

RECONSTRUCTING RED SEA FISHERIES OF ERITREA: A CASE STUDY OF THE RELATIONSHIP BETWEEN POLITICAL STABILITY AND FISHERIES DEVELOPMENT¹

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ABSTRACT

The fisheries catch in the Eritrean Red Sea Exclusive Economic Zone (EEZ) was reconstructed from 1950 to 2010 based on published data, government reports, surveys and field interviews. Six major fisheries, different in terms of their operation, the fish they target and their market, were identified. Overall, the fisheries went through major shifts from the state of high catches dominated by small pelagic beach seining in the 1950s (slightly under 30,000 t-year⁻¹) and 1960s to the domination by bottom trawling prevailing since the 1990s. The catches started to decline to less than 2,500 t-year⁻¹, a catch level which lasted from the mid-1970s to the first few years after independence (1991), before recovering and reaching a new peak of about 20,000 t-year⁻¹ at the beginning of 2000s. The artisanal fisheries, which target mainly fresh fish for direct human consumption, have exhibited a relatively steady upward trend since independence. The reconstructed total catch for the period from 1950 to 2010 was 2.2 times the data reported by Eritrea to the Food and Agriculture Organization of the United Nations (FAO). The political events strongly impacted the fisheries of Eritrea, notably its struggle of independence.

INTRODUCTION

Eritrea borders the Red Sea (Figure 1), and its continental shelf, i.e., waters shallower than 200 m, where most of the fishing occurs, covers about 50,000 km². Due to its harsh environmental conditions, the coast is not densely populated. However, archaeological studies of middle stone-age middens from the Eritrean coast indicate that humans were exploiting near-shore marine organisms such as giant clams and other molluscs about 125,000 years ago (Walter *et al.* 2000). In the recent past, the most common fishing activity along the Eritrean coast was diving for trochus and pearl oyster by local people, and handling mainly by Yemeni fishers. In the mid-1940s, beach seining for schools of sardines and anchovies started and it flourished as the main fishing activity for the next few decades (Ben-Yami 1964). In terms of the total catch and the number of people involved either directly or indirectly in the fishery, the Eritrean fishery reached its peak in the 1950s and 1960s. Starting in the 1970s, the fishery went through rapid decline and almost completely disappeared at the end of the 1980s. After the independence of Eritrea in 1991, the fishery started to recover and there has been an increase in fishing activities. The newly recovered fishery does not rely on beach seining. Rather it is dominated by hook and line and gillnet fisheries in the artisanal sector, and bottom trawling in the industrial sector (Tesfamichael 2001). It is important to note that some of the reports written about Eritrean fishery before 1991 refer to the fishery as 'Ethiopian' because until then, Eritrea was part of Ethiopia. In 1991, Eritrea gained its *de facto* independence and international recognition followed in 1993. These reports also frequently use the Ge'ez calendar, based on the Coptic calendar used by the Orthodox church of Eritrea and Ethiopia, which starts in September and is seven and half years behind the Gregorian calendar (GC). All dates in this report refer to the GC unless specified otherwise.

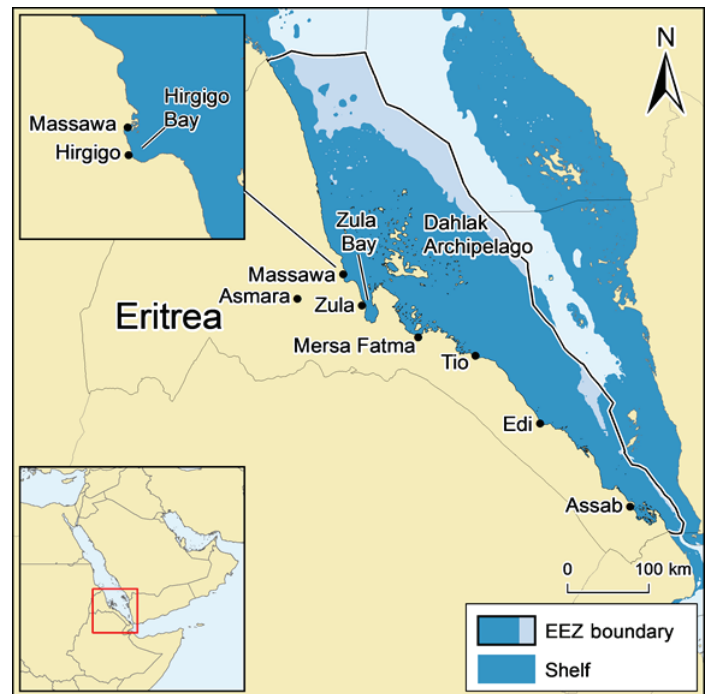


Figure 1. Map of Eritrea and its Red Sea coast, shelf area and Exclusive Economic Zone (EEZ).

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In this report, the catch of fisheries in Eritrean Red Sea EEZ, both by domestic and foreign fleets, are reconstructed from 1950 to 2010. Overall, the fisheries can be divided into three sectors: artisanal, subsistence and industrial. Six major fisheries, categorized by the gear they use and the resources they target, were identified and treated separately. The catch of each gear was further divided to the species or taxa groups that make up the total catch. Each fishery is first briefly introduced, based on its development over time, operation, species targeted and market. The catch reconstruction procedure is then presented and discussed for each gear separately and for the country as a whole.

Artisanal fishery

The artisanal fishery is the most prominent fishery in the Eritrean Red Sea. It is a small-scale fishery with less capital investment (compared to industrial), and locally owned and operated. There are few gears used by the artisanal fishery.

Beach seine fishery

Beach seining started in the mid 1940s (Ben-Yami 1964) and grew until it became the dominant fishing method in the country in the late 1950s and early 1960s, then declined and faded away in the mid-1970s. The beach seine fishery targeted mainly small pelagic fishes (sardines and anchovies) when they approached the coastal waters during the colder months, i.e., starting in October and extending until May. Through many years of practice, the fishers developed a great deal of experience and knowledge in navigating to beach seining areas, spotting fish schools over clear bottoms, encircling them, and hauling their catch. The fishing operation included a mother *dhow* carrying the seine net and other miscellaneous supplies, and one or two small canoes. The mother *dhow* would anchor near a spot which the school of fish was expected to approach, and the canoe(s) would encircle the fish, putting one end of the rope on the shore. The catch was hauled to shore manually and left to dry above the tide for 1 to 2 days. Sometimes the catch would be damaged by rain while drying. Women and children from nearby villages used to scare off birds, thus earning the right to collect and sell what was left on the beach by the fishers. The dried fish would be transported to either Massawa or Assab, the major ports in Eritrea (Figure 1). Sardines and small anchovies were used almost exclusively for fishmeal which was exported to Italy, Greece, Spain, Switzerland and other European countries, while large anchovies were sun-dried, handpicked and mechanically cleaned of impurities to be exported for human consumption to Sri Lanka and other Asian countries (Grofit 1971).

Sardines were found only around Massawa and the Dahlak archipelago, while large anchovies were found only in the southern part around Assab. When this fishery was at its peak in the 1950s and 1960s, there were up to 6 factories in Massawa for fishmeal and cleaning of large anchovies for human consumption, while there were a couple of them in Assab, devoted to cleaning anchovies only. The landing in Massawa was about double that of Assab (Ben-Yami 1964). This fishery accounted for up to 90% of the total landed catch and it played a large role in the economic and social life of local coastal communities.

Beach seining was also used, although to a lesser extent, to exploit stocks of Spanish mackerels (*Scomberomorus* spp.) and mullets (Family Mugilidae) for direct human consumption. Later, starting in the 1970s, when the export of dry fish and fishmeal stopped, beach seining was used to catch fresh fish for a few years and the accidentally caught anchovies and sardines were discarded (Ben-Yami 1964; Grofit 1971). At present, although the resource potential still exists, commercial beach seining for small pelagics does not occur.

Handline fishery

Handlining (hook and line fishing) is one of the oldest forms of fishing practiced along the Eritrean coast, and is a technique that has been used continuously almost exclusively by the small-scale fisheries. In the 1940s, fishers of Yemenite origin, which some of them later settled in Eritrea, started to use handlining to supply markets in Eritrea and Yemen (Ben-Yami 1964). Since 1991, the handlining catch is sold both locally, or exported to markets in the Middle East and Europe. The fishery targets mainly reef-associated fishes, such as snappers (Lutjanidae), groupers (Serranidae) and emperors (Lethrinidae). Handline fishery occurs around the Dahlak Archipelago and along the northern part of the Eritrean coast, where coral reefs are more developed. It is also performed while on foot from the shore, or from small canoes. Also wooden boats of about 10m long with inboard or outboard engine are used in this fishery.

Usually, only one hook is tied to one end of the line, which is lowered into the water. When the fishers feel that a fish is biting, they start pulling the line back to the boat with their bare hands; indeed, many fishers have cuts on their hands, sustained when they fight to haul the fish into their boats. Fish caught in previous trips are cut into smaller pieces to be used as bait at the beginning of a given trip. Later, low-grade fish are used as bait. Fishing starts in the late afternoon and is carried out throughout the night, until dawn. Overall trip length may range from a few to 10 days, usually as determined by either fish storage capacity (ice boxes), or the ice supply. Because the technique is very selective, this fishery does not have a discarding problem. Recently handlining and gillnetting represent the major artisanal fisheries in Eritrea.

Gillnet fishery

Gillnets were used for shark fishing for a long time, but also for other large pelagic species. Gillnets started to be common only in the 1980s, according to interviews with old fishers, and Giudicelli (1984). Once gillnet fishing started, however, it became an important part of the artisanal fisheries. Their main target is Spanish mackerel (*Scomberomorus commerson*) but also catch barracudas (*Sphyræna* spp.), jacks (Carangidae) and sharks. They set their nets at night mainly in the central and southern part of the coast. The net is immersed for about 2-3 hours, to avoid the entangled fish from spoilage, and post-capture predation by predators, notably sharks. Gillnet fishing is highly affected by moon phase. The new moon is the best time to catch fish using gillnet, where trips last only up to 2 days to fill the fish storage. However, during full moon, trips are longer and some fishers switch to handlining. This fishery is less selective than the handline fishery and has discards, mainly small tunas like kawakawa (*Euthynnus affinis*), which fetch a relatively low price.

Shark fishery

Shark fishing has been common along the Eritrean coast for a long time (Ben-Yami 1964). Sharks were caught by handline, bottom longline and inshore gillnet mainly in the central and southern part of the coast. Shark fishing trips are one of the longest. Ice is not needed in this fishery, and as a result, fishers stay up to a month at sea with short stops at villages near their fishing ground to renew their water supply, drying and collecting their catches (fins and meat) until they come back to land their catches. During the 1950s and 1960s, shark fishing used to occur during the hot months of summer, alternating with the beach seine fishery. Whenever the beach seining fishery faced problems, fishers used to switch to shark fishing. For example in 1967 when export of fishmeal was disrupted by the closure of the Suez Canal, most fishers switched to shark fishing, resulting in high catch of sharks. Shark, either the fin or the flesh, is not favored in Eritrea, thus it has been mainly an export-oriented fishery. In the past, the flesh used to be salted and sun dried on the beach after gutting and fining. The dried meat would be tightly stacked and sewn in straw mats locally called 'ferasila' (Campbell 1993), which weighed about 15 kg. About 5 – 6 kg of wet shark flesh were needed to produce 1 kg of dried shark meat (Grofit 1971). Both the dried fin and meat were exported to Aden, Yemen, where they were re-exported to East Asian markets. Because the flesh was dried on the beach, it had sand impurities; hence, it was not the best quality in the Aden market and did not fetch good price. This eventually decreased the demand of shark meat from Eritrea and together with political instability, resulted in the decline of the fishery starting in the early 1970s. After 1991, dried shark fins were exported, but not continuously. However, the flesh was not used and it is common to see rotting shark carcasses on the beaches. The fishers have the tradition of not throwing away the unwanted catch back into the water because they believe it will contaminate the sea and scare off the fish they target.

Sea cucumber fishery

Sea cucumber gathering has been done in shallow waters by women and young kids for many years at low level (Ben-Yami 1964). A major sea cucumber fishery started in 2000 exclusively for export due to the high demand for the product in China and other East Asian countries. Since its start in 2000, the reported local catch (mainly of *Holothuria* spp. and *Actinopyga* spp.) increased rapidly, peaked in 2002 and then started to decline (Tewelde and Woldai 2007), despite an increasing demand. The decline could be a sign of overexploitation of the resource, although some of the catch is known to be sold illegally in Yemen where prices are higher, and fishing supplies cheaper (Tewelde and Woldai 2007). Gathering is normally done by skin diving, but as the shallow parts of the stock are getting depleted, the deeper parts are increasingly being exploited as well. Collectors use air compressor and hookah diving to reach deeper waters. As they operate with little or no training and improper equipment, accidents are common, with serious health problems and deaths among divers. Proper SCUBA equipment is used very rarely. The collectors dive with a sack to fill with hand-picked sea cucumbers. The catch is processed first by boiling and then drying the boiled sea cucumbers on the beach. When this fishery started in 2000, the catch was small and used to be sold in markets in Yemen, but later as the catch increased, it was exported directly to East Asian markets.

Other artisanal fisheries

The fisheries included in this category are all for invertebrates: shell fish, lobster, snail 'nail' and pearl fisheries. Shell collection in shallow waters by women and young children, and skin diving by men was one of the oldest fishing activities in the Eritrean Red Sea. Most of the shell collection occurred in the summer months, when the water is warm enough for skin diving, and there was no beach seining. The main targets were trochus shells, mother of pearl shells, pearl oyster, and ornamental conchs (Ben-Yami 1964). Similar to those in the shark fishery, the trips were very long, up to 30 days, with 20 – 40 crews and supplies replenished from the settlements near the fishing grounds. No equipment was used except sometimes home-made masks called 'nadur', which limited operations to shallow waters although gradually, proper dive masks were introduced. The main product was semi-finished buttons, exported mainly to Italy. The industry was very active in the 1950s when 6 button factories were established in Massawa. Most fishers preferred to sell their catch in Suakin, Sudan, where they received better prices. Based on interviews with old fishers, about 40 sailing boats used to go to Sudan to sell shells until 1978 before it was prohibited by the government for the fishers to sell outside the country. Most of the fishers switched to other fishing activities and the shell fishery was abandoned.

Snail 'nails' (operculum) were and still are collected by women and children in shallow waters. The nails are dried and sold for use in the cosmetic industry. Lobster fishing occurs mainly in the Assab area. So far, the main bottleneck of this fishery is a lack of market.

Subsistence fishery

The majority of the subsistence catch is associated with the artisanal fishery. It includes part of the artisanal fishery catch that is consumed by the crew, and freely given to family members, friends and people in the community who need help. There is a well-established social tradition locally called '*kusar*' throughout the Red Sea, where part of the catch is separated to be given freely before the remaining is sold. In some smaller communities, it is a taboo to sell the whole catch before part of the catch is given to people who need the support. It is a local social support system, which is enforced by social ostracism of those who do not conform.

Industrial fishery

The industrial fishery, has higher capital investment, uses more advanced technology (e.g., GPS, winch) and uses bigger vessels compared to the artisanal sector. It includes two gear types namely bottom trawl and longline. The former is almost exclusively owned and operated by foreign companies, while the latter is a local operation. The market for the industrial fishery is mainly export.

Trawl fishery

The trawl fishery in the Eritrean Red Sea, which is operated mainly by foreign vessels, was divided, especially in the early years, into inshore shrimp trawling, which was done mainly around Hirgigo bay, and offshore trawling targeting fish. The operations were different and data reported separately. The protected shallow bays (less than 45 m) along the Eritrean coast were continuously fished for shrimp since the 1940s (Grofit 1971) by small inshore trawlers owned by locals of Italian descendents from the colonial times who were involved in fisheries, which are more advanced in technology, trade and processing products. Mediterranean trawls with a cod end of 10 – 15 mm (stretched) were used to catch shrimp (Penaeidae), which were sold to foreigners living in Eritrea and Ethiopia. About 90% of the catches were discarded, as only shrimps were retained. The shrimp fishery restarted again in the 1990s after being inactive in the 1970s and 1980s, with landings an order of magnitude higher than the 1950s and 1960s. The recent shrimp fishery is geared toward the export market.

The first exploratory offshore trawling survey was done in 1957 by Israeli trawlers, and later a commercial trawl fishery started in 1959 (Ben-Yami 1964). They used Mediterranean trawl at depth ranges of 45 m to more than 100 m around and south of Massawa. The main catch included lizard fish (*Saurida* spp.) and threadfin bream (*Nemipterus* spp.), which were refrigerated in the trawlers and landed at Eilat, Israel. This fishery had a lot of discard, consisting of fishes such as Apogonidae, Leiognathidae, Platycephalidae and others, and smaller sizes of the targeted species. The retention size for lizard fish and threadfin bream were 15 cm and 22 cm, respectively. The fishery was active until the mid-1970s, before it was disrupted by war and instability. It started again after 1991 by trawlers mainly from Egypt and sometimes from Saudi Arabia.

