfamichael and Awadh (2012), Fishbase (Froese and Pauly, 2012) and Dr. Dori Edelist (University of Haifa, Israel, pers. comm.). The report by Barrania (1979) had catch composition estimates for only 8 of the taxa in the catch, while the rest were put under 'others'. However, local names for some of the components of the 'others' were available, and we assumed a value of 0.3% for each of the taxa for which we were able to find the corresponding scientific names in our sources (Italics in Table 3); only the rest were categorized under 'others'. The FAO catch composition was used from 1998 to 2010 (Table 4). From 1990 to 1997, the values of 1998 were used. From 1985 to 1989, we interpolated the catch composition to allow a relatively smoother transition of the fishery from inshore coral reef to pelagic. Although there is evidence that the fishery switched its target fishes from reef-associated to pelagic, it is unrealistic to assume the shift happened within a year, as there are capital investment and technical issues that need to be considered. We allowed 5 years for the shift to happen.

Table 3. Catch composition (%) for Jordanian artisanal fishery from 1950 to 1984 (Barrania 1979).

Arabic name	Scientific name	Common name	Family	Catch %
Sho'or	Lethrinidae	Emperors	Lethrinidae	57.2
Fares	Lutjanidae	Snappers	Lutjanidae	18.4
Segan	Siganidae	Rabbit fishes	Siganidae	3.0
Reem	*Carangoides* spp.	Trevallies	Carangidae	2.9
Freeden	*Polysteganus coeruleopunctatus*	Blueskin seabream	Sparidae	2.6
Bohar	*Lutjanus bohar*	Two-spot red snapper	Lutjanidae	1.7
Gerbeden	Sparidae	Porgies	Sparidae	1.7
Sultan Ibrahim	Mullidae	Goat fish	Mullidae	0.4
Reshan	*Gerres oyena*	Common silver-biddy	Gerreidae	*0.3*[a]
Qamar	*Gymnocranius grandoculis*	Blue-lined large-eye bream	Lethrinidae	*0.3*
Hereed	Scaridae	Parrotfish	Scaridae	*0.3*
Dagham	*Epinephelus* spp.	Grouper	Serranidae	*0.3*
Shran	*Cephalopholis miniata*	Coral hind	Serranidae	*0.3*
Tween	Serranidae	Grouper	Serranidae	*0.3*
Others[b]	—	—	—	10.2

[a] Italic values are assumed percentages, [b]Others include taxa with local names Aisoun, Boas and Track.

Table 4. Catch composition (%) of Jordanian artisanal fishery from 1998 to 2010 based on FAO data.

Common name	Scientific name	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Emperors	Lethrinidae	1.66	1.25	0.67	1.18	0.57	0.76	0.69	1.25	0.68	1.28	2.00	4.11	5.15
Frigate/bullet tunas	*Auxis* spp.	1.66	2.50	1.33	2.94	2.84	3.05	2.78	3.13	2.72	3.21	4.00	4.11	4.41
Fusiliers	Caesionidae	12.47	11.25	11.31	8.82	6.82	9.92	8.33	8.75	7.48	8.33	8.67	6.85	6.62
Kawakawa	*Euthynnus affinis*	21.62	22.50	21.96	23.53	22.73	25.19	24.31	25.00	29.93	28.85	28.00	21.00	25.00
Longtail tuna	*Thunnus tonggol*	1.66	1.25	1.33	1.76	1.70	1.53	2.08	1.25	1.36	2.56	3.33	5.02	7.35
Marine fishes	Others	2.49	4.38	4.66	3.53	5.68	6.11	6.94	6.25	4.76	6.41	6.67	9.13	4.41
Narrow-barred Spanish mackerel	*Scomberomorus commerson*	0.21	0.63	0.17	0.59	0.57	0.76	0.69	1.25	1.36	1.28	1.33	3.20	5.15
Scads nei	*Decapterus* spp.	16.63	15.63	16.64	15.29	14.20	16.79	13.89	10.63	10.20	12.82	10.67	12.33	5.88
Skipjack tuna	*Katsuwonus pelamis*	29.11	27.50	29.95	30.59	29.55	32.82	31.25	34.38	34.01	28.21	28.67	20.55	20.59
Rabbitfishes	Siganidae	8.32	7.50	6.66	6.47	4.55	0.00	3.47	3.75	2.72	2.56	2.00	4.57	4.41
Tuna-like fishes	Scombridae	2.49	2.50	3.33	2.35	7.95	0.00	3.47	2.50	2.04	2.56	2.00	4.57	5.15
Yellowfin tuna	*Thunnus albacares*	1.66	3.13	2.00	2.94	2.84	3.05	2.08	1.88	2.72	1.92	2.67	4.57	5.88

Subsistence fishery

The catch of the subsistence fishery consists of two components; the first is the catch of small boats mainly for direct consumption by the fishers' families and communities. A small portion of their catch may be sold or exchanged in kind. These catches are not reported at all. The second component of the subsistence catch is part of the catch of the bigger boats that is consumed by the crew and given to family and friends. For the small boats it was calculated based on a survey (Barrania, 1979), where it was estimated that a total of about 12 boats made day trips and caught 6 – 10 kg (average 8 kg·day^{-1}). We assumed the total number of fishing days per year to be 250 and thus could compute the total catch to be 24 t·year^{-1}. For the bigger boats, we assumed that 10% of their catch was consumed by crew and/or given to family members. The percentages used to calculate the artisanal fishery catch composition were used to calculate the composition of subsistence catch composition as well, because they employ similar gears.

Recreational fishery

A recreational fishery exists in the Jordanian Gulf of Aqaba and it is growing fast (FAO, 2003). However, data on its size and catches do not exist. The recreational fishery catch was estimated using the population of Aqaba, the main coastal settlement on the Jordanian coast, taken from www.populstat.info and Wikipedia (2012). Data were not available for the whole time series, and interpolation was used to fill the gaps (Table 5). The recreational fishery was assumed to start in 1974, after the war between Israel and Arab countries in 1973, so zero was assigned from 1950 to 1973. From 1974 onward, it was calculated using a participation rate of 8%. To derive this rate we started with the regional participation value of 0.12 (Cisneros-Montemayor and Sumaila, 2010). Note the participation ratios in Cisneros-Montemayor and Sumaila (2010) are given for the whole country and as a percentage. In our calculations, we used population size of only Aqaba, the main coastal settlement because the coastal people are the ones to be involved more in recreational fishing than people far from the coast. Therefore the rate of 0.12% was adjusted for the population size of Aqaba using the ratio of Aqaba population to the total Jordanian population from 1974 to 2010, which was 1.5 % (i.e., the total population is 65 times that of Aqaba). Hence the participation ratio was multiplied by 65, making the participation percentage only for Aqaba to be 8%. In addition, we assumed that recreational fishers go fishing a total of 15 days·year^{-1}. As for the catch rate, we assumed a rate of 1 kg·day^{-1} for 1974 and 0.5 kg·day^{-1} for 2010. The rate was interpolated between those two years. Finally, the annual recreational fishery estimate was calculated as a product of population, participation ratio, number of days per year, and catch rate. The catch composition of recreational fishery was taken from Saudi Arabia's recreational fishery in the Red Sea, where emperors accounted for 40%, sea breams 30%, groupers 20% and 'others' 10% (Tesfamichael and Rossing, 2012).

Table 5. Population of Aqaba

Year	Pop. (10^3)	Year	Pop. (10^3)
1970	15	1993	67
1979	27	1994	63
1985	36	1998	80
1986	37	2002	96
1989	44	2007	98
1990	46	2009	109

Source: www.populstat.info, except 2007 and 2009 from Wikipedia

Israel

Artisanal fishery

Fishery catch data were obtained from '*Bamidgeh*', a publication of the Israeli Department of Agriculture for some years between 1954 and 1985, after which we used reports from '*The Fisheries and Aquaculture of Israel*' (Table 6). The 1954 total catch estimate, from Cohen (1957), was carried back to 1950 as the gear and fishing grounds appear to have remained similar during those years. For periods where data were missing, FAO data were used selectively. The FAO data for Israel have some inconsistency, mainly reports of zero catches for some periods; however we were able to get non-zero estimates from national sources. On the other hand, for some periods, the catch values reported in the FAO database matched the sources from the Israeli fishery administration. It is safe to conclude that Israel reported its fishery catch in the Red Sea accurately to FAO, for some periods, vis-à-vis its national reports. Thus, we used FAO data from 1981 to 1985 because the FAO data and other sources for neighboring years (1979, 1980 and 1986) were the same. Similarly, FAO data were used from 1991 to 2002 and 2008. FAO data were not used for 1955 – 1967, 1969 – 1978, 1987, 1989 – 1990, where FAO data contained numerous zero catches. Instead the catches were estimated using interpolation. For 2009 and 2010, data from Israeli Department of Fisheries Statistical Yearbooks, DoFSY (Dr. Dori Edelist, pers. comm.) were used; these values differed from the FAO dataset.

The composition of the catch, predominantly comprised of snappers (Table 7) was obtained from Sarig (1982) and was used from 1950 to 2005. However, since 2006, the catch composition changed, as pelagic species started to become abundant in the catch. So for 2006–2010, catch composition data obtained from DoFSY (Dr. Dori Edelist, pers. comm.) were used.

Israel fished in Eritrean waters beginning in 1958 (Ben-Tuvia, 1968; Sarig, 1969). Since these catches originated from Eritrean waters, they are reported in the Eritrea catch reconstruction (see Tesfamichael and Mohamud, 2012 this volume for details on this fishery).

Table 6. Data sources for estimating Israel's catch in the Gulf of Aqaba.

Year	Catch (t)	Source
1954	60	Cohen (1957)
1968	200	Ben-Tuvia (1968)
1979	250	Sarig (1982)
1980	283	Sarig (1982)
1981	257	FAO[a]
1982	76	FAO
1983	68	FAO
1984	102	FAO
1985	150	FAO
1986	150	Sarig (1987)
1988	130	Anonymyous (1992)
1991	35	FAO
1992	98	FAO
1993	80	FAO
1994	110	FAO
1995	150	FAO
1996	225	FAO
1997	171	FAO
1998	137	FAO
1999	98	FAO
2000	120	FAO
2001	120	FAO
2002	30	FAO
2003	30	Snovsky and Shapiro (2004)
2004	100	Shapiro (2005)
2005	75	Shapiro (2006)
2006	75	Shapiro (2007)
2007	50	Shapiro (2008)
2008	50	FAO
2009	70	DoFSY[b]
2010	40	DoFSY

[a] http://www.fao.org/fishery/topic/16072/en
[b] Based on Israeli Department of Fisheries statistical yearbooks

Subsistence fishery

Israel publishes its annual fishery statistics for its fishery in the Gulf of Aqaba, and that is also what is reported to FAO, at least for most years. The reports clearly state that the data do not include part of the catch that is consumed by the crew and catch given to families and friends (Snovsky and Shapiro, 2004). This constitutes the subsistence fishery in our report. The subsistence catch in the Israeli Gulf of Aqaba fishery was estimated as a percentage of the artisanal catches. Based on interviews with fishers (Dr. Dori Edelist, pers. comm.), 5% of the total catch of artisanal fishers is consumed by the crew and given freely to family and friends, which was used as an anchor point for 2010. As observed in other Red Sea countries, the ratio is generally higher for earlier years (see the other chapters). We assumed 10% in 1950. The ratio was interpolated from 1950 to 2010. The composition of the subsistence fishery was taken from the ratios of the artisanal fishery.

