Reconstructing Kuwait's marine fishery catches: 1950-2010[1]

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Abstract

Kuwait's fisheries have grown substantially over the past 60 years. Here, Kuwait's fisheries are reconstructed to include discards, recreational, and illegal catches. The resulting estimates of just under 2 million t are 6.4 times the 312,250 t reported to FAO, and discards, which constitute the largest missing sector, are 10 times greater than the total landed finfish in the country. This study illustrates the magnitude of the data reporting problems faced by Kuwait and provides further evidence for the need for more and better-enforced fisheries regulations in the region.

Introduction

Kuwait is located in the northeast of the Arabian Peninsula, on the shore of the Persian Gulf (Figure 1). It lies between latitudes 28° and 31° N, and longitudes 46° and 49° E, and borders Saudi Arabia to the south and Iraq to the north. Kuwait is one of the world's smallest countries in terms of land mass and is characterized by flat, sandy desert. It has nine islands, eight of which remain uninhabited. The capital, Kuwait City is located on Kuwait Bay, a natural deep-water harbor.

Kuwait was a British colony from 1899-1961 and is now a constitutional emirate with the oldest directly elected parliament among the Arab Persian Gulf countries. Kuwaiti nationals are a minority of the population, making up just 1 million out of the 3.5 million people. The country's economy is almost solely based on crude oil, which makes up nearly half of GDP and 95% of export revenues (World Factbook, 2011)

Interestingly, despite their predominately small-scale nature, Kuwait's fisheries remain the second most important natural resource after oil (Carpenter 1997). In general, fisheries management in Kuwait is not well developed, although weakly enforced legislation has been in place for the industrial shrimp fishery since the early 1980s. Because fisheries are of minor economic importance (at least when compared to oil), and therefore are of low political significance. The fisheries consist of two main sectors: a limited industrial (large-scale) shrimp fishery and substantial artisanal (small-scale) finfish and shrimp fisheries.

Methods

Fisheries catches as presented by the FAO on behalf of Kuwait occur in FAO statistical area 51. Total fish catches were estimated by following the conceptual framework outlined in Zeller (2006; 2007). Data were gathered from published and grey literature, and subsequently combined with clearly defined assumptions and interpolations.

Industrial sector

The industrial, or large-scale sector, consists exclusively of a shrimp trawl fishery. This sector started in the early 1960s and expanded rapidly, and by 2006, it grew to 35 trawlers. The main shrimp species targeted are the green tiger prawn (*Penaeus semisulcatus*), jinga shrimp (*Metapenaeus affinis*) and the kidi shrimp (*Parapenaeopsis stylifera*), with seasonal reported landings ranging from 1,000 to 5,200 t (Ye *et al.* 1999a). The official shrimp fishing

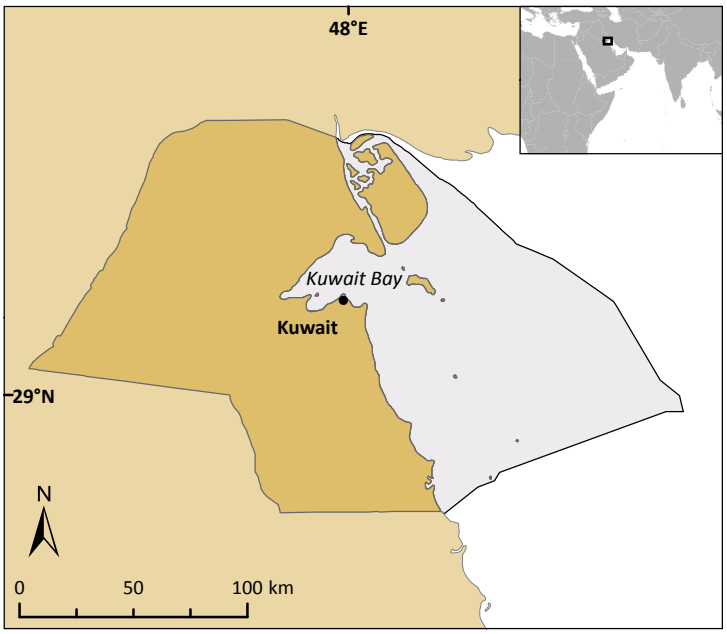

Figure 1. Map of Kuwait, showing the extent of its EEZ (grey area).

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season runs from September 1 of any given year to early/late spring of the next depending on catch rates. Trawling occurs in the coastal waters from 5 to 35 m depth, although Kuwait Bay and a three-mile coastal zone have been closed to trawling since 1983 (Ye *et al.* 1999b). Official reported shrimp landings were assigned to both the industrial and artisanal sectors. It has been reported that 45% of total shrimp landings are caught by artisanal vessels. As the industrial shrimp fishery did not begin until 1960, the proportion of shrimp catches caught be industrial vessels was interpolated from zero percent in 1959 to 55% in 1965. From 1965-2010, the proportion of 55% was kept constant.

Considerable illegal shrimp fishing occurs during the 3-6 month closed season (Mohammed *et al.* 1998; Siddiqui and Al-Mubarak 1998; Al-Sabbagh and Dashti 2009), suggesting poor to non-existent monitoring and enforcement of management rules. Here, it was conservatively estimated that out-of-season shrimp catches comprise 10% of total reported shrimp catch, starting from the earliest incident (1990) of illegal catches mentioned in the literature (Al-Sabbagh and Dashti 2009) to 2010. A set tonnage of 500 t was reported as being caught illegally in 1992. These illegal shrimp catches were also assigned to both the artisanal and industrial sectors using the same proportions as were used for the reported catches.