Longline fishery

Although longlines were used for shark fishing in the past, a major longline fishery was started in 1999 by an Australian/Eritrean joint venture. It uses mainly fibreglass boats with inboard or outboard engine with a winch to pull in the line. The bait used is Indian mackerel (*Rastrelliger kanagurta*), caught either by a dedicated seining boat, or sometimes imported. Most of the skippers reported that bait has been the main bottleneck for their operation. They target coral reef-associated carnivorous fishes, but they do not fish in the coral reef area itself because of gear entanglement problems. The fishers mark the spots (using GPS) where they had the best catch and return to the same site again and again until the catch declines. This can cause localized overfishing of some species, especially territorial ones. As the line is hauled in, it is common to see retrieved fish that are half eaten, probably by shark. It is also common to see sharks caught in the line; they are usually thrown back to the sea either dead or alive. The catch of this fishery was very rewarding; about 2 t were caught in 2 days by a fast boat that had 4 crew members, as noted by the first author while onboard in 2000.

MATERIALS AND METHODS

An extensive search was made for published papers, reports and other documentations to be used as the basis for the reconstruction of the Eritrean Red Sea fisheries. Most of the materials for the early years were government reports, and expert technical and survey reports. A good description of the fisheries by resource type, gear, operation, total catch, composition and some effort data for the past fisheries was given by Ben-Yami (1964), who was in the Eritrean Red Sea as an expert working for the then Ethiopian government as a master fisher from 1960 to 1963. Grofit (1971), who was also an advisor to the Ethiopian government, from 1966 to 1969, gave a follow-up account of the fisheries based on Ben-Yami (1964) and his own experiences. Most of the information in the 1980s and early 1990s was based on FAO technical reports written by experts who made short visits to the area, notably Giudicelli (1984). For the period after Eritrea became independent in 1991, most of the data were obtained from the Ministry of Fisheries (MOF), which keeps relatively good records of the fisheries activities in the country. Interviews were also done, by the first author, with fishers of a wide age range to obtain a general understanding of the fisheries at different periods and were also used as supplementary information when quantitative data were missing (Tesfamichael *et al.*

in press). For example, the qualitative information given by the fishers was used for interpolations where there were data gaps (see below).

For some years, catch data were given in some reports and those were used as anchors points for the reconstruction procedure. The years for which data were unavailable, interpolations or extrapolations were performed using the anchor points and information as to what happened in the fisheries during those years. Different approaches were used for different fisheries based on the information available and the nature of their operations; hence the reconstruction method is given below for each fishery.

Artisanal fishery

Beach seine fishery

The beach seine fishery in Eritrea can be divided into two categories: one targeting export markets for fishmeal and dried fish of small pelagic species such as sardines and anchovies. The other category is beach seining of relatively larger fishes for direct consumption through the local market. The records on the export fishery were thorough and informative, including files from customs office, which provided information on how much of the final products, fish meal powder and dried fish, were exported (Tesfamichael and Pauly 2011).

The earliest reported catch of the beach seine fishery for export was 25,000 t for the early 1950s (Johnson 1956). Because this fishery was well established by the mid-1940s (Ben-Yami 1964), 25,000 t is taken as the total annual catch from 1950 to 1955. Catch estimates from 1958 to 1963 were available from Ben-Yami (1964), 1964 – 1967 from Grofit (1971) and 1968–1975 from Sanders and Morgan (1989), which also presented data for 1979 and 1980. The next data for the small pelagic beach seine fishery appeared in FAO database under Ethiopia for 1976 and 1980–1987 (FAO 2010); following that period, the fishery declined, and collapsed in 1990. In 2000, an exploratory project was introduced to exploit the small pelagic resource. The catch was generally very low except for 2006, when 293 t was reported (MOF 2007); after that, the catches were zero from 2007 to 2010 (MOF 2012).

From exported dry sardines and anchovies and fishmeal, Ben-Yami (1964) calculated the total catch using the ratio 4:1 of gross catch to final processed product. For the reconstruction, first the data were assigned to the corresponding Gregorian calendar based on the months the fishing occurred, i.e., from October to May, 3/8 of the catch reported for Ge'ez calendar year 1951 was allocated to Gregorian calendar year 1958 and 5/8 to 1959. Based on the yearly catch calculated for 1959–1962, the ratio of catch for October – December to January – May was computed to be 1:1.9; the few months catch for 1958 and 1963 were scaled up to the whole year using this ratio. The landings in Assab were estimated to be half that of Massawa (Ben-Yami 1964). The national total was calculated by adding the Massawa and Assab landings, which were the only two places where the beach seine catch was landed. To the total landed catch, 5% was added to account for unreported catch from 1950 to 1975 when the fishery was active. Because of fishmeal production, there was no discard in this fishery; however, part of the catch was spoiled by rain during drying, some eaten by birds and some spoiled due to bad handling. Based on interviews with fishers, the unreported catch was estimated to be 5% of the landed catch, a conservative estimate (Tesfamichael and Pitcher 2007). The same procedure was followed for 1964–1967 from Grofit (1971) and 1968–1975 from Sanders and Morgan (1989). For the years 1956 and 1957, interpolations were used to match the decline of the fishery in those years (Figure 2; Table 1).

Table 1. Summary of the Eritrean beach seine fishery reconstruction procedures.

Period	Dry fish and fishmeal		Fresh fish		
	Source/Remarks	Unreported (%)	Reported (t)	Source/Remarks	Unreported (%)
1950-55	Johnson (1956)	5	400	Equal to 1960-62	0
1956-57	Interpolation		400	Equal to 1960-62	0
1958-59	Ben-Yami (1964)	5	400	Equal to 1960-62	0
1960-63	Ben-Yami (1964)	5	400	Ben-Yam (1964)	0
1964-66	Grofit (1971)	5	400	Equal to 1960-62	0
1967-68	Grofit (1971); Sanders and Morgan (1989)	5	400	Equal to 1960-62	30
1969-71	Sanders and Morgan (1989)	5	400	Equal to 1960-62	0
1972-75	Sanders and Morgan (1989)	5		Interpolation	30
1976-78	FAO (2010)			Interpolation	30
1979	FAO (2010)		331	Sanders and Morgan (1989)	30
1980	FAO (2010)		269	Sanders and Morgan (1989)	30
1981-87	FAO (2010)			Interpolation	30
1988-89	Zero catch			Interpolation	30
1990-99	Zero catch			Zero catch	0
2000-10	MOF (2012)			Zero catch	0

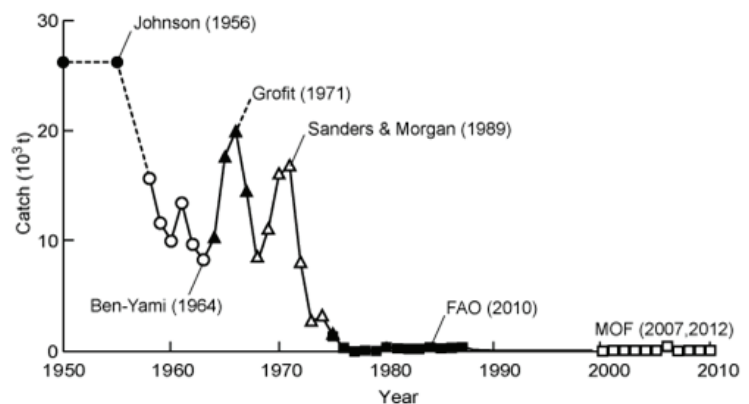


Figure 2. Sources used for catch reconstruction of the Eritrean beach seine fishery for the export market from 1950 to 2010.

The species composition of the total catch was calculated based on the information that the landings in Massawa were generally equal amounts of anchovy and sardine; however, for Assab, it was all anchovy (Ben-Yami 1964). As the Massawa landings were double those of Assab, a ratio of 1:2 sardine to anchovies was used for 1950–1971, except for 1967 and 1968, where all the catch was allocated to anchovy. According to Grofit (1971), export of fishmeal stopped in 1967 due to the closure of the Suez Canal, which was the main route to the market in Europe; then, all the fisheries switched to anchovy fishing, shark fishing and handlining. Fishmeal export started again in 1969, as alternative markets were found in neighbouring countries and Asia (Grofit 1971), resulting in increase in catch (Figure 2). Thus, the ratio 1:2 for sardine and anchovies was used. Although the exact year when the fishmeal industry stopped again was not given, we assume that it was in 1972, based on the qualitative information that Giudicelli (1984) gave about the decline in the industry and the fact that the catch was low, back to the same level as in 1968 when fishmeal export stopped. Thus, the catch from 1972 to 1976 and 1980–1987 was allocated only to anchovies (Figure 3, Appendix Table A1). The common species were anchovies: *Encrasicholina heteroloba* and *Thryssa baelama*, and sardine *Herklotsichthys quadrimaculatus*. After 1987, neither anchovy nor sardine was landed as the whole industry was shut down and whatever was reported for beach seine was assumed to be for fresh fish consumption.

The average annual catch of beach seine for fresh fish for direct human consumption was estimated to be 400 t in the early years (Ben-Yami 1964). This value was used from 1950 to 1972, as the fishery was more or less stable during that period. Two data points were available for 1979 and 1980, 331 t and 269 t, respectively (Sanders and Morgan 1989). These data were recorded at the main landing sites where fish were sold through formal market channels, which would usually be delivered to the fish market in Asmara, the capital city of Eritrea. These data points were given in Ge'ez calendar, hence converted to the Gregorian calendar; they pertained only to fresh food fish, as fishmeal and dry fish were not being produced at that time, according to interviews conducted by the first author, and Giudicelli (1984). For the years 1973 to 1979, interpolation was applied to estimate the catch, which suggested a slight decline in the fishery during those years. The fishery stopped in 1990, as was the case with some of the other fisheries as well, due to civil unrest. From 1981 to 1989, the catch was estimated by interpolation. Not all fish that was caught by the beach seine fishery for fresh fish went through the proper market channels where data recordings were possible. The low grade fish were either sold in bulk to the fish meal processing plants, when they were operating, or sold through the informal markets to the local people on the coast. Sometimes not all the low grade fish could be sold to the locals; the rest would be thrown away. For 1967, 1968 and since 1972, when there was not production of fishmeal, the unrecorded catch (consisting mainly of kawakawa (*Euthynnus affinis*), which did not fetch a good price in the market) was estimated to amount to 30% of the landed catch (Giudicelli 1984). This was added to the landings of food fish by beach seine to calculate the total catch. Table (1) summarizes the procedure of the beach seine catch reconstruction, while Figure (4) shows the reconstructed catch and the sources and interpolations of beach seine fishery for local consumption.

The species composition of fresh fish beach seining for direct consumption was calculated based on data given in Ben-Yami (1964), who reported the catch to consist of jacks (Carangidae; 62.5%), queen fish (*Scomberoides* spp.; 25%), and mullets (Mugillidae; 12.5%). The unrecorded catches were assumed to consist of 67% kawakawa (*Euthynnus affinis*) and the rest a mix of many taxa with minor contributions, based on the qualitative information given in Giudicelli (1984) (Figure 5). The overall catch composition of the beach seine fishery is given in Table (A2).

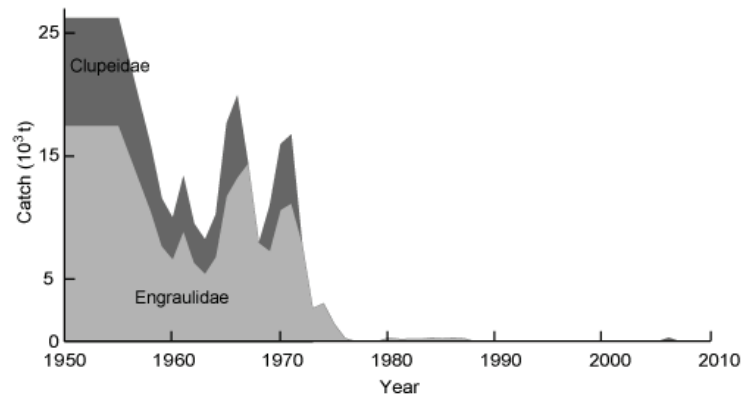


Figure 3. Catch composition of the Eritrean beach seine fishery for export markets from 1950 to 2010.

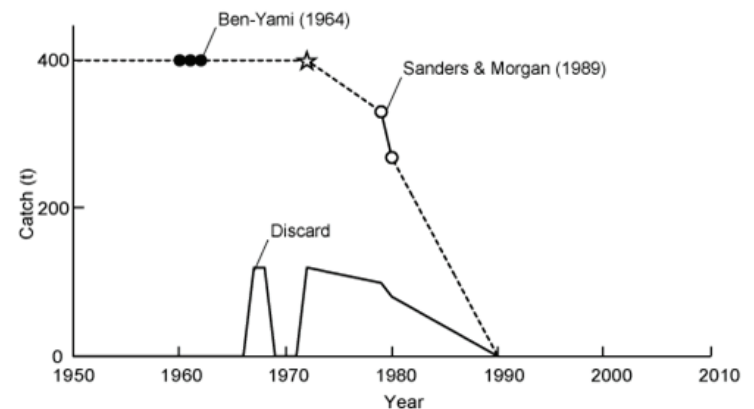


Figure 4. Sources used for the catch reconstruction of the Eritrean beach seine fishery for local consumption from 1950 to 2010. The star in 1972 indicates the end of the 400 t assumed catch.

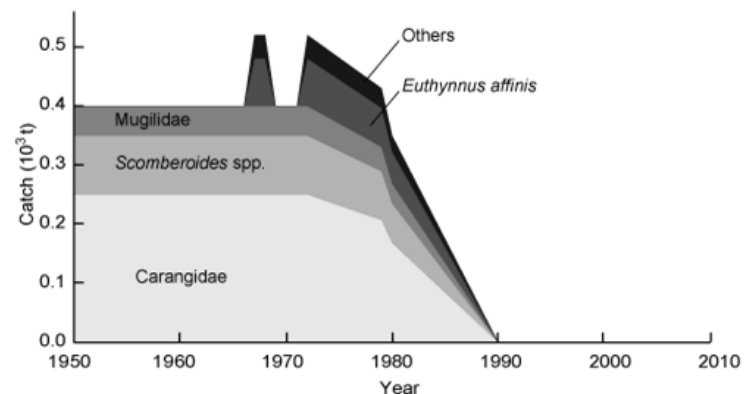


Figure 5. Catch composition of the Eritrean beach seine fishery for local consumption from 1950 to 2010.

Handline fishery

Ben-Yami (1964) estimated the annual landings of the handline fishery to be 300 t, which was used from 1950 to 1965, except for 1960 and 1961, where 100 t were added to reflect the extra effort in those years. In 1966, some fishers, who used to do beach seining, switched to handlining and the catch increased to 1,000 t annually (Grofit 1971). This value was used from 1966 to 1976, a period when the fishery did not change much. In 1977, war broke out in the coastal area and disrupted the artisanal fisheries. After 1977, estimates were given for two years, 1981 and 1983, by Giudicelli (1984), while Sanders and Morgan (1989) compiled total landings from 1977 to 1986. Those landings were assigned only to the artisanal fisheries, which were predominantly handline and gillnet fisheries, as they were the only fisheries operating mainly to supply local communities. Gillnet started to be prominent only later, in the 1970s (Giudicelli 1984). Total artisanal landing for 1992–1995 was obtained from Tesfamichael and Zeremariam (1998) and for 1996–2010 from the Eritrean Ministry of Fisheries database (MOF 2007, 2012), which separated the artisanal catch by gear type.

This fishery uses very selective gear, thus it hardly has any discard. However, not all the fish that is caught is reported in the formal channels. Some of the fish is directly sold to people in areas where data recording does not occur. This is in addition to part of the catch being given freely to family and friends, and which is treated separately, as subsistence fishery, in this report. Based on interviews with old fishers who were active in the 1950s and 1960s, we found out that up to half of their catch did not go to formal market channels (landing sites). Thus, we assumed that the total catch to be double of what was reported, as was also done in a survey of artisanal fisheries in neighbouring Sudan (Chakraborty 1983). Thus, the unreported catch was estimated to be 300 t-year⁻¹ from 1950 to 1976. From 1966 to 1976, the catches given by Grofit (1971) were taken as an estimate of the total, including unreported. Given that Ben-Yami (1964) estimated a maximum of 700 t, including unreported catch and that, after 1991, when the fishery again was in full swing, an annual maximum of 1,300 t was being caught, the 1,000 t-year⁻¹ estimate by Grofit (1971) from 1966 to 1976 seemed reasonable to be the total catch. For the period 1977–2010, unreported catch was estimated based on Giudicelli (1984), who estimated the landings to be 328 t for 1981. Based on the assumption that about half of the catch did not go through proper channels, i.e., remained unrecorded, the unreported catch was estimated to be 328 t for 1981. For the rest of the years from 1977 to 2010, population size was used as a proxy to calculate the total unreported catch, here assumed to go only to local consumption. Hence, the unreported catch was calculated by multiplying 328 t by the ratio of population size of the respective year to 1981. Figure (6) shows our estimates of the unreported catch of fresh fish artisanal fisheries, i.e., handline and gillnet fisheries. In 1990 and 1991, the whole of Eritrea was at the peak of the independence war and fishing was much reduced; however, the coastal people were still fishing, and supplied some of the local demand. Thus, we assumed the amount caught to be equal to the unreported catch estimated from demographics.

The artisanal catch from 1977 to 1995 was not divided between handline and gillnet. The first division appeared in the Ministry of Fisheries database starting in 1996 (MOF 2007), and the average ratio of handline to gillnet was 3.13:1. This ratio was used to divide the reconstructed total artisanal landing from 1990 to 1995. From 1977 to 1986, a ratio of 4.5:1 was used as gillnetting was just starting and more catch came from handlining. No data were available from 1987 to 1989, hence they were interpolated (Figure 7).