Table 7. Catch composition (%) of Israel's artisanal fisheries in the Gulf of Aqaba.

Common name	Scientific name	1950-2005	2006-2010
Red snapper	Lutjanidae	48	10
Tuna-like	Scombridae	32	30
Groupers	Serranidae	12	7
Jacks and pompanos	Carangidae	0	20
Swordfish	*Xiphias gladius*	0	10
Goatfish	Mullidae	0	5
Cephalopods	Cephalopods	0	5
Barracudas	*Sphyraena* spp.	0	3
Rabbitfish	*Siganus* spp.	0	2
Others	Others	8	8

Recreational fishery

Similar to Jordan, the recreational fishery of Israel in the Gulf of Aqaba was calculated based on the population of its largest coastal city in the Red Sea, Eilat (Table 8). The recreational fishery was assumed to start in 1974, after the 1973 war. The participation ratio of 0.12 was used in the calculations (Cisneros-Montemayor and Sumaila, 2010) and the number of days fished per year was assumed to be 20. Again, similar to Jordan, the participation ratio was adjusted to the population of Eilat, which had an average of a little less than 1% of the total Israeli population from 1974 to 2010. We assumed 1% and multiplied the participation ratio by 100. The catch rate per day was assumed to be 1 kg·day^{-1} for 1974 and 0.5 kg·day^{-1} in 2010. Catch rates were interpolated for the intervening years. The catch composition of the recreational fishery was taken from Saudi Arabia's recreational fishery in the Red Sea, where emperors accounted for 40%, sea breams 30%, groupers 20% and 'others' 10% (Tesfamichael and Rossing, 2012).

Table 8. Population of Eilat.

Year	Pop. (10^3)	Year	Pop. (10^3)
1972	13	1995	32
1974	14	1999	40
1979	19	2000	41
1983	19	2002	43
1992	30	2008	47
1994	33	2010	48

Source: http://www.populstat.info/, except 2008 and 2010 from Wikipedia

Comparing reconstructed catches with FAO data

The reconstructed catches , i.e., what were caught in the EEZ's of the respective countries and excluding what they caught in other countries' EEZ's , were compared to the data for the respective country in the FAO database www.fao.org/fishery/statistics/software/fishstat/en). Since the subsistence and recreational fisheries were not reported at all, only the reconstructed artisanal catches were compared to the FAO data. In order to be able to compare taxon by taxon, the FAO data, when only totals were given, were divided into the components using the ratios in the reconstructed catches. For Israel, large quantities of brush-tooth lizardfish (*Saurida undosquamis*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*) catches were reported in the FAO data mainly from 1965 to 1972, which were higher than the reconstructed total catch. This is the period when Israel fished in Eritrean waters, so they were excluded from the taxon-to-taxon comparison as they were deemed to be caught outside the EEZ. For other taxa, if the amount in the reconstruction was higher than its value in the FAO database, the difference is assigned as 'unreported catch'; if it is the opposite, then it is 'over-reported catch'. The part of the reconstructed catch that is accounted in the FAO data is referred as 'reported catch' in our result.

Results

Jordan

Our results suggest that the catch in Jordanian waters ranged from slightly less than 150 t in 1950 to a maximum of a little more than 300 t in 2009. The lowest catch was towards the second half of the 1970s (Figure 2) and also given in Appendix Table (A1). The total catch showed an increasing trend from its lowest values in the late 1970s until its peak in 2009. In contrast, the data supplied to FAO were lower than the reconstructed total catch for most of the period, except in the early period, where a total of 200 t was reported in the FAO for a few years. These years correspond with the time the Jordanian fishers were fishing outside the Jordanian waters, i.e., mainly in Saudi Arabia. Since the origin of these catch was outside Jordan, we did not include them as Jordanian catch from Jordanian waters in our reconstruction. Instead they were accounted in their country of origin, Saudi Arabia (see Tesfamichael

and Rossing, 2012 this volume). Similar to the reconstruction, the highest catch reported in the FAO database was for 2009. The FAO database has zero catches for some years. This is due to a lack of reporting by Jordan to FAO and does not mean that there were no fishery catches. Such data gaps can be very misleading in the assessment and management of fishery (Pitcher *et al.*, 2002). From the late 1990s, the FAO data were equal to the total artisanal fishery, which is the only reported fishery to FAO as subsistence and recreational are not reported at all.

When the reconstructed total catch of Jordan in Jordanian waters is divided into different sectors, the artisanal fishery has the lion's share with 62%, followed by the subsistence fishery at 20% and the recreational fishery at 18% (Figure 2, Table A1). Jordan does not have an industrial fishery (PERSGA, 2002), therefore, the artisanal fishery has the strongest influence on the pattern of the overall total. The subsistence fishery follows a pattern similar to that of the artisanal fishery because it was calculated as a ratio of the artisanal fishery. The recreational fishery started in 1974 and its contribution became important only in the later years.

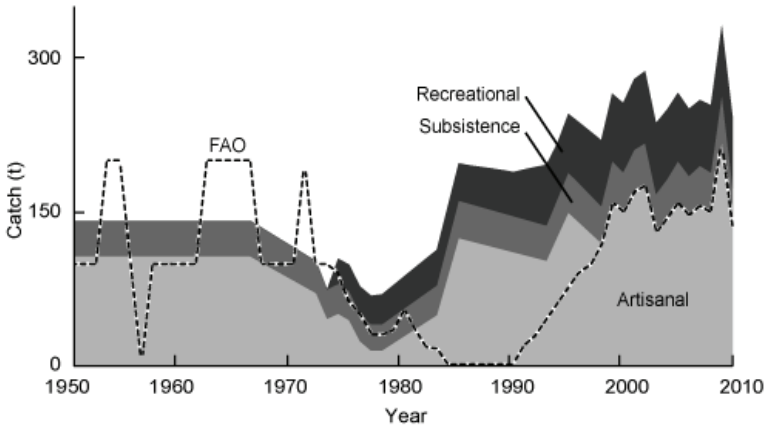

Figure 2. Total catch of the Jordanian fishery in the Gulf of Aqaba by sectors and the total catch Jordan reported to FAO from 1950 to 2010.

The total marine catch within Jordanian waters was found to be 1.7 times the catches reported to the FAO from 1950 to 2010. This can be attributed to two main factors: first there are zero catches for some years in the FAO database. Second, the unreported catch, which consists mainly of subsistence and recreational fisheries, is not included in the FAO database at all. The unreported catch accounted for 52% of the reconstructed total catch. The reported catch (part of the reconstructed catch accounted in the FAO data) represented only 48% of the total catch (Figure 3, Table A2).

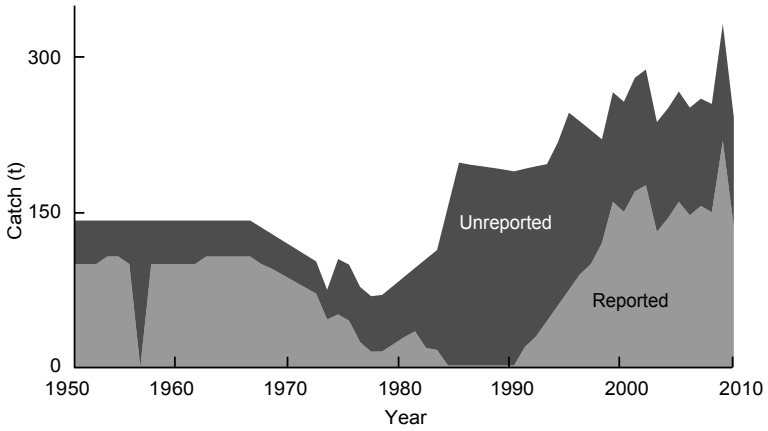

Figure 3. Total catch of the Jordanian fishery in the Gulf of Aqaba by components from 1950 to 2010. Reported catch refers to the part of the reconstructed catch accounted in the FAO data.

There are 21 identified taxonomic groups that made up the total artisanal fishery catch of Jordan in the inner Gulf of Aqaba (Figure 4). The most dominant taxon is emperors (Lethrinidae) at 29%, followed by skipjack tuna (*Katsuwonus pelamis*) at 15% and kawakawa (*Euthynnus affinis*) at 12%. Although there are numerous other taxa in the catch, they contribute smaller amounts, hence showing all of them on the composition figure is difficult and superfluous. Thus, the taxa with minor contribution are lumped together with the category 'others' in the figure for all sectors in this report. A more detailed taxonomic composition is, however, given in the appendix tables (e.g., see Table A3 for Jordan's artisanal fishery). The catch composition of Jordan's artisanal fishery exhibits two distinct phases, one before 1985 and the second after 1990. The earlier catch composition consisted mainly of coral reef-associated fishes, without a component of pelagic taxa. In contrast, the later period consisted of mainly pelagic taxa, with the reef-associated fishes being less abundant. Based on the sources for the composition (see methods), a reasonable explanation for the shift can be that in the early period, when Jordanian fishers used to venture out to neighboring countries, their target was coral reef-associated fishes. Therefore, the gear and technology they used must have influenced the fishers fishing in Jordanian waters to also target coral reef-associated fishes and/or the fishers visiting neighboring waters may also spend time fishing domestic waters. In addition, even if the reef-associated total catch was not high compared to the total catch from pelagic resources in the later years (see Figure 4, the total catch after 1985 is

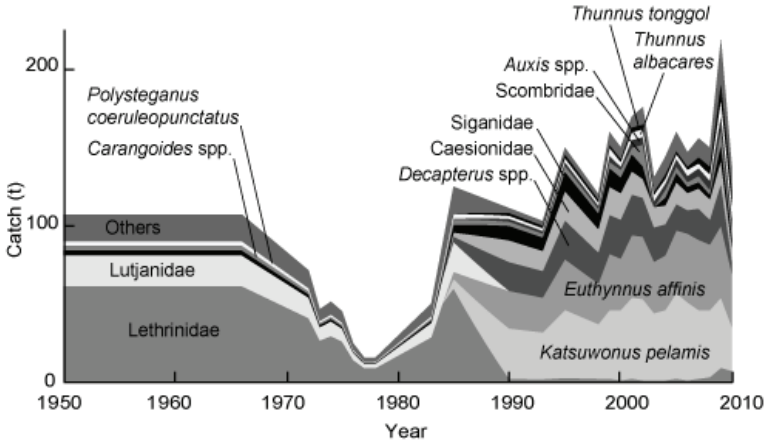

Figure 4. Catch composition of the Jordanian artisanal fishery in the Gulf of Aqaba from 1950 to 2010.

generally higher than the period before), it would have been a good addition to their catches from the neighboring waters. However, later when they were not allowed to fish in neighboring waters, they had to focus on Jordanian resources and target the more abundant resource which is the pelagic fishes.

The catch composition of the subsistence fishery is similar to the artisanal fishery (Figure 5, Table A4), as the same catch composition ratios were used. However, it does not show strong fluctuations like the artisanal fishery; it stays more or less stable. This is quite realistic for a subsistence fishery. As its name indicates, this is catch consumed by locals, is a source of food security, and it is usually less affected by external factors (e.g., market and politics) compared to the other fisheries. The catch composition of the recreational fishery has only three identified taxa (Figure 6, Table A5). The composition of the total catch of Jordan in the Red Sea strongly resembles that of the artisanal fishery (Figure 7, Table A6), simply because artisanal fishery has the highest contribution to the total catch.

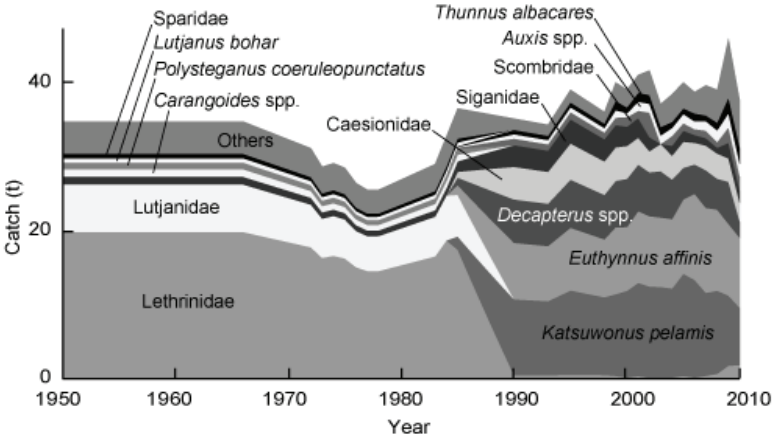

Figure 5. Catch composition of the Jordanian subsistence fishery in the Gulf of Aqaba from 1950 to 2010.

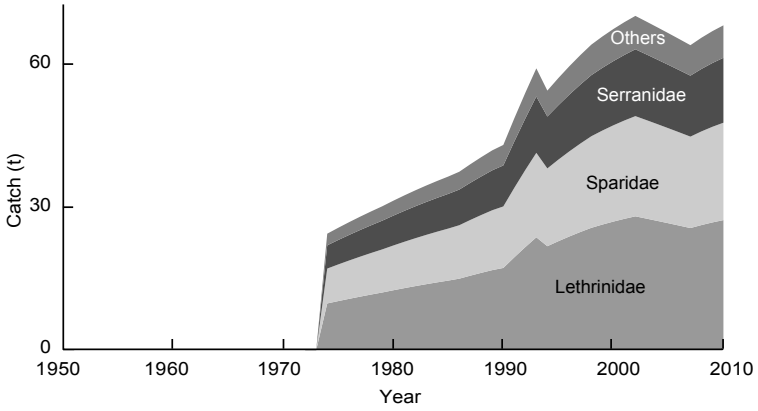

Figure 6. Catch composition of the Jordanian recreational fishery in the Gulf of Aqaba from 1950 to 2010.

Israel

The reconstructed total catch of Israel in the Gulf of Aqaba increased continuously from its low value of a little more than 60 t·year^{-1} at the beginning of the 1950s until it reached its peak of 346 t in 1980 (Figure 8, Table A7). After 1980, it exhibited more fluctuations than in earlier years and stayed at relatively lower values, except for a smaller peak in 1996. Compared to Jordan, Israeli catches showed lower fluctuations. There are large discrepancies between the reconstructed catch and the data submitted to FAO by Israel, with the latter ranging from zero catches from 1950 to 1964 to a peak of 1,000 t in 1965. While the early catches of zero show the absence of reporting and should not mean there was no fishing. The high values are what Israel caught in the whole Red Sea, including outside its EEZ in the Eritrean EEZ, because catch statistics by the FAO are categorized by FAO statistical area (to which the whole Red Sea falls into one category) and fishing country, without any information indicating EEZ area. However, our catch reconstruction focuses on the use of catch data for ecosystem management, which makes it practical to report by the EEZ the catch originated, with clear indication who caught the fish as well. Thus, the Israeli catches from Eritrean waters are reported in the catch reconstruction of Eritrea (see Tesfamichael and Mohamud, 2012 this volume). Starting 1979, the FAO data matched with the artisanal catches, the only sector reported to FAO, except when the FAO values were zero, which again could be due to lack of reporting. The artisanal sector had the highest contribution to the reconstructed total catch in the Israeli fishery in the Gulf of Aqaba, contributing 76%. The second was recreational fishery with 18%; the subsistence fishery (6%) was last (Figure 8). Artisanal and subsistence fisheries operated for the entire period, 1950 – 2010; while the recreational fishery began only in 1974. As in Jordan, the pattern of the total catch is shaped mainly by the artisanal fishery.

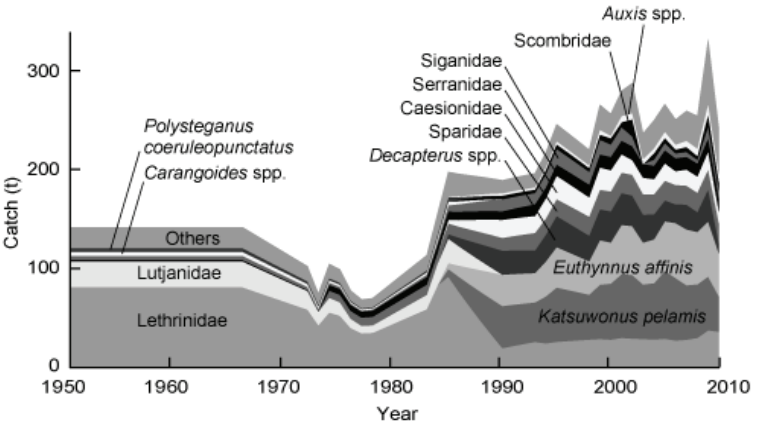

Figure 7. Composition of the total catch of Jordanian fisheries in the Gulf of Aqaba from 1950 to 2010.

Overall, the reconstructed catch was 1.4 times the catches reported to FAO. If the years where Israel was fishing in Eritrean waters, from 1958 to 1968, are excluded from the analysis, the reconstructed catch is 1.8 times the catches reported to FAO. The unreported catch accounts for 62% of the reconstructed catch. The reported catch (part of the reconstructed catch accounted in the FAO data) represented only 38% (Figure 9, Table A8).

The catch composition of the artisanal fishery was dominated by snappers (Lutjanidae) accounting for 47% of the reconstructed total catch. The second most important group was tuna-like pelagic species (Scombridae), with a contribution of 32% and groupers (Serranidae) was third with 12% (Figure 10, Table A9). These three groups accounted for more than 90% of the reconstructed total catch. The diversity of the total catch is higher in the later years with some taxa, mainly pelagic, that were not dominant in the early years were represented with a higher percentage in the later years. The catch composition of the subsistence fishery is the same as that of the artisanal fishery, because the catch composition ratios used in the artisanal fishery were used for the subsistence fishery as well (Figure 11, Table A10).

The total recreational catch estimate for Israel in the Gulf of Aqaba was generally low, a maximum of 63 t·year^{-1} in the early 2000s. It increased continuously until it reached its peak and then declined slowly (Figure 12, Table A11). As compared to the Israeli recreational fishery in Mediterranean, where the catch of recreational fishery was comparable to the that of the artisanal fishery (Edelist *et al.*, in press), our estimate for the Gulf of Aqaba was very conservative; only 24% of the artisanal catch. The composition of the recreational fishery was dominated by three taxa (Figure 12). The catch composition of the total catch reflected more or less that of the artisanal fishery. The contribution of snappers (Lutjanidae) was reduced from 47% in the artisanal fishery to 38% in the total catch and that of tuna-like fishes was also reduced from 32% to 26%. On the other hand, the contribution of groupers (Serranidae) increased from 12% to 13%. Although, the contribution of the three taxa was moderated by the contribution of the other sectors to the artisanal fishery, they still were the dominant taxa in the total catch (Figure 13, Table A12).

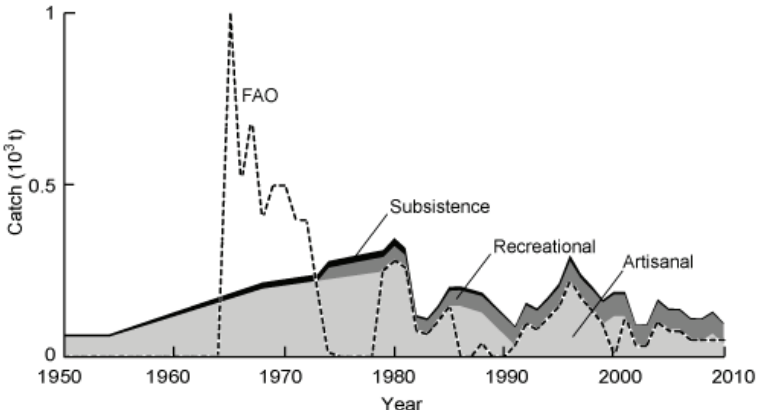

Figure 8. Total catch of the Israeli fishery in the Gulf of Aqaba by sectors and the total catch Israel reported to FAO from 1950 to 2010.