For 1983, Giudicelli (1984) estimated the total artisanal catch to be around 2,000 t, based on the number of boats during his visit to the Eritrean coast and catch rates from Yemen calculated by Walczak (1977). In his report, Giudicelli (1984) stated that the fishery showed some sign of renewal, following its decline at the end of the 1970s, with the fishers using mainly handline and gillnet, and targeting prime fresh fish species such as snappers, groupers and emperors. However, we fear this estimate is too

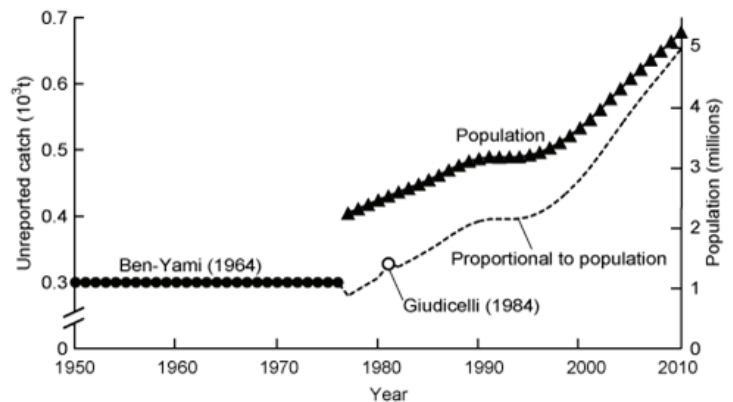


Figure 6. Estimation of the unreported catch of the Eritrean artisanal fisheries (1950–2010), using handline and gillnet, with extrapolation based on demographics (see text).

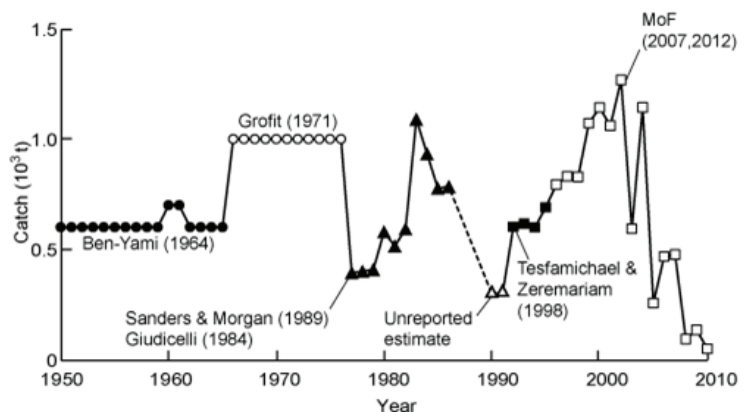


Figure 7. Sources used for the catch reconstruction of the Eritrean handline fishery from 1950 to 2010.

high: first, the total catch of prime fresh fish, prior to the decline, was 1,000 t according to Grofit (1971). Secondly, the maximum catch was 1,319 t in 2002 when the fishery flourished again after Eritrean independence. Hence, we assume the 2,000 t reported by Giudicelli (1984) were an over estimate, and reduced it to 1,000 t, with an estimated unreported catch of 346 t. Figure (7) shows the reconstructed catch, with interpolations and sources. The decline after 2003 is mainly because fishers shifted from handlining to the more lucrative sea cucumber fishery.

The only taxonomic composition record for the early catches was given to be 57.2% snappers (Lutjanidae), 16.9% groupers (Serranidae), 15.6% scavengers or emperors (Lethrinidae) and 10.3% other taxa (Ben-Yami 1964). These ratios were used from 1950 to 1989. From 1996 to 2004 a detailed catch composition of the handline fishery was available (MOF 2007), and its weighted average was used from 1990 to 1995 and from 2005 to 2010 (Figure 8 and Table A3). Since the list of taxa in the catch composition was usually very large, not all of them can be represented in the figures. Throughout this report, only the major groups are presented in the graph, while more detailed catch composition data are given in the appendix tables.

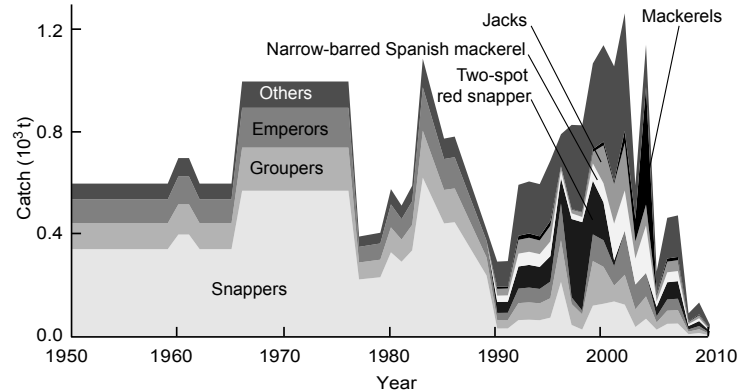


Figure 8. Catch composition of the Eritrean handline fishery from 1950 to 2010.

Gillnet fishery

The gillnet fishery for shark is reported separately (see below); here only the gillnet fishery for fresh food fish is reported. According to Giudicelli (1984) and interviews by the senior author with fishers, gillnets for non-shark fishery, although used for a long time, started to be important to artisanal fishers around 1977. The gillnet catch was calculated from the total, including unreported catch, of the artisanal fishery (see the handline fishery section for the calculations) by dividing it by 5.5 from 1977 to 1986 and by 4.13 from 1990 to 1995. Gillnet landings are given separately in the MOF database for 1996 to 2010 (MOF 2007, 2012). From 1996 to 2010, the unreported catch ratio of gillnet fishery from the total unreported catch of artisanal fishery as described above (see Figure 6) was taken to be proportional to the gillnet to handling reported catch. For the period from 1987 to 1989, the gillnet fishery catch was interpolated (Figure 9). The catch composition was calculated based on data from the database of the Ministry of Fisheries of Eritrea from 1996 to 2004 (MOF 2007). For the rest of the years, the weighted average of 1996–2004 was used (Figure 10 and Table A4). The low catch in 2004 is explained by the fact that the sea cucumber fishery was the first choice for fishers to be involved in because of its high economic return.

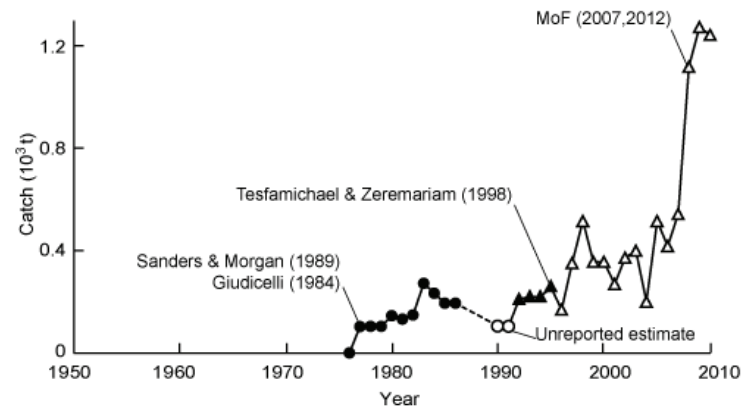


Figure 9. Sources used for the catch reconstruction of the Eritrean gillnet fishery from 1950 to 2010.

Shark fishery

The shark fishery was active for a long time; however, the earliest available catch estimates were from 1963 to 1968 (Grofit 1971); these catches were aggregated with landings of small pelagics. However, from 1966 to 1968, they were disaggregated, and the ratio of shark to small pelagics for 1966 and 1967 were used to disaggregate the landings of 1963–1965. The 1968 ratio was not included because many fishers switched from beach seining for small pelagics to shark fishery by the sudden closure of the Suez Canal, which resulted in a spike in shark catch in 1968. From 1969 to 1977, landings were taken from Sanders and Morgan (1989). All catch reports were given in Ge'ez calendar and were converted to Gregorian calendar based on the fact that in the past, the shark fishery operated mainly during the hot months, i.e., alternating with the beach seine fishery.

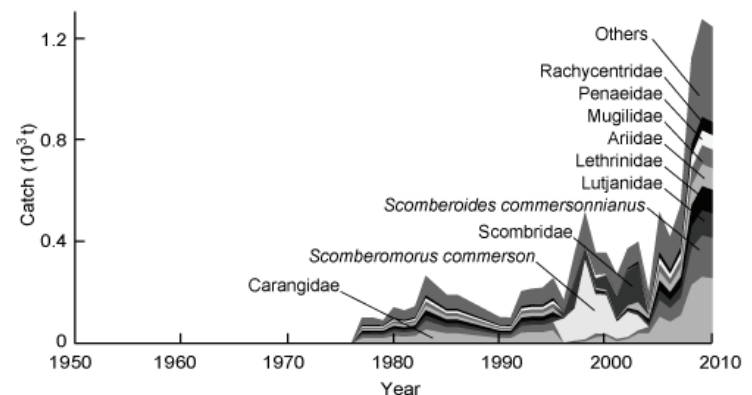


Figure 10. Catch composition of the Eritrean gillnet fishery from 1950 to 2010.

Catches from 1950 to 1962 were assumed to be the same as in 1963, because the shark fishery had been active for a long time in the area and was relatively stable during that period. Shark catch from 1996 to 2010 were obtained from the MOF database (MOF 2007, 2012). However, the shark catch reported are not all that is caught; a conservative estimate of unreported catch to be 10% of the reported catch was used. The data gap between 1977 and 1996 was filled by estimating the catch to be 14 t·year⁻¹, which is the amount for both 1977 and 1996. This is a reasonable estimate as interviews with fishers revealed that the shark fishery continued during those years (Figure 11).

Sea cucumber fishery

Although the main and latest fishery for sea cucumber started mainly around 2000 (Tewelde and Woldai 2007), catches of sea cucumber together with snail nail and pearl were reported from 1962 to 1965 (Grofit 1971). The average of the total catch over those years was 16 t and was taken to be the annual catch from 1950 to 1976. Out of the 16 t, 15 t were assumed to be sea cucumber (mainly *Holothuria* spp. and *Actinopyga* spp.) while the rest is assumed, based on interviews, to be snail nail and pearl. From 1998 to 2006, data were available from Tewelde and Woldai (2007), who reported on an extensive socio-economic survey of the Eritrean sea cucumber fishery. Their catch estimates are likely to be reliable, because the fishery is for export and only few companies were involved. Data were not available from 2007 to 2010, and we used the value of 2006 (Figure 12). All sea cucumber data were expressed as dry weight, after the boiling and drying processes and were converted to wet weight based on data from Purcell *et al.* (2009). Here we used the mean of their conversion data for boiled and dried *Holothuria* spp. and *Actinopyga* spp. (i.e., 10.2% of wet weight).

Other artisanal fisheries

The fisheries included in this category are trochus shells, lobsters, shell fish nail and pearls. Earliest trochus shell collection data available were from Reynolds *et al.* (1993), who reported 300 t for 1955; the same amount was assumed for 1950–1954 during which the fishery was relatively stable. Data from 1958 to 1962 and 1963 to 1968 were available from Ben-Yami (1964) and Grofit (1971), respectively. From 1969 to 1974 and 1977, data were obtained from Reynolds *et al.* (1993). From 1978 to 2010, no data were available on shell collection; however, the collection of shell by women and young children in shallow water was still occurring. Thus, a minimum of 1 t·year⁻¹ was assumed for that period. Interpolation was used to estimate the catches for 1956, 1957, 1975 and 1976 (Figure 13).

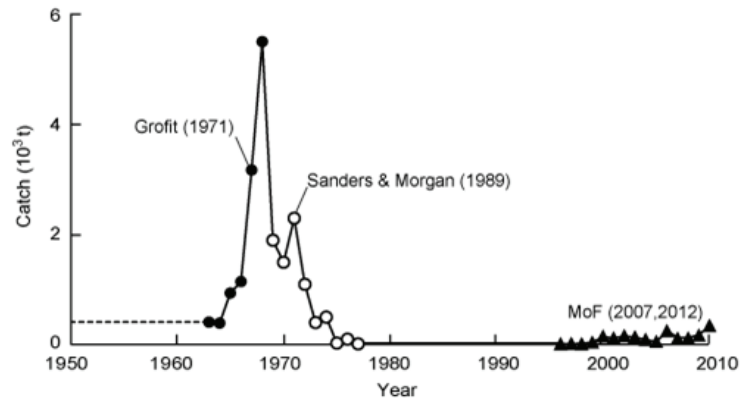


Figure 11. Sources used for the catch reconstruction of the Eritrean shark fishery from 1950 to 2010.

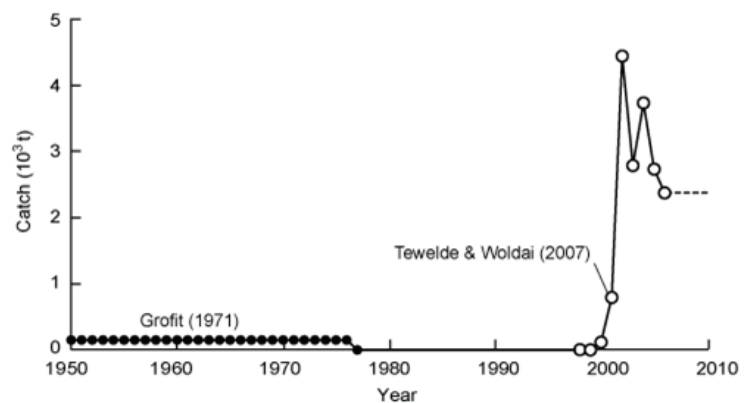


Figure 12. Sources used for the catch reconstruction of the Eritrean sea cucumber fishery from 1950 to 2010.

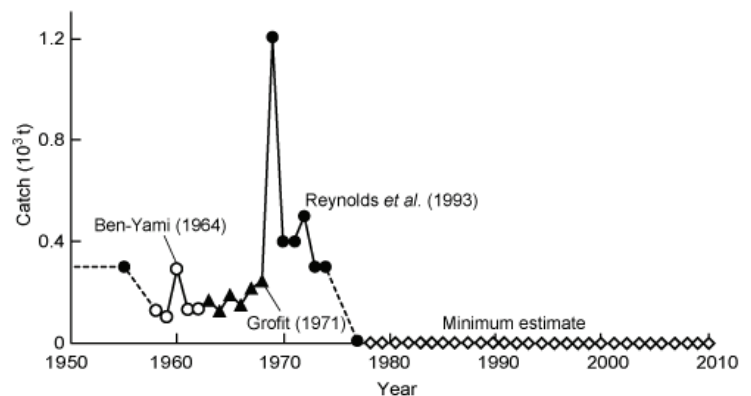


Figure 13. Sources used for the catch reconstruction of the Eritrean trochus shell fishery from 1950 to 2010.

Grofit (1971) reported an annual catch of 5 t of lobster, and this value is used from 1950 to 1977. For the period from 1978 to 2010, a minimum catch of 1 t·year⁻¹ was estimated, which is close to the reports from MOF (2007). Based on observations, interviews and field notes of Eritrean fishery officers, the snail nails and pearl catch was estimated at a conservative minimum value of 1 t·year⁻¹ from 1950 to 2010.

Subsistence fishery

As the source of the subsistence catch is the artisanal fishery catch, its magnitude and composition was estimated as a proportion of the artisanal catch. However, not all the fisheries categorized in the artisanal fishery are represented in the subsistence fishery. The catch or product of the artisanal fishery which are targeted for export—such as shark fin, sea cucumber, shell fishes – are not given freely to family and friends. These products do not contribute to the local food supply. Hence, only the gillnet and handline fisheries were considered for the subsistence fishery reconstruction. For estimating the subsistence fishery, it was divided into two periods. First from 1950 to 1992, when the gillnet and handline fisheries were less commercialized and a good proportion of the catch was given freely to sustain the local communities. Although motorization of boats, which triggers the commercialization of catches, started in the 1960s, we set the less-commercialized period until 1992, because the independence war of Eritrea affected the commercialization of the fishery and kept it very local. We allocated a value equal to 30% of the reconstructed catch of gillnet and handline fisheries to be the amount of subsistence catch from 1950–1992. This is a very conservative value, as interviews with fishers and managers indicated that about half of the catch used to be given for free. The percentage was reduced to 20% for 1993, when fishery infrastructures and markets were flourishing after independence, and for 2010, we assumed the subsistence catch to be only 10% of gillnet and handline fisheries catch. The percentages for the years between 1993 and 2010 were interpolated (Figure 14 and Table A5).

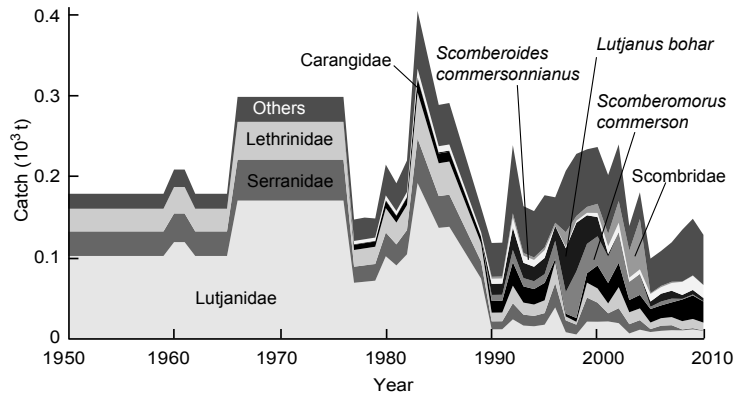


Figure 14. Catch composition of the subsistence catch of Eritrea from 1950 to 2010.

Industrial fishery

Trawl fishery

Since the shrimp fishery was reported separately for most of the period, we estimated it separately from the finfish trawl fishery. A total of 30 t of shrimp were landed from inshore waters around Massawa during the early years (Grofit 1971), and this value was assumed to apply from 1950 to 1970 (Figure 15). The shrimp trawlers were small local boats. Grofit (1971) also reported that shrimp accounted for only 10% of the total catch, which was used to calculate the discard amount to be 270 t·year⁻¹, which is similar to the estimate by Ben-Yami (1964) for 1960–1963. The main shrimp species caught were *Penaeus semisulcatus*, *Marsupenaeus japonicus*, *Melicertus latisulcatus* and *Metapenaeus monoceros*, while the discard was composed of small fishes belonging mainly to the families Leiognathidae, Fistulariidae and Trichiuridae. Sanders and Morgan (1989) reported landings of 20 t for 1976, from which the discard was calculated to be 180 t. Giudicelli (1984) reported that trawling totally disappeared by the beginning of the 1980s; as a result, a catch of zero was assigned from 1981 to 1995. The catch from 1971 to 1975 and 1977 to 1980 were interpolated. The first shrimp trawl catch after Eritrea's independence occurred in 1996 and it was not reported separately as 'shrimp catch' as it was in the past. Rather, it was a component of the trawlers' catch; thus, for 1996–2010, the shrimp catch was calculated from the total catch composition of trawlers (MOF 2007, 2012).

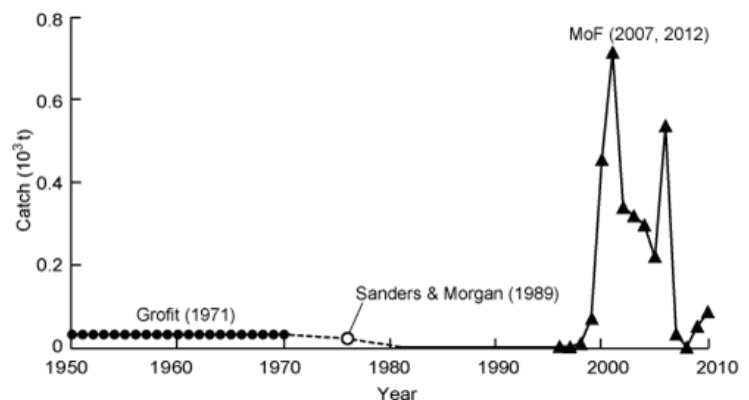


Figure 15. Sources used for the catch reconstruction of shrimp fishery in the Eritrean Red Sea from 1950 to 2010.

The highest catch of shrimp was in 2001, more than 700 t (Figure 15). This is higher than the generally cited 500 t maximum sustainable yield (MSY) of shrimp for Eritrea (Giudicelli 1984). This raises questions about the MSY estimate, which was made in the 1970s and 1980s and based on little research. In addition, the fishery has expanded spatially, i.e., new fishing grounds are fished now, which were not known during the limited surveys of the 1970s and 1980s.

Before the 1970s, the trawlers operating along the Eritrean coast came from Israel, except the small inshore boats mainly for shrimp. The first report of offshore trawling for fish, as opposed to inshore for shrimp, was for the first experimental Israeli trawling off the coast of Eritrea in 1958 (Ben-Yami 1964). The report also contained data of landings until 1962. The landings for 1963 – 1967 were obtained from Grofit (1971). Data from 1968 to 1980 were obtained from Sanders and Morgan (1989), who reported the landings for 1969/70 to be only 100 t. This data point was not used as there was no justification for the sudden drop. It is possible this is a typographic error, hence the average of the landings of the years before and after was taken instead. All records were adjusted from the Ge'ez calendar to the Gregorian calendar. Giudicelli (1984) reported that trawlers were not operating in the 1980s; as a result, the catch was zero until 1994, when trawler landings appeared again. Data for 1994 and 1995 were taken from Tesfamichael and Zeremariam (1998) and those for 1996–2010 from the MOF database (MOF 2007, 2012). Figure 16 shows the reconstructed total trawl landings excluding shrimp.

In addition to the shrimp trawl catch, as described above and shown in Figure 15), the taxonomic composition of the retained catch of non shrimp trawling was calculated from 1958 to 1980 using the ratios given in Ben-Yami (1964). MOF (2007) reported catch composition data from 1996 to 2006. They were used here as presented, while for 1994 and 1995, and 2007–2010 the weighted average ratios of 1996–2006 were used (Figure 17 and Table A6). The dominant taxa are lizard fish and threadfin bream, which account for more than 50% of the total retained catch. There are two clearly separate phases in the trawl fishery in the Eritrea Red Sea based on the origin of the trawlers. The first, from late the 1950s to the end of the 1970s was when trawling was done by Israeli trawlers; the second from the mid-1990s to 2010 was mainly by Egyptian trawlers (Tesfamichael and Mehanna 2012).

The trawl fishery has large amount of discards, and hence they were estimated separately. For the earlier period (1950–1980), the discards were calculated from two separate datasets: trawling for fish and shrimp trawling. For the former, the discarded catch amounted to 44% of the total catch (Ben-Yami 1964), while for the latter it was 90% of total catch (Ben-Yami 1964; Grofit 1971). For the period from 1981 to 2010, unlike the earlier period, there was not separate shrimp dataset, hence discards were calculated all together. Discard data were available from the MOF database from 1996 to 2003 (MOF 2007), and the average of those years, i.e., 43.5% (similar to the value from 1950 to 1980) was used for 1994, 1995 and 2004–2010. As there was no trawling from 1981 to 1993, discards were zero for that period. Once the total discarded catch amounts were established, the next step was to disaggregate them to their taxonomic components. There was no information on the composition of discarded catch from Eritrea during our analysis of Eritrean catch. Thus, it was calculated using data from Yemen (Tesfamichael *et al.* 2012), which has similar ecosystems and trawling practices. Two separate periods were considered in calculating the composition of discarded catches: 1950 – 1957 and 1958 – 2010. In the earlier period, the sole target of trawling was shrimps and everything else was discarded. In the second period, however, some fish were retained; hence they were eliminated from the calculation and the ratios of the remaining taxa were scaled up to make the total 1 (Figure 18 and Table A7).

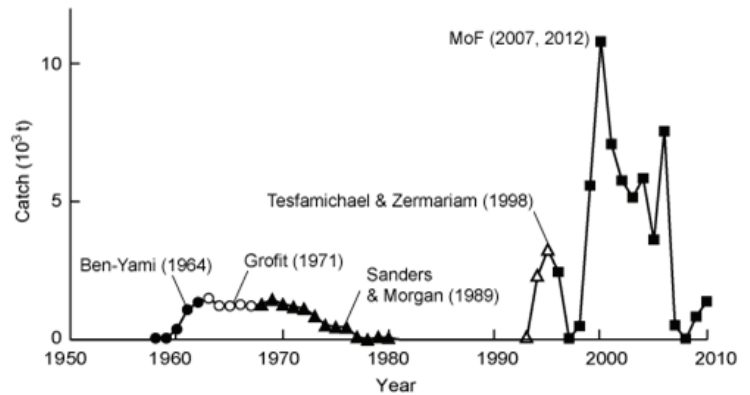


Figure 16. Sources used for the catch reconstruction of trawl fishery (excluding shrimp) in the Eritrean Red Sea from 1950 to 2010.

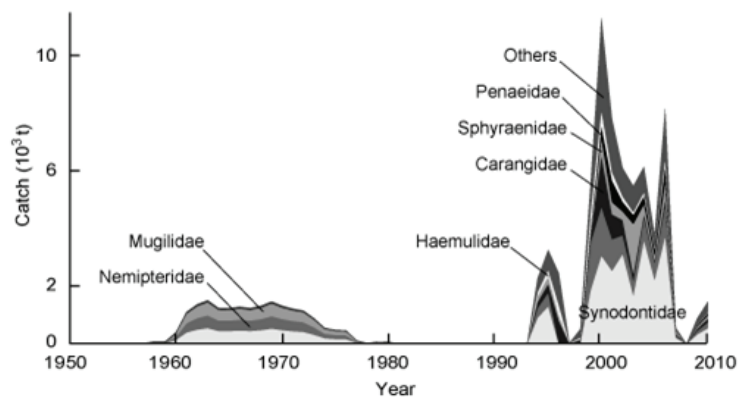


Figure 17. Catch composition of the retained catch of trawl fisheries in the Eritrean Red Sea from 1950 to 2010.

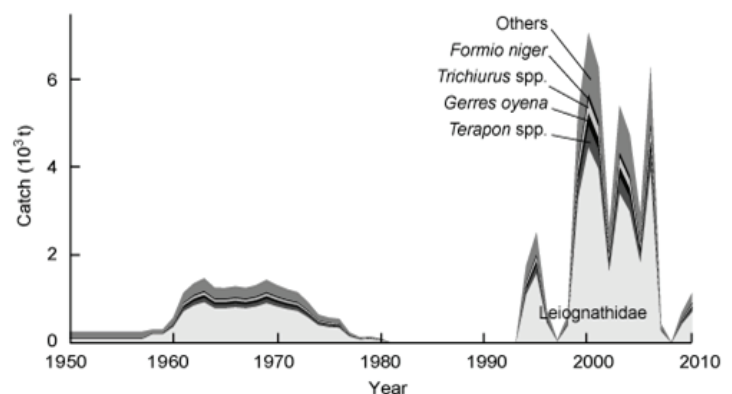


Figure 18. Composition of the discarded catch of trawl fisheries in the Eritrean Red Sea from 1950 to 2010.

Longline fishery

Before the 1970s, different reports mentioned that longlines were being used in the shark fishery. The recent longline fishery started in 1999 and targeted non-shark fishes that dwell in and near coral reefs. Since the shark fishery is presented separately in this report, we describe here only the recent longline fishery. Catch data were available from 1999 to 2010 (MOF 2007, 2012). Based on the first author's observation onboard longline fishing boats, about 10% of the total catch was discarded, which included mainly top predators such as sharks. The composition of the landed catch, i.e., excluding discard, was available from the MOF database for 2000, 2001, 2004 and 2006 (MOF 2007). The 10% discard was added to the unidentified group 'others'. For years for which catch composition data were not available, the weighted mean of the reported composition was used (Figure 19 and Table A8).

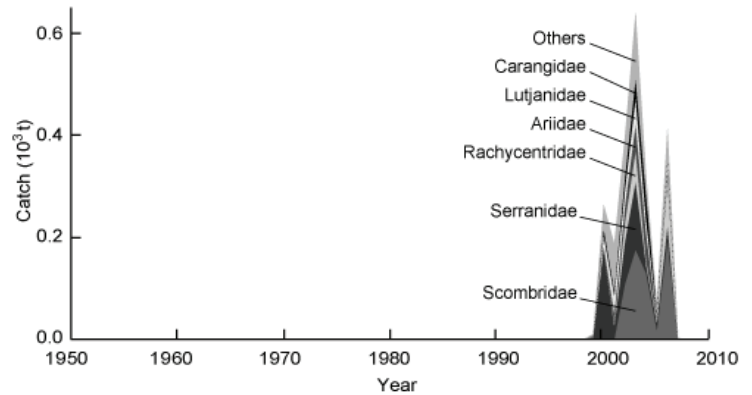


Figure 19. Catch composition of the Eritrean longline fishery from 1950 to 2010.

Comparing reconstructed catches with FAO data

The reconstructed catch data were compared to what Eritrea (Ethiopia pre 1993) reported to the FAO (www.fao.org/fishery/statistics/software/fishstat/en). After the total catch and composition of each gear were reconstructed, whenever the contribution of 'others' was more than 10%, it was reduced to 10% and the difference distributed to the rest of the taxa proportional to their values. The comparison was done at taxonomic level. There were few taxa that were in the FAO data but not in the reconstructed catch. They were allocated to the appropriate sector. Their amount in the reconstructed catch was taken to be the same proportion they had in the total FAO data. The amounts were later deducted from the 'others' of the sector to which they were allocated. Since the FAO data were only a total by taxon, they were divided into the different gears based on the proportion of the taxa for each gear in the reconstructed catch. Then each taxon in the reconstructed data was compared with its corresponding value in the FAO data. The part of the reconstructed catch that is accounted in the FAO data is referred as 'reported catch' in our result. When the catch of any taxon was higher in the reconstructed dataset compared to the FAO data, which was in most cases, the difference was taken to be unreported catch. In a few incidences, the FAO data were higher than the reconstructed catch, and were taken as over-reporting.

RESULTS

The reconstructed total fisheries catch in the Eritrean Red Sea Exclusive Economic Zone (EEZ) by the sectors (both domestic and foreign vessels) is shown in Figure (20) and Appendix Table (A9), together with the total reported catch by FAO on behalf of Eritrea. The fishery went through major changes. The total catch was quite high in the 1950s and the late 1960s. It started to decline in the early 1970s and remained very low in the 1970s and 1980s, but started to increase again in the mid-1990s. The artisanal fisheries were dominant by far (76%), followed by the industrial fisheries (22%, 12% retained and 10% discards). The industrial fishery had the highest contribution from 1994 to 2006, where it contributed more than 50% of the total catch (except for 1997 and 1998). The trawl fisheries' contribution varied depending on whether they received permits.

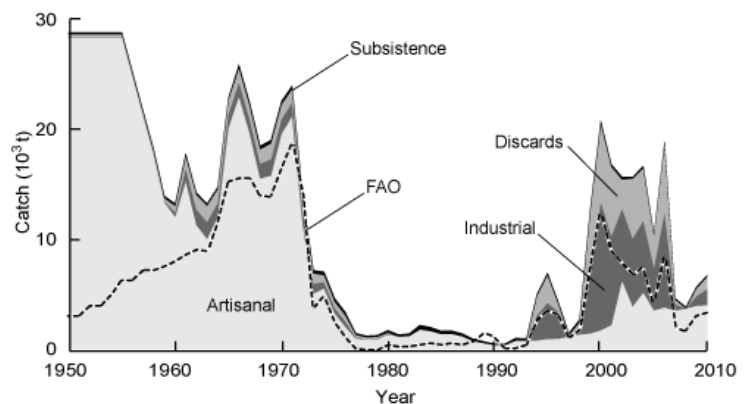


Figure 20. Reconstructed catch by sectors and total catch as reported to FAO by Eritrea in its Red Sea EEZ from 1950 to 2010.

The reported catch (part of the reconstructed catch accounted in the FAO data) represented 38% of the total catch, which obviously brings the accuracy of the reported data into question (Figure 21, Table A10). The unreported landed catch had the highest contribution to the total catch (52%). The major part of the reported catch was the beach-seine fishery in the 1950s and 1960s (Figure 22), which was under-reported in the FAO data. The discards, which are not reported in the FAO database, contributed 10%, and they became more visible starting the late 1990s, with the increase in the trawl fishery.

Taking the individual gears, the main contributor to the high catch in the 1950s and 1960s was the beach seine fishery for small pelagic fishes (Figure 22, Table A11), while the increase in total catch after the mid-1990s was mainly due to bottom trawling. The small-scale artisanal fisheries, which consisted mainly of handlining and gillnetting, were the most steady in their operation. The shark and sea cucumber fisheries made relatively high contributions to the total catch in the late 1960s and early 2000s, respectively (Figure 22). Once these fisheries declined, they did not recover, despite a strong demand. The recent high does not match the highest catch in the early period, mainly because of the absence of the small pelagic purse seine fishery.

The taxonomic composition of the total catch is shown in Figure (23) and the corresponding data are given in Table (A12). The small pelagic fishes (anchovies and sardines) dominated the 1950s and 1960s, while demersal fishes dominated after 1990. The changes in species composition over time are explained largely by the changes in the fishing gear dominating during the periods in question. The catch composition after 1990 shows more diverse groups with sizable catches, unlike in the early years which were dominated by a few taxa. Discards, which are usually omitted from official reports, were high, especially in the latter years. This is due to the fact that demersal trawling became prominent in recent years, and the absence of an industry to make use of the bycatch they generate, e.g. through processing it to fishmeal.

DISCUSSION

The fisheries in Eritrea’s EEZ went through some major fluctuations, with a relatively high total catch up to the mid-1950s, followed by a decline and a recovery starting in the mid-1960s. Then it went through a rapid decline starting in the early 1970s and stayed very low until the beginning of the 1990s. Towards the end of the 1990s, the catch increased again, but not to the high levels it reached in the early years. These fluctuations are explained by major geopolitical changes and market availability for the fishery products. This is in contrast to fisheries that have more stable political and market atmosphere, where the changes that occur are explained in terms of the changes in the fishery resources. In the latter case, the changes are not usually as abrupt as we see them in the Eritrean case.

The first decline, which occurred in 1955, was due to the fact that the small pelagic beach seine fishery, which was dominant at the time, used to be conducted by fishers from Yemen, who were banned from Eritrean waters in late 1954 (Ben-Yami 1964). The (small) next peak, which occurred in 1961, was due to the Yemeni fishers being allowed back into Eritrean waters, but only for one year. Then the fishery recovered, and attained a new peak in 1966, as a result of motorization that allowed the fishers to increase their catch (Grofit 1971). After 1966, a decline occurred, especially in the beach seining fishery, mainly due to the closure of the Suez Canal, due to the 6-Day War between Israel and the neighbouring Arab countries. The Suez Canal was the main route for the export of the beach seine fisheries product, i.e., fishmeal, which was exclusively export-oriented. Although the beach seine fishery declined rapidly after 1966, some of the decline was compensated by the growth of the shark fishery. The next peak was in 1971, and is attributed to the creation of alternative markets in neighbouring countries and Asia for the beach seine fishery catch (Grofit 1971).