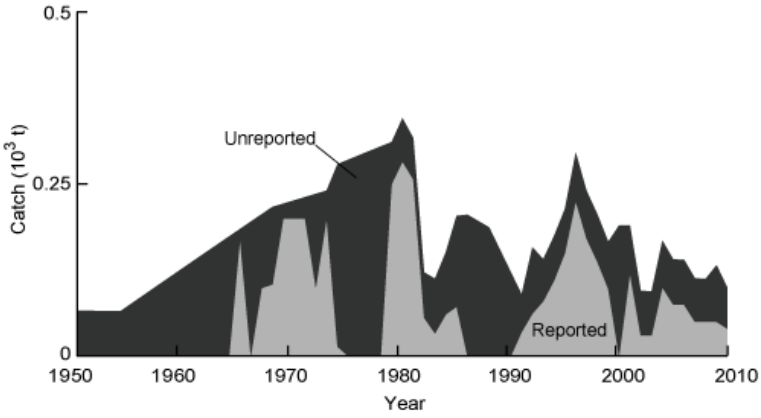

Figure 9. Total catch of the Israeli fishery in the Gulf of Aqaba by components from 1950 to 2010. Reported catch refers to the part of the reconstructed catch accounted in the FAO data.

Discussion

Jordan and Israel have been plagued by numerous conflicts since 1950. This tumultuous history is mirrored in the state of the fisheries. Some of the fluctuations of their fisheries are attributed to political stability or the lack of it in the region. Their small coastal access to the Gulf of Aqaba made them to have the lowest total catch of all the countries bordering the Red Sea. Hence, there is little motivation for either country to collect data, and assess and manage their fisheries. Most of the fisheries data appear to be collected only by university researchers and sporadically by the fisheries administrations (Tellawi, 2001). For effective policies to manage the fisheries to be developed and implemented, consistent time series data are essential (Caddy and Gulland, 1983; PERSGA, 2002; Tesfamichael, 2012).

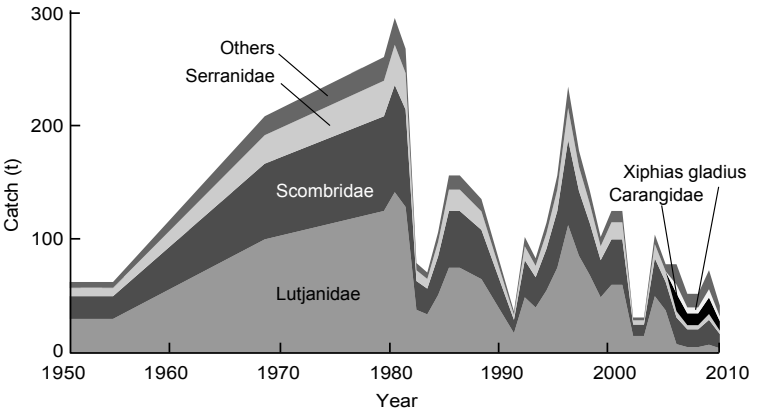

Figure 10. Catch composition of the Israeli artisanal fishery in the Gulf of Aqaba from 1950 to 2010.

This study showed considerable discrepancies between the reconstructed catch and data supplied to the FAO by the Jordanian and Israeli governments. One source of discrepancy is the fact that the 'official data' is for a larger spatial area (an FAO area) than what we are trying to reconstruct (an EEZ), and therefore do not necessarily refer to Israeli or Jordanian waters, but also to waters further south (in Eritrea for Israel, and Saudi Arabia for Jordan). However, for the period after fishing in the southern Red Sea waters ended, the reconstructed catch is 148% and 65% higher than

the catches that Jordan and Israel, respectively, reported to the FAO. We note that such 'official' underestimates are common (Zeller and Haper, 2009).

The sharp decline of the Jordanian fisheries catch in the 1970s and 1980s could be due to the political instability and a direct result of phosphate dust emissions (PERSGA, 2006), compounded by harmful fishing practices. Jordan has a substantial phosphate mine. Industrial pollution of the marine environment is a recurrent theme on the Jordanian side of the Gulf of Aqaba, and affects fishery (IRIN, 2006). Tourism is an important contributor to the local economies (Al Ouran, 2005), and it will be impacted if pollution and excess fishing harm the reefs which form the main habitat in the inner Gulf of Aqaba. The Israeli fishery also showed a decline in the Gulf of Aqaba.

The reconstructed catch derived here is proposed as an improvement over the data currently available. All our estimates are conservative and our assumptions clearly stated. It will be beneficial to strike a balance between industrial development, fisheries and tourism for the inner Gulf of Aqaba, which will permit the coexistence of these sectors, along with a revival of the natural habitats and their fauna and flora. Examples exist of such beneficial coexistence, one being Monterey Bay, in California, USA, which experienced a tourism-led revival following its near destruction by a succession of out-of-control industries (Palumbi and Sotka, 2010). This may serve as a model for the inner Gulf of Aqaba.

Acknowledgements

We would like to thank Dr. Dori Edelist from the University of Haifa for providing insights and data for the Israeli fishery in the Gulf of Aqaba and reading the draft of the report. His comments enriched the content of the report. We also thank Dr. James Shapiro for supplying data on Israel's fisheries. This is a contribution of the *Sea Around Us*, a scientific collaboration between the University of British Columbia and The Pew Charitable Trust.

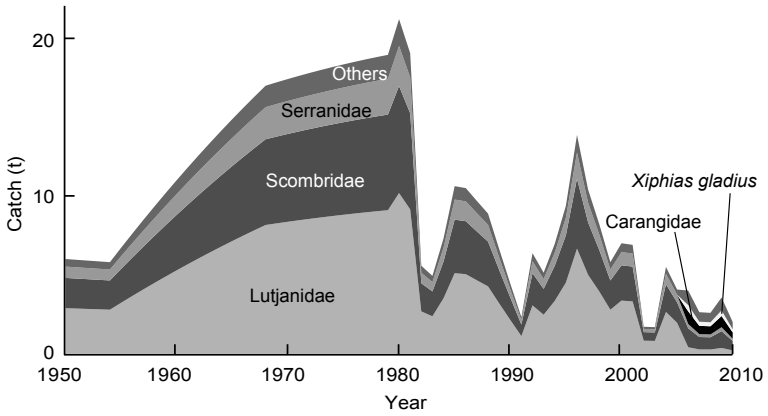

Figure 11. Catch composition of the Israeli subsistence fishery in the Gulf of Aqaba from 1950 to 2010.

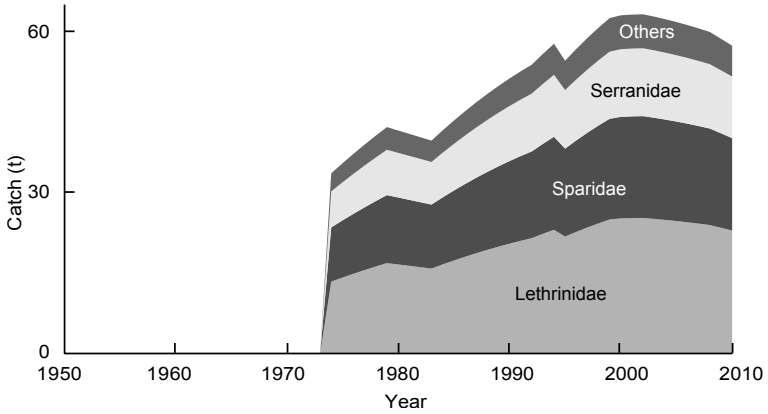

Figure 12. Catch composition of the Israeli recreational fishery in the Gulf of Aqaba from 1950 to 2010.

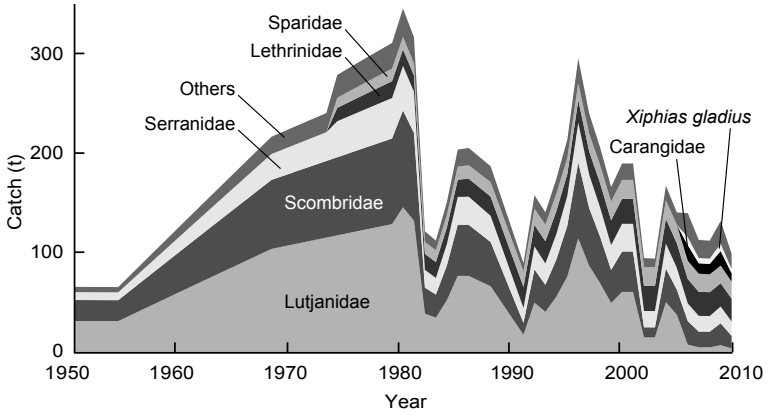

Figure 13. Composition of the total catch of the Israeli fisheries in the Gulf of Aqaba from 1950 to 2010.

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Appendix Table A1. Total catch of the Jordanian fishery in the Gulf of Aqaba by sectors and the total catch (in tonnes) Jordan reported to FAO from 1950 to 2010.

Year	FAO landings	Reconstructed total catch	Artisanal	Subsistence	Recreational
1950	100	142	107	35	0
1951	100	142	107	35	0
1952	100	142	107	35	0
1953	200	142	107	35	0
1954	200	142	107	35	0
1955	100	142	107	35	0
1956	0.25	142	107	35	0
1957	100	142	107	35	0
1958	100	142	107	35	0
1959	100	142	107	35	0
1960	100	142	107	35	0
1961	100	142	107	35	0
1962	200	142	107	35	0
1963	200	142	107	35	0
1964	200	142	107	35	0
1965	200	142	107	35	0
1966	200	142	107	35	0
1967	100	135	101	34	0
1968	100	129	95	34	0
1969	100	122	89	33	0
1970	100	116	83	32	0
1971	200	109	77	32	0
1972	100	102	71	31	0
1973	100	75	46	29	0
1974	92	105	51	29	24
1975	65	99	45	29	26
1976	49	78	25	26	27
1977	31	69	15	26	28
1978	31	70	16	26	29
1979	36	79	22	26	30
1980	56	88	29	27	31
1981	35	96	36	28	32
1982	19	105	43	28	33
1983	17	114	50	29	35
1984	2	156	88	33	35
1985	2	198	125	37	36
1986	2	196	122	36	37
1987	2	194	120	36	39
1988	2	193	117	36	40
1989	2	191	114	35	42
1990	2	189	111	35	43
1991	20	192	109	35	49
1992	30	194	106	35	54
1993	45	196	103	34	59
1994	60	218	127	37	54
1995	75	246	150	39	57
1996	90	238	140	38	60
1997	100	229	130	37	62
1998	120	220	120	36	64
1999	160	266	160	40	66
2000	150	257	150	39	67
2001	170	280	170	41	69
2002	176	288	176	42	70
2003	131	237	131	37	69
2004	144	250	144	38	68
2005	160	266	160	40	66
2006	147	251	147	39	65
2007	156	260	156	40	64
2008	150	255	150	39	66
2009	219	332	219	46	67
2010	136	242	136	38	68

Appendix Table A2. Total catch (in tonnes) of the Jordanian fishery in the Gulf of Aqaba by components from 1950 to 2010. Reported catch refers to the part of the reconstructed catch accounted in the FAO data.