The contribution of foreign trawl fishery was important from 1961 to 1971. The major reason for the strong decline after 1971 was political instability. As the Eritrean independence war was gaining momentum, it expanded to the coastal area. As a result, the Ethiopian government, who was in control in Eritrea at the time, declared martial law.

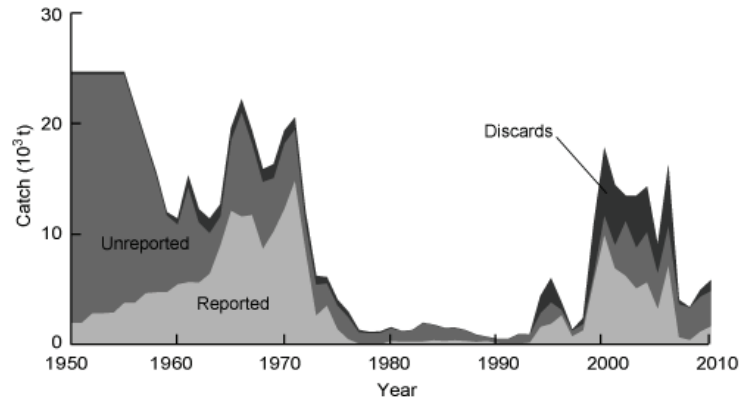


Figure 21. Reconstructed catch by components in the Red Sea EEZ of Eritrea from 1950 to 2010. Reported catch refers to the part of the reconstructed catch accounted in the FAO data.

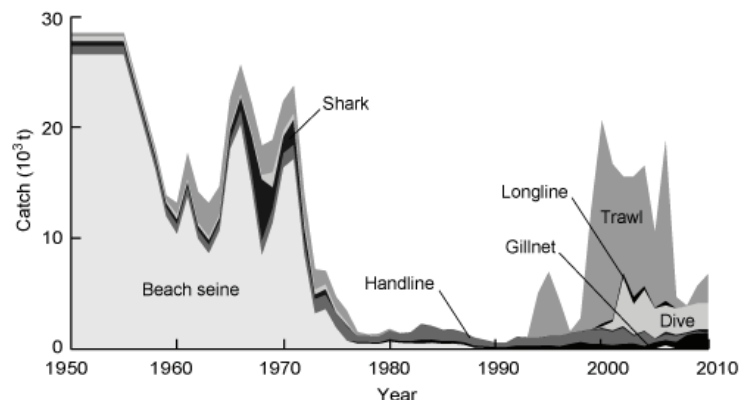


Figure 22. Total catches of the fisheries in the Red Sea EEZ of Eritrea by different gears from 1950 to 2010.

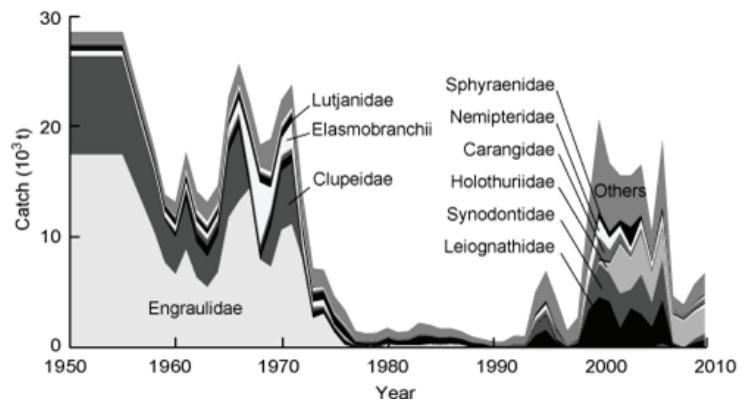


Figure 23. Taxonomic composition of the reconstructed total catch of the fisheries in the Red Sea EEZ of Eritrea from 1950 to 2010.

The fishery infrastructure was destroyed and most of the foreign companies involved in the fishing industry, such as trawling and fishmeal processing plants, left the country. Many local fishers also went into exile in neighbouring countries. Eritrea became independent in 1991, and soon after, the fishery industry started to recuperate. The first peak after 1991 was in 1995 as some foreign trawlers started to operate in Eritrean waters again. They stopped in 1997, however, causing a decline in total catch. But they reinitiated their operations in 1998 and increased rapidly to the next peak in 2000. After 2000, the decline in the trawl fishery catch was partly compensated by the rapidly increasing catch of sea cucumber.

Overall, the most stable fishery throughout the whole period was the artisanal fishery, which targets fish for direct human consumption, particularly handlining, and the gillnet fishery. Most of the fresh fish artisanal fisheries catch is sold in local markets. Some of it is distributed freely, and this sustenance catch goes straight to the households. Fish is the main staple food for the coastal people and that is why handline and gillnet fisheries were active even during the war. The fisheries that showed rapid increase and decline (even while the demand was still high) were those that targeted a small number of vulnerable species, i.e., the shark and sea cucumber fisheries. These two fisheries are similar in many ways. They both yield a dry product, which allows fishers to remain fishing at sea for several days, unlike fisheries that yield fresh product, which forces the fishers to land their catch before it is spoiled. Second, their products are exclusively for export and the demand for shark fin and sea cucumber has been increasing globally. As these products have high market prices, fishers preferred them over other targets, except in the 1950s and 1960s, where the high catch of beach seining made this operation very profitable. The rapid decline of these shark and sea cucumbers fisheries, despite a high effort level, suggest much diminished populations of the target groups, which demands immediate research and action.

This is, to our knowledge, the first attempt to document and standardize the fisheries catches in the Eritrean Red Sea EEZ (both by local and foreign vessels) comprehensively over a long time series (1950–2010), with each gear and type of fishery covered and their catch composition established. We believe this is a crucial step for the assessment of the existing fisheries, and the potential development of new ones (Tesfamichael 2012). The fisheries in Eritrea's waters went through several shifts due to geopolitical changes and that has affected how data have been recorded – or not. For those years where data were not available, it was necessary to infer catches from other years, combined with the best knowledge available to us regarding what kind of changes had happened during those years. We used all the reports we could find to understand the fisheries in Eritrea and also interviewed more than 200 fishers and managers (Tesfamichael *et al.* in press). Our procedures and assumptions are transparent and open to objective criticism. We considered it unacceptable to simply ignore certain fisheries or years from consideration because detailed data were not available (Tesfamichael and Pitcher 2006).

However, one aspect that remains problematic is illegal fisheries. Here, we partially account for them through a portion of the unreported catch. Some of the above results may thus change in the future, when new data become available.

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Appendix Table A1. Catch composition (in tonnes) of the Eritrean beach seine fishery for export markets from 1950 to 2010.

Year	Engraulidae	Clupeidae
1950	17,500	8,750
1951	17,500	8,750
1952	17,500	8,750
1953	17,500	8,750
1954	17,500	8,750
1955	17,500	8,750
1956	15,173	7,587
1957	12,846	6,423
1958	10,519	5,260
1959	7,731	3,865
1960	6,681	3,340
1961	8,951	4,476
1962	6,366	3,183
1963	5,505	2,753
1964	6,869	3,434
1965	11,803	5,902
1966	13,312	6,656
1967	14,466	0
1968	8,006	0
1969	7,350	3,675
1970	10,675	5,338
1971	11,200	5,600
1972	8,006	0
1973	2,691	0
1974	3,084	0
1975	1,411	0
1976	250	0
1977	0	0
1978	0	0
1979	0	0
1980	289	0
1981	198	0
1982	200	0
1983	200	0
1984	300	0
1985	250	0
1986	300	0
1987	250	0
1988	0	0
1989	0	0
1990	0	0
1991	0	0
1992	0	0
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	0	2
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	293
2007	0	0
2008	0	0
2009	0	0
2010	0	0

Appendix Table A2. Catch composition (in tonnes) of the Eritrean beach seine fishery for local consumption from 1950 to 2010.

Year	Carangidae	<i>Scomberoides</i> spp.	Mugilidae	<i>Euthynnus affinis</i>	Others
1950	250	100	50	0	0
1951	250	100	50	0	0
1952	250	100	50	0	0
1953	250	100	50	0	0
1954	250	100	50	0	0
1955	250	100	50	0	0
1956	250	100	50	0	0
1957	250	100	50	0	0
1958	250	100	50	0	0
1959	250	100	50	0	0
1960	250	100	50	0	0
1961	250	100	50	0	0
1962	250	100	50	0	0
1963	250	100	50	0	0
1964	250	100	50	0	0
1965	250	100	50	0	0
1966	250	100	50	0	0
1967	250	100	50	80	40
1968	250	100	50	80	40
1969	250	100	50	0	0
1970	250	100	50	0	0
1971	250	100	50	0	0
1972	250	100	50	80	40
1973	244	98	49	78	39
1974	238	95	48	76	38
1975	231	93	46	74	37
1976	225	90	45	72	36
1977	219	88	44	70	35
1978	213	85	43	68	34
1979	207	83	41	66	33
1980	168	67	34	54	27
1981	151	60	30	49	24
1982	134	54	27	43	21
1983	118	47	24	38	19
1984	101	40	20	32	16
1985	84	34	17	27	13
1986	67	27	13	22	11
1987	50	20	10	16	8
1988	34	13	7	11	5
1989	17	7	3	5	3
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	0	0
1995	0	0	0	0	0
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
2006	0	0	0	0	0
2007	0	0	0	0	0
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	0	0	0	0

Appendix Table A3. Catch composition (in tonnes) of the Eritrean handline fishery from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1950	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	400	118	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	400	118	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	343	101	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	572	169	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	225	66	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	229	68	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	233	69	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	331	98	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	294	87	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	339	100	92	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	623	184	170	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	533	158	145	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	444	131	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	449	133	122	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	379	112	103	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	309	91	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	240	71	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	32	33	28	43	25	27	8	14	15	14	10	9	8	7	6	4	2
1991	32	33	28	43	25	27	8	14	15	14	10	9	8	7	6	4	2
1992	65	66	57	87	50	54	16	29	30	28	20	18	16	15	13	7	5
1993	67	68	58	89	51	55	16	29	31	28	21	18	16	15	13	7	5
1994	65	66	56	86	50	54	16	29	30	28	20	17	16	14	13	7	4
1995	75	76	65	100	58	62	18	33	34	32	23	20	18	17	15	8	5
1996	215	164	144	99	29	16	0	86	21	8	0	0	0	0	5	0	2
1997	46	82	26	307	22	15	2	104	84	7	0	22	3	48	27	0	16
1998	28	60	14	347	20	18	1	98	71	9	6	54	8	37	17	3	23
1999	122	175	105	210	68	45	11	84	32	15	59	38	3	32	39	6	4
2000	129	145	104	148	75	149	15	14	35	63	94	25	24	31	34	20	3
2001	138	62	76	23	144	156	10	0	97	73	42	57	54	30	30	18	8
2002	126	117	172	1	158	186	47	0	32	127	44	16	71	6	9	16	0
2003	38	69	97	0	101	67	88	0	1	23	6	0	23	0	0	30	0
2004	71	87	93	0	186	82	460	0	0	34	12	0	18	0	0	53	0
2005	28	28	24	37	21	23	7	12	13	12	9	7	7	6	5	3	2
2006	51	51	44	67	39	42	12	22	23	21	16	14	12	11	10	6	4
2007	52	52	45	69	40	43	13	23	24	22	16	14	12	12	10	6	4
2008	10	10	9	13	8	8	2	4	5	4	3	3	2	2	2	1	1
2009	15	15	13	19	11	12	4	6	7	6	5	4	4	3	3	2	1
2010	5	5	5	7	4	4	1	2	2	2	2	1	1	1	1	1	0

1: Lutjanidae <Snappers>; 2: Serranidae; 3: Lethrinidae; 4: *Lutjanus bohar*; 5: *Scomberomorus commerson*; 6: Carangidae; 7: Scombridae <Tunas>; 8: *Pristipomoides multidens*; 9: *Lethrinus microdon*; 10: Sphyrnidae; 11: *Lutjanidae* <Job fishes>; 12: *Epinephelus chlorostigma*; 13: *Scomberoides commersonianus*; 14: *Epinephelus malabaricus*; 15: *Lutjanus gibbus*; 16: Ariidae; 17: *Lethrinus mahsena*

Table A3 continued

Year	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1957	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	81
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43
1990	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	5
1991	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	5
1992	0	3	2	0	1	1	1	0	0	0	0	0	0	0	0	0	11
1993	0	3	2	0	1	1	1	0	0	0	0	0	0	0	0	0	11
1994	6	3	2	0	1	1	1	1	0	0	0	0	0	0	0	0	11
1995	7	3	3	0	1	1	1	1	0	0	0	0	0	0	0	0	12
1996	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1997	2	0	8	0	0	4	0	0	0	0	0	0	0	0	0	0	1
1998	1	0	7	0	0	1	0	0	0	0	0	0	0	0	0	1	3
1999	9	2	6	0	0	0	2	0	0	0	0	0	0	0	0	0	2
2000	8	5	3	7	0	5	1	2	0	0	0	1	0	0	0	0	3
2001	13	6	3	6	1	2	3	3	1	1	0	0	0	0	1	0	1
2002	7	11	0	6	3	1	0	1	1	0	1	0	1	0	0	0	104
2003	7	9	0	4	16	1	2	0	3	3	1	0	0	1	0	0	2
2004	10	14	0	11	7	0	2	0	1	0	0	1	0	0	0	0	1
2005	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	5
2006	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	8
2007	4	2	2	0	1	1	0	0	0	0	0	0	0	0	0	0	8
2008	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2009	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

18: Haemulidae; 19: Rachycentridae; 20: *Lethrinus lentjan*; 21: *Pomadasys argenteus*; 22: Bothidae; 23: Scombridae <Mackerels>; 24: Mugilidae; 25: Sparidae; 26: *Chanos chanos*; 27: Palinuridae; 28: Scaridae; 29: Labridae; 30: Rhinobatidae; 31: Belonidae; 32: Sepiidae; 33: Siganidae; 34: Others

Appendix Table A4. Catch composition (in tonnes) of the Eritrean gillnet fishery from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	21	13	0	8	8	7	0	6	5	4	4	4	4	3	2	0	0
1978	21	13	0	8	8	7	0	6	5	4	4	4	4	3	2	0	0
1979	22	13	0	8	8	7	0	6	5	4	4	4	4	3	2	0	0
1980	30	19	0	11	11	10	0	9	7	6	5	5	5	4	3	0	0
1981	27	17	0	10	10	9	0	8	6	6	5	5	5	4	3	0	0
1982	31	19	0	12	11	10	0	9	7	6	5	5	5	4	3	0	0
1983	56	35	0	21	20	18	0	16	12	11	9	9	9	7	6	0	0
1984	48	30	0	18	17	16	0	14	11	10	8	8	8	6	5	0	0
1985	40	25	0	15	15	13	0	11	9	8	7	7	7	5	4	0	0
1986	40	25	0	15	15	13	0	11	9	8	7	7	7	5	4	0	0
1987	36	22	0	13	13	12	0	10	8	7	6	6	6	5	4	0	0
1988	31	19	0	12	11	10	0	9	7	6	5	5	5	4	3	0	0
1989	26	16	0	10	10	9	0	8	6	5	4	4	4	3	3	0	0
1990	22	13	0	8	8	7	0	6	5	4	4	4	4	3	2	0	0
1991	21	13	0	8	8	7	0	6	5	4	4	4	4	3	2	0	0
1992	43	27	0	16	16	14	0	12	10	9	7	7	7	6	5	0	0
1993	45	28	0	17	16	15	0	13	10	9	8	8	8	6	5	0	0
1994	45	28	0	17	16	15	0	13	10	9	7	8	8	6	5	0	5
1995	53	33	0	20	19	17	0	15	12	11	9	9	9	7	6	0	6
1996	2	2	95	1	1	0	19	6	0	1	0	0	4	1	2	6	1
1997	5	7	128	2	2	1	100	3	0	2	1	5	6	1	3	18	0
1998	9	8	318	5	6	1	33	4	4	3	3	2	0	6	0	39	1
1999	25	15	154	9	8	8	34	4	14	2	5	0	0	4	1	24	2
2000	30	9	153	6	7	7	57	3	3	2	3	4	0	1	1	18	1
2001	9	9	68	5	4	3	89	0	2	3	2	2	0	0	0	35	1
2002	18	8	99	8	6	9	135	4	1	7	1	0	0	0	2	22	2
2003	40	13	59	11	7	33	150	1	0	9	2	0	0	0	1	9	4
2004	41	26	0	16	15	14	0	12	9	8	7	7	7	5	4	0	2
2005	106	66	0	40	38	35	0	30	23	22	18	18	18	14	11	0	7
2006	86	53	0	32	31	28	0	25	19	18	14	14	15	11	9	0	6
2007	112	69	0	42	41	37	0	32	25	23	19	19	19	14	12	0	12
2008	231	143	0	87	84	76	0	66	51	47	38	39	39	30	25	0	24
2009	263	163	0	99	95	86	0	75	58	53	44	44	44	34	28	0	7
2010	257	159	0	96	93	84	0	73	57	52	43	43	43	33	27	0	8

1: Carangidae; 2: *Scomberoides commersonianus*; 3: *Scomberomorus commerson*; 4: Lutjanidae <Snapper>; 5: Lethrinidae; 6: Ariidae; 7: Scombridae <Tunas>; 8: Mugilidae; 9: Penaeidae; 10: Rachycentridae; 11: Lutjanidae <Job fishes>; 12: *Lethrinus microdon*; 13: *Euthynnus affinis*; 14: *Lutjanus bohar*; 15: *Chanos chanos*; 16: Sphyrnaeidae; 17: Haemulidae