Year	Reported	Unreported
1950	100	42
1951	100	42
1952	100	42
1953	107	35
1954	107	35
1955	100	42
1956	0	142
1957	100	42
1958	100	42
1959	100	42
1960	100	42
1961	100	42
1962	107	35
1963	107	35
1964	107	35
1965	107	35
1966	107	35
1967	100	35
1968	95	34
1969	89	33
1970	83	32
1971	77	32
1972	71	31
1973	46	29
1974	51	54
1975	45	54
1976	25	53
1977	15	54
1978	16	55
1979	22	56
1980	29	58
1981	35	61
1982	19	86
1983	17	97
1984	2	154
1985	2	196
1986	2	194
1987	2	192
1988	2	191
1989	2	189
1990	2	187
1991	20	172
1992	30	164
1993	45	151
1994	60	158
1995	75	171
1996	90	148
1997	100	129
1998	120	100
1999	160	106
2000	150	106
2001	170	110
2002	176	112
2003	131	106
2004	144	106
2005	160	106
2006	147	104
2007	156	104
2008	150	105
2009	219	113
2010	136	106

Appendix Table A3. Catch composition (in tonnes) of the Jordanian artisanal fishery in the Gulf of Aqaba from 1950 to 2010.

Year	Lethrinidae	*Katsuwonus pelamis*	*Euthynnus affinis*	Lutjanidae	*Decapterus* spp.	Caesionidae	Siganidae	Scombridae	*Carangoides* spp.	*Auxis* spp.	*Polysteganus coeruleopunctatus*
1950	61	0	0	20	0	0	3	0	3	0	3
1951	61	0	0	20	0	0	3	0	3	0	3
1952	61	0	0	20	0	0	3	0	3	0	3
1953	61	0	0	20	0	0	3	0	3	0	3
1954	61	0	0	20	0	0	3	0	3	0	3
1955	61	0	0	20	0	0	3	0	3	0	3
1956	61	0	0	20	0	0	3	0	3	0	3
1957	61	0	0	20	0	0	3	0	3	0	3
1958	61	0	0	20	0	0	3	0	3	0	3
1959	61	0	0	20	0	0	3	0	3	0	3
1960	61	0	0	20	0	0	3	0	3	0	3
1961	61	0	0	20	0	0	3	0	3	0	3
1962	61	0	0	20	0	0	3	0	3	0	3
1963	61	0	0	20	0	0	3	0	3	0	3
1964	61	0	0	20	0	0	3	0	3	0	3
1965	61	0	0	20	0	0	3	0	3	0	3
1966	61	0	0	20	0	0	3	0	3	0	3
1967	58	0	0	19	0	0	3	0	3	0	3
1968	54	0	0	18	0	0	3	0	3	0	2
1969	51	0	0	16	0	0	3	0	3	0	2
1970	48	0	0	15	0	0	2	0	2	0	2
1971	44	0	0	14	0	0	2	0	2	0	2
1972	41	0	0	13	0	0	2	0	2	0	2
1973	27	0	0	9	0	0	1	0	1	0	1
1974	29	0	0	9	0	0	2	0	1	0	1
1975	26	0	0	8	0	0	1	0	1	0	1
1976	14	0	0	5	0	0	1	0	1	0	1
1977	9	0	0	3	0	0	0	0	0	0	0
1978	9	0	0	3	0	0	0	0	0	0	0
1979	13	0	0	4	0	0	1	0	1	0	1
1980	17	0	0	5	0	0	1	0	1	0	1
1981	21	0	0	7	0	0	1	0	1	0	1
1982	25	0	0	8	0	0	1	0	1	0	1
1983	29	0	0	9	0	0	2	0	1	0	1
1984	50	0	0	16	0	0	3	0	3	0	2
1985	60	6	5	19	3	3	5	1	3	0	3
1986	47	12	9	15	7	5	6	1	2	1	2
1987	35	17	13	11	10	7	7	1	2	1	2
1988	24	23	17	7	13	10	8	2	1	1	1
1989	12	28	21	3	16	12	8	2	1	2	0
1990	2	32	24	0	19	14	9	3	0	2	0
1991	2	32	23	0	18	14	9	3	0	2	0
1992	2	31	23	0	18	13	9	3	0	2	0
1993	2	30	22	0	17	13	9	3	0	2	0
1994	2	37	27	0	21	16	11	3	0	2	0
1995	2	44	32	0	25	19	12	4	0	2	0
1996	2	41	30	0	23	17	12	3	0	2	0
1997	2	38	28	0	22	16	11	3	0	2	0
1998	2	35	26	0	20	15	10	3	0	2	0
1999	2	44	36	0	25	18	12	4	0	4	0
2000	1	45	33	0	25	17	10	5	0	2	0
2001	2	52	40	0	26	15	11	4	0	5	0
2002	1	52	40	0	25	12	8	14	0	5	0
2003	1	43	33	0	22	13	0	0	0	4	0
2004	1	45	35	0	20	12	5	5	0	4	0
2005	2	55	40	0	17	14	6	4	0	5	0
2006	1	50	44	0	15	11	4	3	0	4	0
2007	2	44	45	0	20	13	4	4	0	5	0
2008	3	43	42	0	16	13	3	3	0	6	0
2009	9	45	46	0	27	15	10	10	0	9	0
2010	7	28	34	0	8	9	6	7	0	6	0

Table A3 continued

Year	*Thunnus albacares*	*Thunnus tonggol*	*Lutjanus bohar*	Sparidae	Serranidae	*Scomberomorus commerson*	Mullidae	*Gerres oyena*	*Gymnocranius grandoculis*	Scaridae	Others
1950	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1951	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1952	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1953	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1954	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1955	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1956	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1957	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1958	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1959	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1960	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1961	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1962	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1963	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1964	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1965	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1966	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1967	0	0	2	2	1	0	0.4	0.3	0.3	0.3	10
1968	0	0	2	2	1	0	0.4	0.3	0.3	0.3	10
1969	0	0	2	2	1	0	0.4	0.3	0.3	0.3	9
1970	0	0	1	1	1	0	0.3	0.2	0.2	0.2	8
1971	0	0	1	1	1	0	0.3	0.2	0.2	0.2	8
1972	0	0	1	1	1	0	0.3	0.2	0.2	0.2	7
1973	0	0	1	1	0	0	0.2	0.1	0.1	0.1	5
1974	0	0	1	1	1	0	0.2	0.2	0.2	0.2	5
1975	0	0	1	1	0	0	0.2	0.1	0.1	0.1	5
1976	0	0	0	0	0	0	0.1	0.1	0.1	0.1	3
1977	0	0	0	0	0	0	0.1	0.0	0.0	0.0	2
1978	0	0	0	0	0	0	0.1	0.0	0.0	0.0	2
1979	0	0	0	0	0	0	0.1	0.1	0.1	0.1	2
1980	0	0	0	0	0	0	0.1	0.1	0.1	0.1	3
1981	0	0	1	1	0	0	0.1	0.1	0.1	0.1	4
1982	0	0	1	1	0	0	0.2	0.1	0.1	0.1	4
1983	0	0	1	1	1	0	0.2	0.2	0.2	0.2	5
1984	0	0	1	1	1	0	0.4	0.3	0.3	0.3	9
1985	0	0	2	2	1	0	0.4	0.3	0.3	0.3	11
1986	1	1	1	1	1	0	0.3	0.2	0.2	0.2	9
1987	1	1	1	1	1	0	0.2	0.2	0.2	0.2	8
1988	1	1	1	1	0	0	0.2	0.1	0.1	0.1	6
1989	2	2	0	0	0	0	0.1	0.1	0.1	0.1	4
1990	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1991	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1992	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1993	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1994	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1995	2	2	0	0	0	0	0.0	0.0	0.0	0.0	4
1996	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1997	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1998	2	2	0	0	0	0	0.0	0.0	0.0	0.0	3
1999	5	2	0	0	0	1	0.0	0.0	0.0	0.0	7
2000	3	2	0	0	0	0	0.0	0.0	0.0	0.0	7
2001	5	3	0	0	0	1	0.0	0.0	0.0	0.0	6
2002	5	3	0	0	0	1	0.0	0.0	0.0	0.0	10
2003	4	2	0	0	0	1	0.0	0.0	0.0	0.0	8
2004	3	3	0	0	0	1	0.0	0.0	0.0	0.0	10
2005	3	2	0	0	0	2	0.0	0.0	0.0	0.0	10
2006	4	2	0	0	0	2	0.0	0.0	0.0	0.0	7
2007	3	4	0	0	0	2	0.0	0.0	0.0	0.0	10
2008	4	5	0	0	0	2	0.0	0.0	0.0	0.0	10
2009	10	11	0	0	0	7	0.0	0.0	0.0	0.0	20
2010	8	10	0	0	0	7	0.0	0.0	0.0	0.0	6

Appendix Table A4. Catch composition (in tonnes) of the Jordanian subsistence fishery in the Gulf of Aqaba from 1950 to 2010.