Table A4 continued

Year	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
1978	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
1979	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	16
1981	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
1982	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	16
1983	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	30
1984	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	26
1985	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	21
1986	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	21
1987	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	19
1988	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	17
1989	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
1990	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
1991	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
1992	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	23
1993	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	24
1994	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	24
1995	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	28
1996	0	0	1	0	0	5	0	0	1	2	0	0	0	0	0	0	18
1997	0	0	1	1	0	23	0	1	0	2	0	0	0	0	0	0	36
1998	0	0	12	1	0	0	0	5	2	1	0	0	0	0	1	0	52
1999	0	0	6	0	0	0	1	1	3	0	0	0	0	0	0	0	36
2000	1	0	5	0	0	0	0	3	3	2	0	0	0	0	0	0	36
2001	0	1	4	0	1	0	0	1	0	0	0	0	0	0	0	1	26
2002	2	1	9	0	6	0	0	0	0	0	0	0	0	0	0	0	31
2003	2	5	12	0	0	0	0	0	0	0	0	0	0	0	0	0	40
2004	2	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	22
2005	5	3	0	2	0	0	1	0	0	0	0	0	0	0	0	0	57
2006	3	2	0	2	21	0	1	0	0	0	0	0	0	0	0	0	26
2007	0	3	0	2	0	0	2	0	0	0	0	0	0	0	0	0	60
2008	2	6	0	4	0	0	3	0	0	0	1	0	1	0	0	0	123
2009	23	7	0	5	0	0	4	0	0	0	1	1	1	0	0	0	140
2010	21	7	0	4	0	0	4	0	0	0	1	1	1	0	0	0	137

18: *Pomadasys argenteus*; 19: Bothidae; 20: Serranidae; 21: Mullidae; 22: Portunidae; 23: *Thunnus tonggol*; 24: Istiophoridae; 25: *Epinephelus chlorostigma*; 26: *Epinephelus malabaricus*; 27: *Sphyrna barracuda*; 28: Belonidae; 29: Rhinobatidae; 30: Pomacanthidae; 31: Scaridae; 32: Scombridae <Mackerels>; 33: Sepiidae; 34: Others

Appendix Table A5. Catch composition (in tonnes) of the subsistence catch of Eritrea from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1950	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	120	35	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	120	35	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	103	30	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	172	51	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	70	20	21	6	0	1	4	0	1	2	1	0	0	2	1	1	0
1978	71	20	21	6	0	1	4	0	1	2	1	0	0	2	1	1	0
1979	72	21	21	6	0	1	4	0	1	2	1	0	0	2	1	1	0
1980	103	29	30	9	0	1	6	0	2	3	1	0	0	3	2	2	0
1981	91	26	27	8	0	1	5	0	1	3	1	0	0	2	2	2	0
1982	105	30	31	9	0	1	6	0	2	3	2	0	0	3	2	2	0
1983	193	55	57	17	0	2	10	0	3	6	3	0	0	5	3	4	0
1984	165	47	49	14	0	2	9	0	2	5	2	0	0	4	3	3	0
1985	138	39	41	12	0	2	7	0	2	4	2	0	0	3	2	3	0
1986	139	40	41	12	0	2	7	0	2	4	2	0	0	3	2	3	0
1987	118	34	35	11	0	1	7	0	2	4	2	0	0	3	2	2	0
1988	96	27	29	9	0	1	6	0	2	3	2	0	0	3	2	2	0
1989	75	21	22	8	0	1	5	0	1	3	1	0	0	2	2	2	0
1990	12	10	11	14	7	14	6	2	6	3	4	4	4	2	2	1	3
1991	12	10	11	14	8	14	6	2	6	3	4	4	4	2	2	1	3
1992	24	20	22	29	15	28	13	5	11	6	8	8	9	4	3	3	5
1993	17	14	15	20	10	19	9	3	8	4	6	6	6	3	2	2	4
1994	16	13	14	19	10	18	8	3	7	4	5	5	6	3	2	2	3
1995	18	14	16	22	11	20	10	3	8	5	6	6	6	3	3	2	4
1996	39	30	26	3	23	18	0	4	4	0	0	3	16	1	0	0	0
1997	8	15	5	3	27	54	2	18	16	0	0	4	18	1	0	0	4
1998	6	12	3	5	58	60	3	6	12	1	2	8	17	1	1	1	10
1999	22	30	19	12	36	35	3	7	5	2	10	6	14	1	1	2	6
2000	21	24	18	28	36	24	5	11	6	4	15	13	2	1	1	1	4
2001	22	10	12	25	32	4	10	15	15	3	7	16	0	0	1	0	9
2002	20	19	26	30	38	0	12	27	5	4	7	22	0	1	3	0	2
2003	7	11	15	15	23	0	5	34	0	9	1	4	0	0	3	0	0
2004	12	12	15	17	25	1	6	62	1	9	3	5	0	2	3	1	0
2005	9	4	8	17	3	7	9	1	4	5	3	2	2	4	3	3	1
2006	10	6	9	16	5	10	8	2	5	4	4	3	3	3	2	2	2
2007	11	6	10	18	5	10	10	1	5	5	4	3	3	4	3	3	2
2008	11	1	10	27	1	5	16	0	5	9	5	0	0	7	5	6	0
2009	12	2	11	29	1	6	18	0	5	9	5	1	1	8	6	6	0
2010	10	1	10	26	0	4	16	0	5	8	4	0	0	7	5	6	0

1: Lutjanidae <Snappers>; 2: Serranidae; 3: Lethrinidae; 4: Carangidae; 5: *Scomberomorus commerson*; 6: *Lutjanus bohar*; 7: *Scomberoides commersonianus*; 8: Scombridae <Tunas>; 9: *Lethrinus microdon*; 10: Ariidae; 11: Lutjanidae <Job fishes>; 12: Sphyracidae; 13: *Pristipomoides multidens*; 14: Mugilidae; 15: Rachycentridae; 16: Penaeidae; 17: *Epinephelus chlorostigma*

Table A5 continued

Year	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1950	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1951	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1952	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1953	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1954	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1955	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1956	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1957	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1958	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1959	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1960	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	22
1961	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	22
1962	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1963	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1964	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1965	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	19
1966	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1967	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1968	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1969	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1970	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1971	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1972	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1973	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1974	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1975	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1976	0	0	0	0	0	0	0	0	0	0.0	0	0.0	0	0	0.0	0.0	31
1977	0	1	0	1	0	0	0	0	0	0.1	0	0.1	0	0	0.0	0.0	16
1978	0	1	0	1	0	0	0	0	0	0.1	0	0.1	0	0	0.0	0.0	16
1979	0	1	0	1	0	0	0	0	0	0.1	0	0.1	0	0	0.0	0.0	13
1980	0	2	0	1	0	0	0	0	0	0.2	0	0.1	0	0	0.0	0.0	23
1981	0	1	0	1	0	0	0	0	0	0.1	0	0.1	0	0	0.0	0.0	20
1982	0	2	0	1	0	0	0	0	0	0.2	0	0.1	0	0	0.0	0.0	23
1983	0	3	0	2	0	0	0	0	0	0.3	0	0.2	0	0	0.0	0.1	43
1984	0	2	0	2	0	0	0	0	0	0.3	0	0.2	0	0	0.0	0.1	37
1985	0	2	0	1	0	0	0	0	0	0.2	0	0.2	0	0	0.0	0.0	30
1986	0	2	0	1	0	0	0	0	0	0.2	0	0.2	0	0	0.0	0.0	31
1987	0	2	0	1	0	0	0	0	0	0.2	0	0.1	0	0	0.0	0.0	26
1988	0	2	0	1	0	0	0	0	0	0.2	0	0.1	0	0	0.0	0.0	22
1989	0	1	0	1	0	0	0	0	0	0.1	0	0.1	0	0	0.0	0.0	17
1990	2	1	2	1	0	1	0	0	0	0.1	0	0.1	0	0	0.0	0.0	5
1991	2	1	2	1	0	1	0	0	0	0.1	0	0.1	0	0	0.0	0.0	5
1992	4	2	4	1	0	1	1	0	1	0.2	0	0.2	0	0	0.0	0.1	10
1993	3	2	3	1	0	1	0	0	0	0.2	0	0.1	0	0	0.0	0.1	7
1994	3	1	2	1	2	1	0	0	0	0.2	0	0.1	0	0	0.1	0.1	7
1995	3	2	3	1	2	1	1	0	0	0.2	0	0.2	0	0	0.1	0.1	8
1996	0	1	1	0	0	0	0	0	0	0.0	1	0.0	0	0	0.0	0.0	3
1997	9	1	5	1	0	3	0	0	1	0.1	4	0.1	1	0	0.1	0.0	7
1998	7	0	3	0	0	4	0	0	1	0.1	0	0.0	0	0	0.1	0.0	9
1999	6	0	6	0	2	1	0	0	1	0.1	0	0.1	0	0	0.1	0.0	6
2000	5	0	5	0	2	1	0	1	0	0.0	0	0.1	1	0	0.4	0.0	7
2001	5	0	5	0	2	1	0	1	1	0.0	0	0.0	0	0	0.4	0.0	4
2002	1	0	1	0	1	0	1	1	0	0.0	0	0.0	0	1	0.2	0.1	21
2003	0	0	0	1	2	0	3	1	0	0.0	0	0.0	0	0	0.1	0.2	7
2004	0	1	0	1	2	0	1	2	0	0.1	0	0.1	0	0	0.0	0.0	3
2005	1	2	1	1	1	0	0	1	0	0.2	0	0.2	0	0	0.0	0.1	8
2006	1	2	1	1	1	0	0	0	0	0.2	0	0.2	0	3	0.0	0.1	4
2007	1	2	1	1	2	0	0	0	0	0.2	0	0.2	0	0	0.1	0.1	8
2008	0	4	0	3	3	0	1	0	0	0.5	0	0.4	0	0	0.0	0.1	14
2009	0	5	0	3	1	0	1	3	0	0.5	0	0.4	0	0	0.0	0.1	15
2010	0	4	0	3	1	0	1	2	0	0.4	0	0.4	0	0	0.0	0.1	14

18: *Epinephelus malabaricus*; 19: *Euthynnus affinis*; 20: *Lutjanus gibbus*; 21: *Chanos chanos*; 22: Haemulidae; 23: *Lethrinus mahsena*; 24: Bothidae; 25: *Pomadasyus argenteus*; 26: *Lethrinus lentjan*; 27: Mullidae; 28: *Thunnus tonggol*; 29: Istiophoridae; 30: Scombridae <Mackerels>; 31: Portunidae; 32: Sparidae; 33: Belonidae; 34: Others

Appendix Table A6. Catch composition (in tonnes) of the retained catch of trawl fisheries in the Eritrean Red Sea from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1950	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
1958	20	16	0	1	16	30	0	0	0	0	0	0	0	0	0	0	0	1
1959	20	16	0	1	16	30	0	0	0	0	0	0	0	0	0	0	0	1
1960	138	112	0	6	109	30	0	0	0	0	0	0	0	0	0	0	0	10
1961	398	323	0	17	314	30	0	0	0	0	0	0	0	0	0	0	0	29
1962	496	402	0	22	391	30	0	0	0	0	0	0	0	0	0	0	0	36
1963	548	445	0	24	432	30	0	0	0	0	0	0	0	0	0	0	0	40
1964	450	365	0	20	355	30	0	0	0	0	0	0	0	0	0	0	0	33
1965	448	363	0	20	353	30	0	0	0	0	0	0	0	0	0	0	0	33
1966	465	377	0	20	367	30	0	0	0	0	0	0	0	0	0	0	0	34
1967	448	364	0	20	353	30	0	0	0	0	0	0	0	0	0	0	0	33
1968	477	387	0	21	376	30	0	0	0	0	0	0	0	0	0	0	0	35
1969	533	432	0	23	420	30	0	0	0	0	0	0	0	0	0	0	0	39
1970	478	387	0	21	376	30	0	0	0	0	0	0	0	0	0	0	0	35
1971	441	358	0	19	348	28	0	0	0	0	0	0	0	0	0	0	0	32
1972	416	338	0	18	328	27	0	0	0	0	0	0	0	0	0	0	0	30
1973	318	258	0	14	251	25	0	0	0	0	0	0	0	0	0	0	0	23
1974	196	159	0	9	154	23	0	0	0	0	0	0	0	0	0	0	0	14
1975	171	139	0	8	135	22	0	0	0	0	0	0	0	0	0	0	0	12
1976	166	134	0	7	131	20	0	0	0	0	0	0	0	0	0	0	0	12
1977	40	32	0	2	31	16	0	0	0	0	0	0	0	0	0	0	0	3
1978	5	4	0	0	4	12	0	0	0	0	0	0	0	0	0	0	0	0
1979	29	24	0	1	23	8	0	0	0	0	0	0	0	0	0	0	0	0
1980	26	21	0	1	20	4	0	0	0	0	0	0	0	0	0	0	0	2
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	910	332	219	184	0	0	148	95	73	0	37	27	22	0	21	0	10	196
1995	1,304	476	314	264	0	0	212	136	105	0	53	38	32	0	17	0	5	305
1996	3	4	804	174	0	2	366	8	675	0	116	58	0	0	0	0	8	235
1997	5	14	1	3	0	0	11	0	0	0	0	0	0	0	0	0	1	2
1998	0	0	131	31	0	11	49	167	22	3	38	0	1	0	0	0	0	50
1999	1,881	1,654	340	116	0	69	580	195	272	0	136	19	22	19	21	0	0	330
2000	3,059	1,692	1,799	580	0	456	506	776	326	446	236	188	115	40	5	0	0	1,086
2001	2,537	1,093	867	416	0	764	280	387	216	128	122	95	122	158	13	0	0	610
2002	3,120	644	538	293	0	339	179	158	20	137	55	11	62	114	2	0	0	430
2003	1,683	502	250	1,727	0	322	84	135	30	45	95	5	49	94	0	0	0	452
2004	3,593	756	161	337	0	296	122	205	28	142	25	6	68	0	2	0	0	406
2005	2,230	580	91	180	0	216	50	44	14	38	18	3	18	9	0	0	0	305
2006	3,740	1,026	268	572	0	577	250	219	148	107	55	270	85	0	0	28	0	816
2007	208	76	50	42	0	32	33	22	17	1	9	6	5	2	0	0	0	54
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
2009	332	121	80	67	0	51	12	34	27	42	14	10	8	0	0	0	0	88
2010	547	200	132	111	0	84	25	57	44	64	22	16	13	0	0	0	0	146

1: Synodontidae; 2: Nemipteridae; 3: Carangidae; 4: Sphyraenidae; 5: Mugilidae; 6: Penaeidae; 7: Haemulidae; 8: Ariidae; 9: Lethrinidae; 10: *Pomadasy argenteus*; 11: Lutjanidae; 12: *Rastrelliger kanagurta*; 13: *Bothus pantherinus*; 14: Leiognathidae; 15: Platycephalidae; 16: *Plectorhynchus schotaf*; 17: *Psettodes erumei*; 18: Others

Appendix Table A7. Composition (in tonnes) of the discarded catch of trawl fisheries in the Eritrean Red Sea from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11
1950	84	9	5	5	3	3	3	3	3	1	1
1951	84	9	5	5	3	3	3	3	3	1	1
1952	84	9	5	5	3	3	3	3	3	1	1
1953	84	9	5	5	3	3	3	3	3	1	1
1954	84	9	5	5	3	3	3	3	3	1	1
1955	84	9	5	5	3	3	3	3	3	1	1
1956	84	9	5	5	3	3	3	3	3	1	1
1957	84	9	5	5	3	3	3	3	3	1	1
1958	199	22	13	13	6	6	6	6	6	3	3
1959	199	22	13	13	6	6	6	6	6	3	3
1960	361	41	23	23	12	12	12	12	12	6	6
1961	719	81	46	46	23	23	23	23	23	12	12
1962	854	96	55	55	28	28	28	28	28	14	14
1963	926	105	60	60	30	30	30	30	30	15	15
1964	791	89	51	51	26	26	26	26	26	13	13
1965	787	89	51	51	25	25	25	25	25	13	13
1966	811	92	52	52	26	26	26	26	26	13	13
1967	789	89	51	51	25	25	25	25	25	13	13
1968	827	93	53	53	27	27	27	27	27	13	13
1969	905	102	58	58	29	29	29	29	29	15	15
1970	829	94	53	53	27	27	27	27	27	13	13
1971	769	87	50	50	25	25	25	25	25	12	12
1972	725	82	47	47	23	23	23	23	23	12	12
1973	581	66	37	37	19	19	19	19	19	9	9
1974	403	45	26	26	13	13	13	13	13	6	6
1975	360	41	23	23	12	12	12	12	12	6	6
1976	342	39	22	22	11	11	11	11	11	6	6
1977	146	16	9	9	5	5	5	5	5	2	2
1978	76	9	5	5	2	2	2	2	2	1	1
1979	86	10	6	6	3	3	3	3	3	1	1
1980	58	7	4	4	2	2	2	2	2	1	1
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	0	0	0	0	0	0	0	0	0	0	0
1994	1,107	125	71	71	36	36	36	36	36	18	18
1995	1,588	179	102	102	51	51	51	51	51	26	26
1996	464	52	30	30	15	15	15	15	15	7	7
1997	36	4	2	2	1	1	1	1	1	1	1
1998	387	44	25	25	12	12	12	12	12	6	6
1999	3,304	373	213	213	107	107	107	107	107	53	53
2000	4,463	504	288	288	144	144	144	144	144	72	72
2001	3,961	447	256	256	128	128	128	128	128	64	64
2002	1,638	185	106	106	53	53	53	53	53	26	26
2003	3,414	385	220	220	110	110	110	110	110	55	55
2004	2,992	338	193	193	97	97	97	97	97	48	48
2005	1,847	209	119	119	60	60	60	60	60	30	30
2006	3,971	448	256	256	128	128	128	128	128	64	64
2007	271	31	17	17	9	9	9	9	9	4	4
2008	0	0	0	0	0	0	0	0	0	0	0
2009	431	49	28	28	14	14	14	14	14	7	7
2010	711	80	46	46	23	23	23	23	23	11	11

1: Leiognathidae; 2: *Terapon* spp.; 3: *Gerres oyena*; 4: *Trichiurus* spp.; 5: *Formio niger*; 6: *Lupa pelgica*; 7: Platycephalidae; 8: Soleidae; 9: Tetradontidae; 10: Clupeidae; 11: Mullidae

Table A7 continued

Year	12	13	14	15	16	17	18	19	20	21	22
1950	1	41	38	32	12	5	3	3	3	1	11
1951	1	41	38	32	12	5	3	3	3	1	11
1952	1	41	38	32	12	5	3	3	3	1	11
1953	1	41	38	32	12	5	3	3	3	1	11
1954	1	41	38	32	12	5	3	3	3	1	11
1955	1	41	38	32	12	5	3	3	3	1	11
1956	1	41	38	32	12	5	3	3	3	1	11
1957	1	41	38	32	12	5	3	3	3	1	11
1958	3	0	0	0	0	0	0	0	0	0	26
1959	3	0	0	0	0	0	0	0	0	0	26
1960	6	0	0	0	0	0	0	0	0	0	47
1961	12	0	0	0	0	0	0	0	0	0	93
1962	14	0	0	0	0	0	0	0	0	0	110
1963	15	0	0	0	0	0	0	0	0	0	120
1964	13	0	0	0	0	0	0	0	0	0	102
1965	13	0	0	0	0	0	0	0	0	0	102
1966	13	0	0	0	0	0	0	0	0	0	105
1967	13	0	0	0	0	0	0	0	0	0	102
1968	13	0	0	0	0	0	0	0	0	0	107
1969	15	0	0	0	0	0	0	0	0	0	117
1970	13	0	0	0	0	0	0	0	0	0	107
1971	12	0	0	0	0	0	0	0	0	0	99
1972	12	0	0	0	0	0	0	0	0	0	94
1973	9	0	0	0	0	0	0	0	0	0	75
1974	6	0	0	0	0	0	0	0	0	0	52
1975	6	0	0	0	0	0	0	0	0	0	46
1976	6	0	0	0	0	0	0	0	0	0	44
1977	2	0	0	0	0	0	0	0	0	0	19
1978	1	0	0	0	0	0	0	0	0	0	10
1979	1	0	0	0	0	0	0	0	0	0	11
1980	1	0	0	0	0	0	0	0	0	0	8
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	0	0	0	0	0	0	0	0	0	0	0
1994	18	0	0	0	0	0	0	0	0	0	143
1995	26	0	0	0	0	0	0	0	0	0	205
1996	7	0	0	0	0	0	0	0	0	0	60
1997	1	0	0	0	0	0	0	0	0	0	5
1998	6	0	0	0	0	0	0	0	0	0	50
1999	53	0	0	0	0	0	0	0	0	0	426
2000	72	0	0	0	0	0	0	0	0	0	576
2001	64	0	0	0	0	0	0	0	0	0	511
2002	26	0	0	0	0	0	0	0	0	0	211
2003	55	0	0	0	0	0	0	0	0	0	441
2004	48	0	0	0	0	0	0	0	0	0	386
2005	30	0	0	0	0	0	0	0	0	0	238
2006	64	0	0	0	0	0	0	0	0	0	512
2007	4	0	0	0	0	0	0	0	0	0	35
2008	0	0	0	0	0	0	0	0	0	0	0
2009	7	0	0	0	0	0	0	0	0	0	56
2010	11	0	0	0	0	0	0	0	0	0	92

12: *Squilla* spp.; 13: *Carangoides malabaricus*; 14: *Saurida tumbil*; 15: Nemipteridae; 16: *Pomadasys opercularis*; 17: Ariidae; 18: Carangidae; 19: *Plotosis angularis*; 20: Sphyraenidae; 21: Sepiidae; 22: Others

Appendix Table A8. Catch composition (in tonnes) of the Eritrean longline fishery from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12
1950	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0
1999	3	2	1	1	1	1	0	0	0	0	0	1
2000	2	172	0	12	21	12	13	0	6	0	0	26
2001	2	27	5	19	34	9	14	44	4	7	3	19
2002	110	83	37	33	32	23	16	16	4	2	2	40
2003	177	133	60	53	51	38	26	25	6	4	2	64
2004	130	16	8	54	24	48	2	0	0	1	1	32
2005	20	15	7	6	6	4	3	3	1	0	0	7
2006	197	29	94	16	15	4	17	0	0	0	0	41
2007	1	1	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0

1: Scombridae; 2: Serranidae; 3: Rachycentridae; 4: Ariidae; 5: Lutjanidae; 6: Carangidae; 7: Sphyraenidae; 8: *Epinephelus chlorostigma*; 9: Lethrinidae; 10: Haemulidae; 11: *Pomadasys argenteus*; 12: Others

Appendix Table A9. Reconstructed catch (in tonnes) by sectors and total catch as reported to FAO by Eritrea in its Red Sea EEZ from 1950 to 2010.

Year	FAO landings	Reconstructed total catch	Industrial	Artisanal	Subsistence	Discards
1950	3,000	28,599	30	28,119	180	270
1951	3,000	28,599	30	28,119	180	270
1952	4,000	28,599	30	28,119	180	270
1953	4,000	28,599	30	28,119	180	270
1954	5,000	28,599	30	28,119	180	270
1955	6,200	28,599	30	28,119	180	270
1956	6,200	25,051	30	24,571	180	270
1957	7,100	21,503	30	21,023	180	270
1958	7,100	18,054	85	17,475	180	314
1959	7,500	13,848	85	13,270	180	314
1960	8,000	13,166	405	11,982	210	570
1961	8,500	17,684	1,110	15,228	210	1,136
1962	9,000	14,157	1,377	11,251	180	1,350
1963	8,900	13,159	1,519	9,995	180	1,464
1964	11,300	14,661	1,253	11,977	180	1,251
1965	15,200	22,657	1,245	19,988	180	1,244
1966	15,500	25,695	1,293	22,819	300	1,283
1967	15,500	22,325	1,248	19,531	300	1,247
1968	13,900	18,365	1,324	15,432	300	1,308
1969	13,700	18,888	1,477	15,681	300	1,430
1970	16,300	22,406	1,327	19,469	300	1,310
1971	18,800	23,797	1,226	21,056	300	1,215
1972	13,800	13,886	1,157	11,282	300	1,147
1973	3,700	7,162	890	5,054	300	918
1974	4,900	7,027	555	5,535	300	637
1975	2,430	4,637	487	3,282	300	568
1976	970	3,393	470	2,081	300	541
1977	172	1,481	123	979	148	230
1978	15	1,258	26	961	151	120
1979	0	1,314	85	945	149	135
1980	407	1,761	74	1,379	216	92
1981	328	1,368	0	1,175	193	0
1982	350	1,458	0	1,236	221	0
1983	400	2,225	0	1,819	407	0
1984	600	2,037	0	1,689	348	0
1985	500	1,700	0	1,410	290	0
1986	600	1,725	0	1,433	292	0
1987	500	1,453	0	1,204	249	0
1988	723	981	0	775	206	0
1989	1,557	759	0	596	163	0
1990	1,172	533	0	414	119	0
1991	117	535	0	415	119	0
1992	100	1,058	0	818	240	0
1993	475	1,005	0	840	165	0
1994	2,707	5,017	2,275	834	159	1,750
1995	3,559	6,913	3,262	964	178	2,509
1996	3,254	4,346	2,455	983	176	733
1997	1,042	1,501	38	1,198	208	56
1998	1,856	2,714	503	1,369	229	612
1999	6,998	12,598	5,668	1,472	235	5,223
2000	12,713	20,626	11,574	1,761	238	7,054
2001	8,882	16,703	7,995	2,244	203	6,261
2002	7,854	15,570	6,499	6,241	241	2,589
2003	6,691	15,565	6,111	3,916	140	5,397
2004	7,406	16,545	6,465	5,170	182	4,729
2005	4,030	10,442	3,868	3,554	100	2,920
2006	8,816	18,769	8,573	3,810	109	6,277
2007	1,934	4,634	561	3,525	120	428
2008	1,668	3,853	1	3,716	135	0
2009	3,032	5,683	886	3,967	149	681
2010	3,288	6,721	1,461	4,007	129	1,124

Appendix Table A10. Reconstructed catch (in tonnes) by components in the Red Sea EEZ of Eritrea from 1950 to 2010. Reported catch refers to the part of the reconstructed catch accounted in the FAO data.

Year	Reported	Unreported	Discards
1950	2,248	26,080	270
1951	2,248	26,080	270
1952	3,248	25,080	270
1953	3,248	25,080	270
1954	3,328	25,000	270
1955	4,362	23,967	270
1956	4,362	20,419	270
1957	5,358	15,875	270
1958	5,455	12,286	314
1959	5,469	8,066	314
1960	6,295	6,301	570
1961	6,514	10,034	1,136
1962	6,482	6,326	1,350
1963	7,414	4,281	1,464
1964	10,394	3,016	1,251
1965	14,038	7,375	1,244
1966	13,420	10,993	1,283
1967	13,571	7,508	1,247
1968	10,060	6,996	1,308
1969	11,875	5,583	1,430
1970	14,222	6,874	1,310
1971	17,223	5,359	1,215
1972	9,898	2,841	1,147
1973	3,037	3,207	918
1974	4,079	2,311	637
1975	1,580	2,489	568
1976	530	2,322	541
1977	61	1,190	230
1978	4	1,134	120
1979	0	1,179	135
1980	337	1,332	92
1981	256	1,113	0
1982	266	1,192	0
1983	285	1,940	0
1984	413	1,624	0
1985	345	1,356	0
1986	410	1,315	0
1987	342	1,111	0
1988	238	743	0
1989	329	430	0
1990	105	428	0
1991	54	481	0
1992	48	1,010	0
1993	163	842	0
1994	1,817	1,450	1,750
1995	2,144	2,260	2,509
1996	3,059	554	733
1997	849	595	56
1998	1,452	650	612
1999	6,701	674	5,223
2000	11,541	2,031	7,054
2001	7,972	2,469	6,261
2002	7,197	5,785	2,589
2003	5,865	4,303	5,397
2004	6,517	5,300	4,729
2005	3,763	3,759	2,920
2006	8,318	4,175	6,277
2007	720	3,485	428
2008	439	3,414	0
2009	1,342	3,659	681
2010	1,882	3,716	1,124

Appendix Table A11. Total catches (in tonnes) of the fisheries in the Red Sea EEZ of Eritrea by different gears from 1950 to 2010.

Year	Beach seine	Gill net	Handline	Shark	Dive	Longline	Trawl
1950	26,650	0	780	413	456	0	300
1951	26,650	0	780	413	456	0	300
1952	26,650	0	780	413	456	0	300
1953	26,650	0	780	413	456	0	300
1954	26,650	0	780	413	456	0	300
1955	26,650	0	780	413	456	0	300
1956	23,160	0	780	413	399	0	300
1957	19,669	0	780	413	341	0	300
1958	16,179	0	780	413	284	0	399
1959	11,996	0	780	413	261	0	399
1960	10,421	0	910	413	448	0	975
1961	13,827	0	910	413	288	0	2,247
1962	9,948	0	780	413	290	0	2,726
1963	8,658	0	780	413	325	0	2,983
1964	10,703	0	780	394	280	0	2,504
1965	18,105	0	780	937	346	0	2,490
1966	20,367	0	1,300	1,146	306	0	2,575
1967	14,986	0	1,300	3,174	371	0	2,494
1968	8,526	0	1,300	5,508	398	0	2,632
1969	11,425	0	1,300	1,900	1,356	0	2,907
1970	16,413	0	1,300	1,500	556	0	2,637
1971	17,200	0	1,300	2,300	556	0	2,441
1972	8,526	0	1,300	1,100	656	0	2,304
1973	3,198	0	1,300	400	456	0	1,808
1974	3,579	0	1,300	500	456	0	1,192
1975	1,892	0	1,300	30	359	0	1,056
1976	718	0	1,300	100	263	0	1,011
1977	456	131	510	14	16	0	354
1978	443	132	520	14	3	0	146
1979	430	118	530	14	3	0	220
1980	641	184	752	14	3	0	166
1981	515	168	668	14	3	0	0
1982	482	189	770	14	3	0	0
1983	447	345	1,416	14	3	0	0
1984	511	296	1,212	14	3	0	0
1985	426	248	1,009	14	3	0	0
1986	441	248	1,019	14	3	0	0
1987	356	219	861	14	3	0	0
1988	70	190	703	14	3	0	0
1989	35	162	545	14	3	0	0
1990	0	133	383	14	3	0	0
1991	0	132	385	14	3	0	0
1992	0	267	774	14	3	0	0
1993	0	258	730	14	3	0	0
1994	0	261	714	14	3	0	4,025
1995	0	305	820	14	3	0	5,771
1996	0	201	938	16	3	0	3,188
1997	0	413	976	14	3	0	95
1998	0	604	970	19	6	0	1,116
1999	0	415	1,247	42	3	11	10,880
2000	0	412	1,324	143	118	264	18,363
2001	0	310	1,221	120	795	188	14,068
2002	0	427	1,454	159	4,442	398	8,690
2003	0	455	676	135	2,789	639	10,869
2004	0	227	1,298	91	3,735	317	10,876
2005	0	582	288	49	2,735	73	6,715
2006	293	469	523	255	2,378	413	14,437
2007	0	607	531	129	2,378	4	985
2008	0	1,246	102	127	2,378	0	1
2009	0	1,408	148	182	2,378	0	1,567
2010	0	1,368	53	338	2,378	0	2,585

Appendix Table A12. Taxonomic composition (in tonnes) of the reconstructed total catch of the fisheries in the Red Sea EEZ of Eritrea from 1950 to 2010.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1950	17,500	8,751	84	0	150	413	446	253	32	122	132	50	300	3	9
1951	17,500	8,751	84	0	150	413	446	253	32	122	132	50	300	3	9
1952	17,500	8,751	84	0	150	413	446	253	32	122	132	50	300	3	9
1953	17,500	8,751	84	0	150	413	446	253	32	122	132	50	300	3	9
1954	17,500	8,751	84	0	150	413	446	253	32	122	132	50	300	3	9
1955	17,500	8,751	84	0	150	413	446	253	32	122	132	50	300	3	9
1956	15,173	7,588	84	0	150	413	446	253	32	122	132	50	243	3	9
1957	12,846	6,424	84	0	150	413	446	253	32	122	132	50	185	3	9
1958	10,519	5,263	199	20	150	413	446	250	16	122	132	66	128	1	22
1959	7,731	3,869	199	20	150	413	446	250	16	122	132	66	105	1	22
1960	6,681	3,346	361	138	150	413	521	250	112	142	154	159	292	6	41
1961	8,951	4,487	719	398	150	413	521	250	323	142	154	364	132	17	81
1962	6,366	3,197	854	496	150	413	446	250	402	122	132	441	134	22	96
1963	5,505	2,768	926	548	150	413	446	250	445	122	132	482	169	24	105
1964	6,869	3,447	791	450	150	394	446	250	365	122	132	405	124	20	89
1965	11,803	5,914	787	448	150	937	446	250	363	122	132	403	190	20	89
1966	13,312	6,669	811	465	150	1,146	744	250	377	203	220	417	150	20	92
1967	14,466	13	789	448	150	3,174	744	250	364	203	220	403	215	20	89
1968	8,006	13	827	477	150	5,508	744	250	387	203	220	426	242	21	93
1969	7,350	3,690	905	533	150	1,900	744	250	432	203	220	470	1,200	23	102
1970	10,675	5,351	829	478	150	1,500	744	250	387	203	220	426	400	21	94
1971	11,200	5,612	769	441	150	2,300	744	250	358	203	220	398	400	19	87
1972	8,006	12	725	416	150	1,100	744	250	338	203	220	378	500	18	82
1973	2,691	9	581	318	150	400	744	244	258	203	220	300	300	14	66
1974	3,084	6	403	196	150	500	744	238	159	203	220	202	300	9	45
1975	1,411	6	360	171	150	30	744	231	139	203	220	181	203	8	41
1976	250	6	342	166	150	100	744	225	134	203	220	176	107	7	39
1977	0	2	146	40	0	14	302	247	32	90	86	83	10	2	16
1978	0	1	76	5	0	14	308	241	4	91	88	55	1	0	9
1979	0	1	86	29	0	14	313	235	24	93	90	72	1	1	10
1980	289	1	58	26	0	14	445	207	21	131	127	65	1	1	7
1981	198	0	0	0	0	14	395	187	0	117	113	40	1	0	0
1982	200	0	0	0	0	14	455	174	0	134	130	38	1	0	0
1983	200	0	0	0	0	14	838	191	0	247	239	44	1	0	0
1984	300	0	0	0	0	14	717	163	0	212	205	38	1	0	0
1985	250	0	0	0	0	14	597	136	0	176	171	32	1	0	0
1986	300	0	0	0	0	14	603	120	0	178	172	28	1	0	0
1987	250	0	0	0	0	14	510	97	0	151	146	23	1	0	0
1988	0	0	0	0	0	14	417	74	0	124	119	18	1	0	0
1989	0	0	0	0	0	14	325	51	0	97	92	13	1	0	0
1990	0	0	0	0	0	14	53	63	0	47	43	8	1	18	0
1991	0	0	0	0	0	14	53	63	0	47	43	8	1	18	0
1992	0	0	0	0	0	14	106	126	0	94	86	17	1	36	0
1993	0	0	0	0	0	14	100	120	0	89	81	16	1	34	0
1994	0	18	1,107	910	0	14	98	337	332	160	79	16	1	217	125
1995	0	26	1,588	1,304	0	14	113	450	476	205	90	19	1	302	179
1996	0	7	464	3	0	16	255	826	4	847	195	7	1	191	52
1997	0	1	36	5	0	14	57	24	14	33	98	4	1	33	4
1998	0	6	387	0	3	19	39	163	0	46	84	4	1	86	44
1999	0	53	3,324	1,881	0	42	153	423	1,654	403	213	8	1	162	373
2000	0	74	4,503	3,059	115	143	157	2,018	1,692	461	345	5	1	687	504
2001	0	64	4,119	2,537	792	120	165	1,067	1,093	312	103	3	1	554	447
2002	0	27	1,751	3,120	4,439	159	154	797	644	228	228	4	1	480	185
2003	0	55	3,509	1,683	2,786	135	56	410	502	155	226	4	1	1,789	385
2004	0	49	2,992	3,593	3,732	91	98	349	756	151	115	16	1	378	338
2005	0	30	1,856	2,230	2,732	49	76	242	580	85	47	35	1	196	209
2006	0	357	3,971	3,740	2,375	255	93	416	1,026	232	87	28	1	613	448
2007	0	4	273	208	2,375	129	105	223	76	112	59	36	1	67	31
2008	0	0	1	0	2,375	127	108	266	0	102	11	74	1	5	0
2009	0	7	431	332	2,375	182	125	384	121	146	16	83	1	74	49
2010	0	11	711	547	2,375	338	112	419	200	151	6	81	1	113	80