Year	Lethrinidae	*Katsuwonus pelamis*	Lutjanidae	*Euthynnus affinis*	*Decapterus* spp.	Caesionidae	Siganidae	*Carangoides* spp.	*Polysteganus coeruleopunctatus*	Scombridae	*Auxis* spp.
1950	20	0	6	0	0	0	1	1	1	0	0
1951	20	0	6	0	0	0	1	1	1	0	0
1952	20	0	6	0	0	0	1	1	1	0	0
1953	20	0	6	0	0	0	1	1	1	0	0
1954	20	0	6	0	0	0	1	1	1	0	0
1955	20	0	6	0	0	0	1	1	1	0	0
1956	20	0	6	0	0	0	1	1	1	0	0
1957	20	0	6	0	0	0	1	1	1	0	0
1958	20	0	6	0	0	0	1	1	1	0	0
1959	20	0	6	0	0	0	1	1	1	0	0
1960	20	0	6	0	0	0	1	1	1	0	0
1961	20	0	6	0	0	0	1	1	1	0	0
1962	20	0	6	0	0	0	1	1	1	0	0
1963	20	0	6	0	0	0	1	1	1	0	0
1964	20	0	6	0	0	0	1	1	1	0	0
1965	20	0	6	0	0	0	1	1	1	0	0
1966	20	0	6	0	0	0	1	1	1	0	0
1967	20	0	6	0	0	0	1	1	1	0	0
1968	19	0	6	0	0	0	1	1	1	0	0
1969	19	0	6	0	0	0	1	1	1	0	0
1970	18	0	6	0	0	0	1	1	1	0	0
1971	18	0	6	0	0	0	1	1	1	0	0
1972	18	0	6	0	0	0	1	1	1	0	0
1973	16	0	5	0	0	0	1	1	1	0	0
1974	17	0	5	0	0	0	1	1	1	0	0
1975	16	0	5	0	0	0	1	1	1	0	0
1976	15	0	5	0	0	0	1	1	1	0	0
1977	15	0	5	0	0	0	1	1	1	0	0
1978	15	0	5	0	0	0	1	1	1	0	0
1979	15	0	5	0	0	0	1	1	1	0	0
1980	15	0	5	0	0	0	1	1	1	0	0
1981	16	0	5	0	0	0	1	1	1	0	0
1982	16	0	5	0	0	0	1	1	1	0	0
1983	17	0	5	0	0	0	1	1	1	0	0
1984	19	0	6	0	0	0	1	1	1	0	0
1985	17	2	6	1	1	1	1	1	1	0	0
1986	14	4	4	3	2	2	2	1	1	0	0
1987	11	5	3	4	3	2	2	1	0	0	0
1988	7	7	2	5	4	3	2	0	0	1	0
1989	4	9	1	6	5	4	3	0	0	1	0
1990	1	10	0	8	6	4	3	0	0	1	1
1991	1	10	0	8	6	4	3	0	0	1	1
1992	1	10	0	7	6	4	3	0	0	1	1
1993	1	10	0	7	6	4	3	0	0	1	1
1994	1	11	0	8	6	5	3	0	0	1	1
1995	1	11	0	8	6	5	3	0	0	1	1
1996	1	11	0	8	6	5	3	0	0	1	1
1997	1	11	0	8	6	5	3	0	0	1	1
1998	1	10	0	8	6	4	3	0	0	1	1
1999	1	11	0	9	6	5	3	0	0	1	1
2000	0	12	0	9	6	4	3	0	0	1	1
2001	0	13	0	10	6	4	3	0	0	1	1
2002	0	12	0	9	6	3	2	0	0	3	1
2003	0	12	0	9	6	4	0	0	0	0	1
2004	0	12	0	9	5	3	1	0	0	1	1
2005	1	14	0	10	4	4	2	0	0	1	1
2006	0	13	0	12	4	3	1	0	0	1	1
2007	1	11	0	11	5	3	1	0	0	1	1
2008	1	11	0	11	4	3	1	0	0	1	2
2009	2	9	0	10	6	3	2	0	0	2	2
2010	2	8	0	9	2	2	2	0	0	2	2

Table A4 continued

Year	*Thunnus albacares*	*Lutjanus bohar*	Sparidae	*Thunnus tonggol*	Serranidae	*Scomberomorus commerson*	Mullidae	*Gerres oyena*	*Gymnocranius grandoculis*	Scaridae	Others
1950	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1951	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1952	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1953	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1954	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1955	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1956	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1957	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1958	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1959	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1960	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1961	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1962	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1963	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1964	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1965	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1966	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	4
1967	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1968	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1969	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1970	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1971	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1972	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1973	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1974	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1975	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1976	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1977	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1978	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1979	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1980	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1981	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1982	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1983	0	0	0	0	0.3	0	0.1	0.1	0.1	0.1	3
1984	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1985	0	1	1	0	0.3	0	0.1	0.1	0.1	0.1	3
1986	0	0	0	0	0.2	0	0.1	0.1	0.1	0.1	3
1987	0	0	0	0	0.2	0	0.1	0.1	0.1	0.1	2
1988	0	0	0	0	0.1	0	0.0	0.0	0.0	0.0	2
1989	0	0	0	0	0.1	0	0.0	0.0	0.0	0.0	1
1990	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1991	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1992	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1993	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1994	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1995	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1996	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1997	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1998	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
1999	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	2
2000	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	2
2001	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	1
2002	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	2
2003	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	2
2004	1	0	0	1	0.0	0	0.0	0.0	0.0	0.0	3
2005	1	0	0	1	0.0	1	0.0	0.0	0.0	0.0	3
2006	1	0	0	1	0.0	1	0.0	0.0	0.0	0.0	2
2007	1	0	0	1	0.0	1	0.0	0.0	0.0	0.0	3
2008	1	0	0	1	0.0	1	0.0	0.0	0.0	0.0	3
2009	2	0	0	2	0.0	1	0.0	0.0	0.0	0.0	4
2010	2	0	0	3	0.0	2	0.0	0.0	0.0	0.0	2

Appendix Table A5. Catch composition (in tonnes) of the Jordanian recreational fishery in the Gulf of Aqaba from 1950 to 2010.

Year	Lethrinidae	Sparidae	Serranidae	Others
1950	0	0	0	0
1951	0	0	0	0
1952	0	0	0	0
1953	0	0	0	0
1954	0	0	0	0
1955	0	0	0	0
1956	0	0	0	0
1957	0	0	0	0
1958	0	0	0	0
1959	0	0	0	0
1960	0	0	0	0
1961	0	0	0	0
1962	0	0	0	0
1963	0	0	0	0
1964	0	0	0	0
1965	0	0	0	0
1966	0	0	0	0
1967	0	0	0	0
1968	0	0	0	0
1969	0	0	0	0
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0
1973	0	0	0	0
1974	10	7	5	2
1975	10	8	5	3
1976	11	8	5	3
1977	11	8	6	3
1978	12	9	6	3
1979	12	9	6	3
1980	13	9	6	3
1981	13	10	6	3
1982	13	10	7	3
1983	14	10	7	3
1984	14	11	7	4
1985	15	11	7	4
1986	15	11	7	4
1987	16	12	8	4
1988	16	12	8	4
1989	17	13	8	4
1990	17	13	9	4
1991	19	15	10	5
1992	22	16	11	5
1993	24	18	12	6
1994	22	16	11	5
1995	23	17	11	6
1996	24	18	12	6
1997	25	19	12	6
1998	26	19	13	6
1999	26	20	13	7
2000	27	20	13	7
2001	28	21	14	7
2002	28	21	14	7
2003	28	21	14	7
2004	27	20	14	7
2005	27	20	13	7
2006	26	20	13	7
2007	26	19	13	6
2008	26	20	13	7
2009	27	20	13	7
2010	27	20	14	7

Appendix Table A6. Composition of the total catch (in tonnes) of Jordanian fisheries in the Gulf of Aqaba from 1950 to 2010.

Year	Lethrinidae	*Katsuwonus pelamis*	*Euthynnus affinis*	Lutjanidae	*Decapterus* spp.	Sparidae	Caesionidae	Serranidae	Siganidae	*Carangoides* spp.	Scombridae
1950	81	0	0	26	0	0	0	1	4	4	0
1951	81	0	0	26	0	0	0	1	4	4	0
1952	81	0	0	26	0	0	0	1	4	4	0
1953	81	0	0	26	0	0	0	1	4	4	0
1954	81	0	0	26	0	0	0	1	4	4	0
1955	81	0	0	26	0	0	0	1	4	4	0
1956	81	0	0	26	0	0	0	1	4	4	0
1957	81	0	0	26	0	0	0	1	4	4	0
1958	81	0	0	26	0	0	0	1	4	4	0
1959	81	0	0	26	0	0	0	1	4	4	0
1960	81	0	0	26	0	0	0	1	4	4	0
1961	81	0	0	26	0	0	0	1	4	4	0
1962	81	0	0	26	0	0	0	1	4	4	0
1963	81	0	0	26	0	0	0	1	4	4	0
1964	81	0	0	26	0	0	0	1	4	4	0
1965	81	0	0	26	0	0	0	1	4	4	0
1966	81	0	0	26	0	0	0	1	4	4	0
1967	77	0	0	25	0	0	0	1	4	4	0
1968	74	0	0	24	0	0	0	1	4	4	0
1969	70	0	0	22	0	0	0	1	4	4	0
1970	66	0	0	21	0	0	0	1	3	3	0
1971	62	0	0	20	0	0	0	1	3	3	0
1972	59	0	0	19	0	0	0	1	3	3	0
1973	43	0	0	14	0	0	0	1	2	2	0
1974	56	0	0	15	0	7	0	6	2	2	0
1975	52	0	0	14	0	8	0	6	2	2	0
1976	40	0	0	9	0	8	0	6	2	1	0
1977	35	0	0	8	0	8	0	6	1	1	0
1978	35	0	0	8	0	9	0	6	1	1	0
1979	40	0	0	9	0	9	0	7	1	1	0
1980	45	0	0	10	0	9	0	7	2	2	0
1981	49	0	0	12	0	10	0	7	2	2	0
1982	54	0	0	13	0	10	0	7	2	2	0
1983	59	0	0	15	0	10	0	8	2	2	0
1984	83	0	0	22	0	11	0	8	4	3	0
1985	92	8	6	25	4	11	3	9	6	4	1
1986	76	15	11	19	9	11	7	9	8	3	1
1987	61	23	17	14	13	12	10	9	9	2	2
1988	47	30	22	9	17	12	13	9	10	1	3
1989	33	36	27	5	21	13	16	9	11	1	3
1990	20	43	32	0	24	13	18	9	12	0	4
1991	22	42	31	0	24	15	18	10	12	0	4
1992	24	41	30	0	23	16	18	11	12	0	4
1993	26	40	30	0	23	18	17	12	11	0	3
1994	24	47	35	0	27	16	20	11	14	0	4
1995	26	55	41	0	31	17	24	11	16	0	5
1996	27	52	39	0	30	18	22	12	15	0	4
1997	28	49	36	0	28	19	21	12	14	0	4
1998	28	45	34	0	26	19	19	13	13	0	4
1999	29	55	45	0	31	20	23	13	15	0	5
2000	28	57	42	0	31	20	21	13	13	0	6
2001	30	65	50	0	32	21	19	14	14	0	5
2002	29	64	49	0	31	21	15	14	10	0	17
2003	29	55	42	0	28	21	17	14	0	0	0
2004	28	57	44	0	25	20	15	14	6	0	6
2005	29	69	50	0	21	20	18	13	8	0	5
2006	27	63	56	0	19	20	14	13	5	0	4
2007	28	55	56	0	25	19	16	13	5	0	5
2008	30	54	53	0	20	20	16	13	4	0	4
2009	38	54	56	0	33	20	18	13	12	0	12
2010	36	36	43	0	10	20	11	14	8	0	9

Table A6 continued

Year	*Polysteganus coeruleopunctatus*	*Auxis* spp.	*Thunnus albacares*	*Thunnus tonggol*	*Lutjanus bohar*	Sparidae	*Scomberomorus commerson*	Mullidae	*Gerres oyena*	*Gymnocranius grandoculis*	Scaridae	Others
1950	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1951	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1952	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1953	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1954	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1955	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1956	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1957	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1958	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1959	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1960	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1961	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1962	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1963	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1964	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1965	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1966	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1967	4	0	0	0	2	2	0	1	0.4	0.4	0.4	14
1968	3	0	0	0	2	2	0	1	0.4	0.4	0.4	13
1969	3	0	0	0	2	2	0	0	0.4	0.4	0.4	12
1970	3	0	0	0	2	2	0	0	0.3	0.3	0.3	12
1971	3	0	0	0	2	2	0	0	0.3	0.3	0.3	11
1972	3	0	0	0	2	2	0	0	0.3	0.3	0.3	10
1973	2	0	0	0	1	1	0	0	0.2	0.2	0.2	8
1974	2	0	0	0	1	1	0	0	0.2	0.2	0.2	11
1975	2	0	0	0	1	1	0	0	0.2	0.2	0.2	10
1976	1	0	0	0	1	1	0	0	0.2	0.2	0.2	8
1977	1	0	0	0	1	1	0	0	0.1	0.1	0.1	7
1978	1	0	0	0	1	1	0	0	0.1	0.1	0.1	7
1979	1	0	0	0	1	1	0	0	0.1	0.1	0.1	8
1980	1	0	0	0	1	1	0	0	0.2	0.2	0.2	9
1981	2	0	0	0	1	1	0	0	0.2	0.2	0.2	10
1982	2	0	0	0	1	1	0	0	0.2	0.2	0.2	11
1983	2	0	0	0	1	1	0	0	0.2	0.2	0.2	12
1984	3	0	0	0	2	2	0	0	0.4	0.4	0.4	16
1985	3	0	0	0	2	2	0	1	0.4	0.4	0.4	18
1986	3	1	1	1	2	2	0	0	0.3	0.3	0.3	16
1987	2	1	1	1	1	1	0	0	0.2	0.2	0.2	14
1988	1	2	2	2	1	1	0	0	0.2	0.2	0.2	12
1989	1	2	2	2	0	0	0	0	0.1	0.1	0.1	10
1990	0	2	2	2	0	0	0	0	0.0	0.0	0.0	8
1991	0	2	2	2	0	0	0	0	0.0	0.0	0.0	8
1992	0	2	2	2	0	0	0	0	0.0	0.0	0.0	9
1993	0	2	2	2	0	0	0	0	0.0	0.0	0.0	9
1994	0	3	3	3	0	0	0	0	0.0	0.0	0.0	10
1995	0	3	3	3	0	0	0	0	0.0	0.0	0.0	10
1996	0	3	3	3	0	0	0	0	0.0	0.0	0.0	10
1997	0	3	3	3	0	0	0	0	0.0	0.0	0.0	10
1998	0	3	3	3	0	0	0	0	0.0	0.0	0.0	10
1999	0	5	6	3	0	0	0	0	0.0	0.0	0.0	15
2000	0	3	4	3	0	0	0	0	0.0	0.0	0.0	16
2001	0	6	6	4	0	0	1	0	0.0	0.0	0.0	14
2002	0	6	6	4	0	0	1	0	0.0	0.0	0.0	19
2003	0	5	5	3	0	0	1	0	0.0	0.0	0.0	17
2004	0	5	4	4	0	0	1	0	0.0	0.0	0.0	19
2005	0	6	4	3	0	0	3	0	0.0	0.0	0.0	19
2006	0	5	5	3	0	0	3	0	0.0	0.0	0.0	15
2007	0	6	4	5	0	0	3	0	0.0	0.0	0.0	19
2008	0	8	5	6	0	0	3	0	0.0	0.0	0.0	19
2009	0	11	12	13	0	0	8	0	0.0	0.0	0.0	31
2010	0	8	10	13	0	0	9	0	0.0	0.0	0.0	14

Appendix Table A7. Total catch (in tonnes) of the Israeli fishery in the Gulf of Aqaba by sectors and the total catch Israel reported to FAO from 1950 to 2010.

Year	FAO landings	Reconstructed total catch	Artisanal	Recreational	Subsistence
1950	0	66	60	0	6
1951	0	66	60	0	6
1952	0	66	60	0	6
1953	0	66	60	0	6
1954	0	66	60	0	6
1955	0	77	70	0	7
1956	0	88	80	0	8
1957	0	98	90	0	8
1958	0	109	100	0	9
1959	0	120	110	0	10
1960	0	131	120	0	11
1961	0	142	130	0	12
1962	0	153	140	0	13
1963	0	163	150	0	13
1964	0	174	160	0	14
1965	1,000	185	170	0	15
1966	500	196	180	0	16
1967	700	206	190	0	16
1968	400	217	200	0	17
1969	500	222	205	0	17
1970	500	227	209	0	17
1971	400	231	214	0	18
1972	400	236	218	0	18
1973	200	241	223	0	18
1974	14	279	227	34	18
1975	0	286	232	35	18
1976	0	292	236	37	19
1977	0	299	241	39	19
1978	0	305	245	41	19
1979	250	311	250	42	19
1980	283	346	283	42	21
1981	257	317	257	41	19
1982	76	122	76	40	6
1983	68	113	68	40	5
1984	102	151	102	42	7
1985	150	204	150	43	11
1986	0	206	150	45	11
1987	0	196	140	47	10
1988	40	187	130	48	9
1989	0	155	98	50	7
1990	0	122	67	51	4
1991	35	90	35	53	2
1992	98	158	98	54	6
1993	80	141	80	56	5
1994	110	175	110	58	7
1995	150	214	150	55	9
1996	225	296	225	57	14
1997	171	240	171	59	10
1998	137	206	137	61	8
1999	98	166	98	63	6
2000	0	190	120	63	7
2001	120	190	120	63	7
2002	30	95	30	63	2
2003	30	94	30	63	2
2004	100	168	100	62	5
2005	75	141	75	62	4
2006	75	140	75	61	4
2007	50	113	50	61	3
2008	50	112	50	60	3
2009	50	132	70	59	4
2010	50	99	40	57	2

Appendix Table A8. Total catch (in tonnes)of the Israeli fishery in the Gulf of Aqaba by components from 1950 to 2010. Reported catch refers to the part of the reconstructed catch accounted in the FAO data.

Year	Reported	Unreported
1950	0	66
1951	0	66
1952	0	66
1953	0	66
1954	0	66
1955	0	77
1956	0	88
1957	0	98
1958	0	109
1959	0	120
1960	0	131
1961	0	142
1962	0	153
1963	0	163
1964	0	174
1965	170	15
1966	0	195
1967	99	107
1968	104	113
1969	200	22
1970	200	27
1971	200	31
1972	100	136
1973	200	41
1974	14	265
1975	0	286
1976	0	292
1977	0	299
1978	0	305
1979	250	61
1980	283	63
1981	257	60
1982	56	66
1983	33	79
1984	61	90
1985	72	132
1986	0	206
1987	0	196
1988	0	187
1989	0	155
1990	0	122
1991	35	55
1992	62	96
1993	80	61
1994	110	65
1995	150	64
1996	225	71
1997	171	69
1998	137	69
1999	98	68
2000	0	190
2001	120	70
2002	30	65
2003	30	64
2004	100	68
2005	75	66
2006	75	65
2007	50	63
2008	50	62
2009	50	82
2010	40	59

Appendix Table A9. Catch composition (in tonnes) of the Israeli artisanal fishery in the Gulf of Aqaba from 1950 to 2010.

Year	Lutjanidae	Scombridae	Serranidae	Carangidae	*Xiphias gladius*	Mullidae	*Sphyraena* spp.	*Siganus* spp.	Cephalopods	Others
1950	29	19	7	0	0	0	0	0	0	5
1951	29	19	7	0	0	0	0	0	0	5
1952	29	19	7	0	0	0	0	0	0	5
1953	29	19	7	0	0	0	0	0	0	5
1954	29	19	7	0	0	0	0	0	0	5
1955	34	22	8	0	0	0	0	0	0	6
1956	38	26	10	0	0	0	0	0	0	6
1957	43	29	11	0	0	0	0	0	0	7
1958	48	32	12	0	0	0	0	0	0	8
1959	53	35	13	0	0	0	0	0	0	9
1960	58	38	14	0	0	0	0	0	0	10
1961	62	42	16	0	0	0	0	0	0	10
1962	67	45	17	0	0	0	0	0	0	11
1963	72	48	18	0	0	0	0	0	0	12
1964	77	51	19	0	0	0	0	0	0	13
1965	82	54	20	0	0	0	0	0	0	14
1966	86	58	22	0	0	0	0	0	0	14
1967	91	61	23	0	0	0	0	0	0	15
1968	96	64	24	0	0	0	0	0	0	16
1969	98	65	25	0	0	0	0	0	0	16
1970	100	67	25	0	0	0	0	0	0	17
1971	103	68	26	0	0	0	0	0	0	17
1972	105	70	26	0	0	0	0	0	0	17
1973	107	71	27	0	0	0	0	0	0	18
1974	109	73	27	0	0	0	0	0	0	18
1975	111	74	28	0	0	0	0	0	0	19
1976	113	76	28	0	0	0	0	0	0	19
1977	116	77	29	0	0	0	0	0	0	19
1978	118	79	29	0	0	0	0	0	0	20
1979	120	80	30	0	0	0	0	0	0	20
1980	136	91	34	0	0	0	0	0	0	23
1981	123	82	31	0	0	0	0	0	0	21
1982	36	24	9	0	0	0	0	0	0	6
1983	33	22	8	0	0	0	0	0	0	5
1984	49	33	12	0	0	0	0	0	0	8
1985	72	48	18	0	0	0	0	0	0	12
1986	72	48	18	0	0	0	0	0	0	12
1987	67	45	17	0	0	0	0	0	0	11
1988	62	42	16	0	0	0	0	0	0	10
1989	47	31	12	0	0	0	0	0	0	8
1990	32	21	8	0	0	0	0	0	0	5
1991	17	11	4	0	0	0	0	0	0	3
1992	47	31	12	0	0	0	0	0	0	8
1993	38	26	10	0	0	0	0	0	0	6
1994	53	35	13	0	0	0	0	0	0	9
1995	72	48	18	0	0	0	0	0	0	12
1996	108	72	27	0	0	0	0	0	0	18
1997	82	55	21	0	0	0	0	0	0	14
1998	66	44	16	0	0	0	0	0	0	11
1999	47	31	12	0	0	0	0	0	0	8
2000	58	38	14	0	0	0	0	0	0	10
2001	58	38	14	0	0	0	0	0	0	10
2002	14	10	4	0	0	0	0	0	0	2
2003	14	10	4	0	0	0	0	0	0	2
2004	48	32	12	0	0	0	0	0	0	8
2005	36	24	9	0	0	0	0	0	0	6
2006	8	23	5	15	8	4	2	2	4	6
2007	5	15	4	10	5	3	2	1	3	4
2008	5	15	4	10	5	3	2	1	3	4
2009	7	21	5	14	7	4	2	1	4	6
2010	4	12	3	8	4	2	1	1	2	3

Appendix Table A10. Catch composition (in tonnes) of the Israeli subsistence fishery in the Gulf of Aqaba from 1950 to 2010.