1: Engraulidae; 2: Clupeidae; 3: Leiognathidae; 4: Synodontidae; 5: Holothuriidae; 6: Elasmobranchii; 7: Lutjanidae <Snappers>; 8: Carangidae; 9: Nemipteridae; 10: Lethrinidae; 11: Serranidae; 12: Mugilidae; 13: *Trochus* spp.; 14: Sphyraenidae; 15: *Terapon* spp.

Table A12 continued

Year	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1950	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1951	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1952	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1953	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1954	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1955	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1956	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1957	30	5	100	0	5	5	0	0	0	0	3	3	3	3	3
1958	30	0	100	0	13	13	0	0	0	0	6	6	6	6	6
1959	30	0	100	0	13	13	0	0	0	0	6	6	6	6	6
1960	30	0	100	0	23	23	0	0	0	0	12	12	12	12	12
1961	30	0	100	0	46	46	0	0	0	0	23	23	23	23	23
1962	30	0	100	0	55	55	0	0	0	0	28	28	28	28	28
1963	30	0	100	0	60	60	0	0	0	0	30	30	30	30	30
1964	30	0	100	0	51	51	0	0	0	0	26	26	26	26	26
1965	30	0	100	0	51	51	0	0	0	0	25	25	25	25	25
1966	30	0	100	0	52	52	0	0	0	0	26	26	26	26	26
1967	30	0	100	0	51	51	0	0	0	0	25	25	25	25	25
1968	30	0	100	0	53	53	0	0	0	0	27	27	27	27	27
1969	30	0	100	0	58	58	0	0	0	0	29	29	29	29	29
1970	30	0	100	0	53	53	0	0	0	0	27	27	27	27	27
1971	28	0	100	0	50	50	0	0	0	0	25	25	25	25	25
1972	27	0	100	0	47	47	0	0	0	0	23	23	23	23	23
1973	25	0	98	0	37	37	0	0	0	0	19	19	19	19	19
1974	23	0	95	0	26	26	0	0	0	0	13	13	13	13	13
1975	22	0	93	0	23	23	0	0	0	0	12	12	12	12	12
1976	20	0	90	0	22	22	0	0	0	0	11	11	11	11	11
1977	22	9	88	0	9	9	0	4	17	0	5	5	5	5	5
1978	18	9	85	0	5	5	0	4	17	0	2	2	2	2	2
1979	14	9	83	0	6	6	0	4	17	0	3	3	3	3	3
1980	13	13	67	0	4	4	0	5	24	0	2	2	2	2	2
1981	8	12	60	0	0	0	0	5	22	0	0	0	0	0	0
1982	9	13	54	0	0	0	0	5	25	0	0	0	0	0	0
1983	16	24	47	0	0	0	0	9	45	0	0	0	0	0	0
1984	14	21	40	0	0	0	0	8	39	0	0	0	0	0	0
1985	12	17	34	0	0	0	0	7	32	0	0	0	0	0	0
1986	12	17	27	0	0	0	0	7	32	0	0	0	0	0	0
1987	10	15	20	0	0	0	0	6	29	0	0	0	0	0	0
1988	9	13	13	0	0	0	0	5	25	0	0	0	0	0	0
1989	8	11	7	0	0	0	0	4	21	0	0	0	0	0	0
1990	6	14	0	0	0	0	32	59	28	10	0	0	0	0	0
1991	6	14	0	0	0	0	33	60	28	10	0	0	0	0	0
1992	12	28	0	0	0	0	65	120	55	21	0	0	0	0	0
1993	12	27	0	0	0	0	62	114	53	20	0	0	0	0	0
1994	12	121	0	161	71	71	60	110	52	19	56	36	36	36	36
1995	14	166	0	227	102	102	69	126	60	22	68	51	51	51	51
1996	2	9	0	367	30	30	147	119	2	23	15	15	15	15	15
1997	0	2	0	14	2	2	177	363	12	121	1	1	1	1	1
1998	15	171	0	51	25	25	396	413	18	40	13	12	12	12	12
1999	85	213	0	592	213	213	258	250	22	52	128	107	107	107	107
2000	460	819	0	518	288	288	264	174	37	83	149	144	144	144	144
2001	766	430	0	302	256	256	244	27	72	115	140	128	128	128	128
2002	340	221	0	192	106	106	295	1	91	210	54	53	53	53	53
2003	322	259	0	100	220	220	183	0	41	271	111	110	110	110	110
2004	307	335	0	137	193	193	211	6	50	523	98	97	97	97	97
2005	243	93	0	59	119	119	24	57	82	8	60	60	60	60	60
2006	599	274	0	261	256	256	44	88	74	14	128	128	128	128	128
2007	60	70	0	51	17	17	44	93	92	14	9	9	9	9	9
2008	57	86	0	28	0	0	9	48	162	3	0	0	0	0	0
2009	115	132	0	19	28	28	12	59	184	4	14	14	14	14	14
2010	146	150	0	34	46	46	4	44	176	1	23	23	23	23	23

16: Penaeidae; 17: Ariidae; 18: *Scomberoides* spp.; 19: Haemulidae; 20: *Gerres oyena*; 21: *Trichiurus* spp.; 22: *Scomberomorus commerson*; 23: *Lutjanus bohar*; 24: *Scomberoides commersonianus*; 25: Scombridae <Tunas>; 26: Platycephalidae; 27: *Formio niger*; 28: *Lupa pelgica*; 29: Soleidae; 30: Tetradontidae

Table A12 continued

Year	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1950	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1951	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1952	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1953	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1954	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1955	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1956	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1957	0	0	0	0	0	0	0	1	0	1	0	0	0	0	41
1958	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0
1959	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0
1960	0	0	0	0	0	0	0	6	0	6	0	0	0	0	0
1961	0	0	0	0	0	0	0	12	0	12	0	0	0	0	0
1962	0	0	0	0	0	0	0	14	0	14	0	0	0	0	0
1963	0	0	0	0	0	0	0	15	0	15	0	0	0	0	0
1964	0	0	0	0	0	0	0	13	0	13	0	0	0	0	0
1965	0	0	0	0	0	0	0	13	0	13	0	0	0	0	0
1966	0	0	0	0	0	0	0	13	0	13	0	0	0	0	0
1967	80	0	0	0	0	0	0	13	0	13	0	0	0	0	0
1968	80	0	0	0	0	0	0	13	0	13	0	0	0	0	0
1969	0	0	0	0	0	0	0	15	0	15	0	0	0	0	0
1970	0	0	0	0	0	0	0	13	0	13	0	0	0	0	0
1971	0	0	0	0	0	0	0	12	0	12	0	0	0	0	0
1972	80	0	0	0	0	0	0	12	0	12	0	0	0	0	0
1973	78	0	0	0	0	0	0	9	0	9	0	0	0	0	0
1974	76	0	0	0	0	0	0	6	0	6	0	0	0	0	0
1975	74	0	0	0	0	0	0	6	0	6	0	0	0	0	0
1976	72	0	0	0	0	0	0	6	0	6	0	0	0	0	0
1977	75	0	0	5	5	0	6	3	0	2	0	0	0	0	0
1978	73	0	0	5	5	0	6	2	0	1	0	0	0	0	0
1979	71	0	0	5	5	0	6	2	0	1	0	0	0	0	0
1980	61	0	0	7	6	0	8	2	0	1	0	0	0	0	0
1981	55	0	0	6	6	0	7	1	0	0	0	0	0	0	0
1982	50	0	0	7	7	0	8	1	0	0	0	0	0	0	0
1983	50	0	0	12	12	0	15	1	0	0	0	0	0	0	0
1984	43	0	0	11	10	0	13	1	0	0	0	0	0	0	0
1985	36	0	0	9	9	0	11	1	0	0	0	0	0	0	0
1986	30	0	0	9	9	0	11	1	0	0	0	0	0	0	0
1987	24	0	0	8	8	0	9	1	0	0	0	0	0	0	0
1988	18	0	0	7	7	0	8	1	0	0	0	0	0	0	0
1989	11	0	0	6	6	0	7	1	0	0	0	0	0	0	0
1990	5	0	0	24	18	0	7	0	18	0	0	0	11	9	0
1991	5	0	0	24	18	0	7	0	19	0	0	0	11	9	0
1992	9	0	0	49	36	0	15	1	37	0	0	0	23	19	0
1993	9	0	0	46	34	0	14	1	35	0	0	0	21	18	0
1994	9	0	37	45	33	27	14	19	34	18	0	22	21	17	0
1995	11	0	53	52	38	38	17	27	39	26	0	32	24	20	0
1996	5	0	116	25	1	58	2	7	102	7	0	0	0	1	0
1997	7	0	0	105	2	0	3	1	122	1	0	0	27	57	0
1998	0	3	38	86	11	0	4	7	115	6	0	1	69	47	0
1999	0	0	137	38	74	19	6	54	98	53	3	22	46	41	0
2000	0	456	256	45	112	188	8	72	16	72	2	115	32	39	0
2001	0	138	156	114	51	95	15	64	0	64	2	122	112	35	0
2002	0	148	86	37	52	11	58	26	0	26	110	62	34	7	0
2003	0	53	146	1	9	5	80	55	0	55	177	49	25	0	0
2004	8	159	50	8	22	6	34	49	0	48	130	68	0	0	0
2005	20	45	23	35	30	3	33	32	14	30	20	18	11	7	0
2006	16	111	70	42	34	270	116	66	25	64	197	85	15	13	0
2007	21	2	9	48	39	6	28	7	25	4	1	5	16	13	0
2008	43	2	0	48	46	0	53	4	5	0	0	0	3	2	0
2009	49	69	14	56	53	10	60	12	7	7	0	8	4	4	0
2010	47	88	22	50	49	16	58	16	3	11	0	13	2	1	0

31: *Euthynnus affinis*; 32: *Pomadasys argenteus*; 33: Lutjanidae; 34: *Lethrinus microdon*; 35: Lutjanidae <Job fishes>; 36: *Rastrelliger kanagurta*; 37: Rachycentridae; 38: Mullidae; 39: *Pristipomoides multidens*; 40: *Squilla* spp.; 41: Scombridae; 42: *Bothus pantherinus*; 43: *Epinephelus chlorostigma*; 44: *Epinephelus malabaricus*; 45: *Carangoides malabaricus*

Table A12 continued

Year	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1950	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1951	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1952	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1953	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1954	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1955	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1956	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1957	0	38	0	5	0	0	12	1	0	0	0	0	0	0	95
1958	0	0	0	5	0	0	0	1	0	0	0	0	0	0	107
1959	0	0	0	5	0	0	0	1	0	0	0	0	0	0	107
1960	0	0	0	5	0	0	0	1	0	0	0	0	0	0	150
1961	0	0	0	5	0	0	0	1	0	0	0	0	0	0	215
1962	0	0	0	5	0	0	0	1	0	0	0	0	0	0	227
1963	0	0	0	5	0	0	0	1	0	0	0	0	0	0	240
1964	0	0	0	5	0	0	0	1	0	0	0	0	0	0	215
1965	0	0	0	5	0	0	0	1	0	0	0	0	0	0	214
1966	0	0	0	5	0	0	0	1	0	0	0	0	0	0	272
1967	0	0	0	5	0	0	0	1	0	0	0	0	0	0	308
1968	0	0	0	5	0	0	0	1	0	0	0	0	0	0	315
1969	0	0	0	5	0	0	0	1	0	0	0	0	0	0	289
1970	0	0	0	5	0	0	0	1	0	0	0	0	0	0	276
1971	0	0	0	5	0	0	0	1	0	0	0	0	0	0	265
1972	0	0	0	5	0	0	0	1	0	0	0	0	0	0	297
1973	0	0	0	5	0	0	0	1	0	0	0	0	0	0	271
1974	0	0	0	5	0	0	0	1	0	0	0	0	0	0	238
1975	0	0	0	5	0	0	0	1	0	0	0	0	0	0	229
1976	0	0	0	5	0	0	0	1	0	0	0	0	0	0	226
1977	0	0	3	5	0	1	0	1	0	0	0	0	0	0	124
1978	0	0	3	1	0	1	0	1	0	0	0	0	0	0	112
1979	0	0	3	1	0	1	0	1	0	0	0	0	0	0	98
1980	0	0	4	1	0	1	0	1	0	0	0	1	0	0	137
1981	0	0	4	1	0	1	0	1	0	0	0	0	0	0	115
1982	0	0	4	1	0	1	0	1	0	0	0	1	0	0	124
1983	0	0	8	1	0	2	0	1	0	0	0	1	0	0	206
1984	0	0	7	1	0	2	0	1	0	0	0	1	0	0	176
1985	0	0	6	1	0	1	0	1	0	0	0	1	0	0	147
1986	0	0	6	1	0	1	0	1	0	0	0	1	0	0	145
1987	0	0	5	1	0	1	0	1	0	0	0	1	0	0	122
1988	0	0	4	1	0	1	0	1	0	0	0	1	0	0	100
1989	0	0	4	1	0	1	0	1	0	0	0	0	0	0	77
1990	8	0	3	1	3	2	0	1	1	0	0	0	0	1	22
1991	8	0	3	1	3	2	0	1	1	0	0	0	0	1	22
1992	17	0	6	1	6	3	0	1	3	0	0	1	0	1	44
1993	16	0	6	1	6	3	0	1	3	0	0	1	0	1	42
1994	15	0	6	1	5	3	0	1	3	0	0	1	0	1	392
1995	17	0	7	1	6	3	0	1	3	0	0	1	0	1	564
1996	6	0	3	1	2	0	0	1	1	5	0	0	0	0	328
1997	32	0	3	1	19	0	0	1	10	27	0	0	0	5	54
1998	20	0	0	1	27	0	0	1	8	0	0	0	0	2	167
1999	46	0	1	1	5	0	0	1	7	0	0	1	0	0	803
2000	39	0	1	1	4	0	0	1	4	0	0	1	0	6	1,737
2001	34	0	1	2	10	2	0	1	4	0	1	0	0	3	1,176
2002	10	0	3	1	0	4	0	1	0	0	7	0	0	1	840
2003	1	0	4	4	0	25	0	1	0	0	0	0	0	1	1,008
2004	0	0	6	1	0	9	0	1	0	0	0	1	0	0	852
2005	6	0	13	1	2	4	0	1	1	0	0	2	0	1	621
2006	11	0	11	1	4	4	0	1	2	0	24	1	29	1	1,407
2007	11	0	14	1	4	4	0	1	2	0	0	2	0	1	167
2008	2	0	27	1	1	7	0	1	0	0	0	4	0	0	143
2009	3	0	31	1	1	8	0	1	1	0	0	4	0	0	304
2010	1	0	30	1	0	7	0	1	0	0	0	4	0	0	392

46: *Lutjanus gibbus*; 47: *Saurida tumbil*; 48: *Chanos chanos*; 49: Palinuridae; 50: *Lethrinus mahseni*; 51: Bothidae; 52: *Pomadasys opercularis*; 53: Gastropoda; 54: *Lethrinus lentjan*; 55: *Thunnus tonggol*; 56: Portunidae; 57: Istiophoridae; 58: *Plectorhinchus schotaf*; 59: Scombridae <Mackerels>; 60: Others