Year	Lutjanidae	Scombridae	Serranidae	Carangidae	*Xiphias gladius*	Cephalopods	Mullidae	*Sphyraena* spp.	*Siganus* spp.	Others
1950	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1951	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1952	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1953	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1954	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1955	3	2	1	0	0.0	0.0	0.0	0.0	0.0	1
1956	4	2	1	0	0.0	0.0	0.0	0.0	0.0	1
1957	4	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1958	4	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1959	5	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1960	5	4	1	0	0.0	0.0	0.0	0.0	0.0	1
1961	6	4	1	0	0.0	0.0	0.0	0.0	0.0	1
1962	6	4	2	0	0.0	0.0	0.0	0.0	0.0	1
1963	6	4	2	0	0.0	0.0	0.0	0.0	0.0	1
1964	7	5	2	0	0.0	0.0	0.0	0.0	0.0	1
1965	7	5	2	0	0.0	0.0	0.0	0.0	0.0	1
1966	7	5	2	0	0.0	0.0	0.0	0.0	0.0	1
1967	8	5	2	0	0.0	0.0	0.0	0.0	0.0	1
1968	8	5	2	0	0.0	0.0	0.0	0.0	0.0	1
1969	8	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1970	8	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1971	8	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1972	9	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1973	9	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1974	9	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1975	9	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1976	9	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1977	9	6	2	0	0.0	0.0	0.0	0.0	0.0	1
1978	9	6	2	0	0.0	0.0	0.0	0.0	0.0	2
1979	9	6	2	0	0.0	0.0	0.0	0.0	0.0	2
1980	10	7	3	0	0.0	0.0	0.0	0.0	0.0	2
1981	9	6	2	0	0.0	0.0	0.0	0.0	0.0	2
1982	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1983	2	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1984	4	2	1	0	0.0	0.0	0.0	0.0	0.0	1
1985	5	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1986	5	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1987	5	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1988	4	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1989	3	2	1	0	0.0	0.0	0.0	0.0	0.0	1
1990	2	1	1	0	0.0	0.0	0.0	0.0	0.0	0
1991	1	1	-	0	0.0	0.0	0.0	0.0	0.0	0
1992	3	2	1	0	0.0	0.0	0.0	0.0	0.0	1
1993	2	2	1	0	0.0	0.0	0.0	0.0	0.0	0
1994	3	2	1	0	0.0	0.0	0.0	0.0	0.0	1
1995	4	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1996	7	4	2	0	0.0	0.0	0.0	0.0	0.0	1
1997	5	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1998	4	3	1	0	0.0	0.0	0.0	0.0	0.0	1
1999	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
2000	3	2	1	0	0.0	0.0	0.0	0.0	0.0	1
2001	3	2	1	0	0.0	0.0	0.0	0.0	0.0	1
2002	1	1	0	0	0.0	0.0	0.0	0.0	0.0	0
2003	1	1	0	0	0.0	0.0	0.0	0.0	0.0	0
2004	3	2	1	0	0.0	0.0	0.0	0.0	0.0	0
2005	2	1	0	0	0.0	0.0	0.0	0.0	0.0	0
2006	0	1	0	1	0.4	0.2	0.2	0.1	0.1	0
2007	0	1	0	1	0.3	0.1	0.1	0.1	0.1	0
2008	0	1	0	1	0.3	0.1	0.1	0.1	0.1	0
2009	0	1	0	1	0.4	0.2	0.2	0.1	0.1	0
2010	0	1	0	0	0.2	0.1	0.1	0.1	0.0	0

Appendix Table A11. Catch composition (in tonnes) of the Israeli recreational fishery in the Gulf of Aqaba from 1950 to 2010.

Year	Lethrinidae	Sparidae	Serranidae	Others
1950	0	0	0	0
1951	0	0	0	0
1952	0	0	0	0
1953	0	0	0	0
1954	0	0	0	0
1955	0	0	0	0
1956	0	0	0	0
1957	0	0	0	0
1958	0	0	0	0
1959	0	0	0	0
1960	0	0	0	0
1961	0	0	0	0
1962	0	0	0	0
1963	0	0	0	0
1964	0	0	0	0
1965	0	0	0	0
1966	0	0	0	0
1967	0	0	0	0
1968	0	0	0	0
1969	0	0	0	0
1970	0	0	0	0
1971	0	0	0	0
1972	0	0	0	0
1973	0	0	0	0
1974	13	10	7	3
1975	14	11	7	4
1976	15	11	7	4
1977	16	12	8	4
1978	16	12	8	4
1979	17	13	8	4
1980	17	12	8	4
1981	16	12	8	4
1982	16	12	8	4
1983	16	12	8	4
1984	17	12	8	4
1985	17	13	9	4
1986	18	14	9	5
1987	19	14	9	5
1988	19	15	10	5
1989	20	15	10	5
1990	21	15	10	5
1991	21	16	11	5
1992	22	16	11	5
1993	22	17	11	6
1994	23	17	12	6
1995	22	16	11	5
1996	23	17	11	6
1997	24	18	12	6
1998	24	18	12	6
1999	25	19	13	6
2000	25	19	13	6
2001	25	19	13	6
2002	25	19	13	6
2003	25	19	13	6
2004	25	19	12	6
2005	25	19	12	6
2006	24	18	12	6
2007	24	18	12	6
2008	24	18	12	6
2009	23	18	12	6
2010	23	17	11	6

Appendix Table A12. Composition of the total catch (in tonnes) of the Israeli fisheries in the Gulf of Aqaba from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12
1950	32	21	8	0	0	0	0	0	0	0	0	5
1951	32	21	8	0	0	0	0	0	0	0	0	5
1952	32	21	8	0	0	0	0	0	0	0	0	5
1953	32	21	8	0	0	0	0	0	0	0	0	5
1954	32	21	8	0	0	0	0	0	0	0	0	5
1955	37	25	9	0	0	0	0	0	0	0	0	6
1956	42	28	11	0	0	0	0	0	0	0	0	7
1957	47	32	12	0	0	0	0	0	0	0	0	8
1958	52	35	13	0	0	0	0	0	0	0	0	9
1959	58	38	14	0	0	0	0	0	0	0	0	10
1960	63	42	16	0	0	0	0	0	0	0	0	10
1961	68	45	17	0	0	0	0	0	0	0	0	11
1962	73	49	18	0	0	0	0	0	0	0	0	12
1963	78	52	20	0	0	0	0	0	0	0	0	13
1964	84	56	21	0	0	0	0	0	0	0	0	14
1965	89	59	22	0	0	0	0	0	0	0	0	15
1966	94	63	23	0	0	0	0	0	0	0	0	16
1967	99	66	25	0	0	0	0	0	0	0	0	17
1968	104	69	26	0	0	0	0	0	0	0	0	17
1969	106	71	27	0	0	0	0	0	0	0	0	18
1970	109	72	27	0	0	0	0	0	0	0	0	18
1971	111	74	28	0	0	0	0	0	0	0	0	19
1972	113	76	28	0	0	0	0	0	0	0	0	19
1973	116	77	29	0	0	0	0	0	0	0	0	19
1974	118	79	36	13	10	0	0	0	0	0	0	23
1975	120	80	37	14	11	0	0	0	0	0	0	24
1976	122	82	38	15	11	0	0	0	0	0	0	24
1977	125	83	39	16	12	0	0	0	0	0	0	25
1978	127	85	40	16	12	0	0	0	0	0	0	25
1979	129	86	41	17	13	0	0	0	0	0	0	26
1980	146	97	45	17	12	0	0	0	0	0	0	28
1981	133	88	41	16	12	0	0	0	0	0	0	26
1982	39	26	18	16	12	0	0	0	0	0	0	11
1983	35	23	17	16	12	0	0	0	0	0	0	10
1984	52	35	21	17	12	0	0	0	0	0	0	13
1985	77	51	28	17	13	0	0	0	0	0	0	17
1986	77	51	28	18	14	0	0	0	0	0	0	17
1987	72	48	27	19	14	0	0	0	0	0	0	17
1988	67	44	26	19	15	0	0	0	0	0	0	16
1989	50	34	23	20	15	0	0	0	0	0	0	13
1990	34	23	19	21	15	0	0	0	0	0	0	11
1991	18	12	15	21	16	0	0	0	0	0	0	8
1992	50	33	23	22	16	0	0	0	0	0	0	14
1993	41	27	21	22	17	0	0	0	0	0	0	12
1994	56	37	26	23	17	0	0	0	0	0	0	15
1995	77	51	30	22	16	0	0	0	0	0	0	18
1996	115	76	40	23	17	0	0	0	0	0	0	25
1997	87	58	34	24	18	0	0	0	0	0	0	20
1998	70	46	30	24	18	0	0	0	0	0	0	18
1999	50	33	25	25	19	0	0	0	0	0	0	15
2000	61	41	28	25	19	0	0	0	0	0	0	16
2001	61	41	28	25	19	0	0	0	0	0	0	16
2002	15	10	16	25	19	0	0	0	0	0	0	9
2003	15	10	16	25	19	0	0	0	0	0	0	9
2004	51	34	25	25	19	0	0	0	0	0	0	15
2005	38	25	22	25	19	0	0	0	0	0	0	13
2006	8	24	18	24	18	16	8	4	4	2	2	12
2007	5	16	16	24	18	11	5	3	3	2	1	10
2008	5	16	16	24	18	11	5	3	3	2	1	10
2009	7	22	17	23	18	15	7	4	4	2	1	12
2010	4	13	14	23	17	8	4	2	2	1	1	9

1: Lutjanidae; 2: Scombridae; 3: Serranidae; 4: Lethrinidae; 5: Sparidae; 6: Carangidae; 7: *Xiphias gladius*; 8: Cephalopods; 9: Mullidae; 10: *Sphyraena* spp.; 11: *Siganus* spp.; 12: Others