Bycatch (i.e., species that are unintentionally retained by fishing gear) is a major component of shrimp fisheries globally, raising concerns of ecological and economic impacts (Alverson and Hughes 1996; Kelleher *et al.* 2005). The average ratio of bycatch to shrimp is 5:1 in temperate and subtropical waters, and 10:1 in tropical waters (Slavin 1982). The subtropical Kuwaiti shrimp trawl fishery, however, has a fish-to-shrimp bycatch ratio of 15.32:1 (Ye *et al.* 2000). Of this bycatch, 98% is discarded at sea and the remaining 2% is landed, yet not reported (FAO 2006). Thus, both landed and discarded catches are unaccounted for. Species composition ratios were applied from the Ye *et al.* (2000) study. Marine catfish (Ariidae) and elasmobranchs (sharks and rays), which are not consumed in Kuwait for religious reasons, comprise the bulk of the discarded bycatch.

Bycatch was estimated as a multiple of both the reported legal shrimp catch and the unreported illegal catch, and then smoothed by applying a 3-year moving average. The estimated bycatch was subsequently disaggregated into unreported discards (98%) and unreported landed bycatch (2%). On average, the discards from the Kuwaiti shrimp fishery were 10 times higher than the tonnage of finfish reported to be landed in Kuwait annually.

Artisanal sector

The artisanal sector essentially comprises three components: a shrimp fishery, a boat-based finfish fishery and a traditional fixed intertidal stake net fishery. The artisanal shrimp fleet catches 45% of total shrimp landings using both traditional dhows and small outboard motor fibreglass vessels (FAO 2006). Since the industrial shrimp fishery did not begin until 1960, shrimp catches from 1950-1959 were labelled as 100% artisanal. Then, as described above, the artisanal proportion of the shrimp fishery was interpolated from 100% in 1959 to 45% in 1965, and kept constant to 2010. Improvements in the equipment of these fleets have resulted in dhows being able to access the same fishing grounds as the fibreglass vessels. Ye *et al.* (1999a) found nearly identical rates of bycatch and discard between artisanal and industrial shrimp fleets, and therefore the same 15.32:1 ratio was applied to the artisanal shrimp catches (including the illegal catches calculated above) to estimate unreported discards and unreported landed bycatch.

Kuwait's boat-based finfish fishery consists of two vessel types: wooden dhows and speedboats. These vessels are licensed for a single gear type, which can be hemispherical wire traps (*gargoor*), or drift or fixed gillnets of various mesh sizes. The dhow fleet consists of 120 boats, of which 94 use *gargoor* traps and 26 use gillnets (FAO 2006). The speedboat fleet consists of 748 vessels, 28 of which are licensed for *gargoor*, and 720 for gillnets (FAO 2006). The boat-based finfish fishery has seen significant declines in catches in recent years, with a record low of 2,500 tonnes in 2001. This has been attributed to overcapacity, although no efforts have been put into place to reduce capacity and effort (FAO 2006). The reported FAO data (minus the shrimp catch) were taken to be representative of the baseline catch for the boat-based artisanal fishery plus the traditional fixed intertidal stake net fishery.

Significant numbers of sharks are landed in Kuwait, yet are not listed in FAO catch data (Moore *et al.* 2012). The majority of these are caught as bycatch by small speedboats operating gillnets to target teleosts, or less commonly, dhows operating *gargoor* traps. Despite sharks being impermissible to eat by Shiite Muslims, a growing expatriate community has lead to sharks being landed whole and consumed within the country (Moore *et al.* 2012). A handful of countries in the Gulf do report their shark landings, and FAO data from Bahrain (based on its proximity and similar fishery profile) were used to estimate the potential contribution of sharks in Kuwait's catches. Bahrain reported shark catches (Carcharhinidae) for 2004-2010, and these catches were divided by the total reported finfish catch to obtain an average shark to finfish ratio of 5%. This ratio was applied to Kuwait's reported finfish time series.

Recreational sector

An active recreational fishery targets demersal species from small speedboats, but no data are available on the number of participants or species landings (FAO 2006). Cisneros-Montemayor and Sumaila (2010) estimate that

recreational fisheries involve 0.12% of Kuwait's population. Thus, this ratio was applied to the total population from 1950-2010 to get a time series of number of recreational fishers. As a conservative estimate, it was assumed that recreational fishers catch 1 kg of fish per trip and that they only fish on the weekends. Therefore, the number of fishers was multiplied by the number of fishing days (104 days) and by a catch of 1 kg to obtain a rough time series of recreational catches. The estimated catches for the years during and immediately after the first Gulf War (1990-1992) were eliminated, as it was assumed that no recreational fishing occurred. Rao and Behbahani (1999) estimate that the majority of species caught by recreational fishermen are *Epinephelus chlorostigma*, *Sparidentex hasta*, *Otolithes ruber*, and *Acanthopagrus latus*; thus the recreational catch was evenly distributed among those 4 species.

Subsistence Sector

Although vessel owners are Kuwaiti nationals, fishers are foreign workers from Southeast Asia and Iran, who have modest incomes, and therefore have a high incentive to fish for subsistence. From 1960-2010, foreign fishers made up 0.0015% of the population and it was assumed that each fisher takes 5 kg per week for subsistence purposes from the start of the oil boom in 1960 until 2010. It was further assumed that no subsistence fishing occurred during and immediately after the Gulf War, from 1990-1992. Finally, because these take home catches are composed of less desirable species, the catch composition of the discarded species were applied to the subsistence catches.

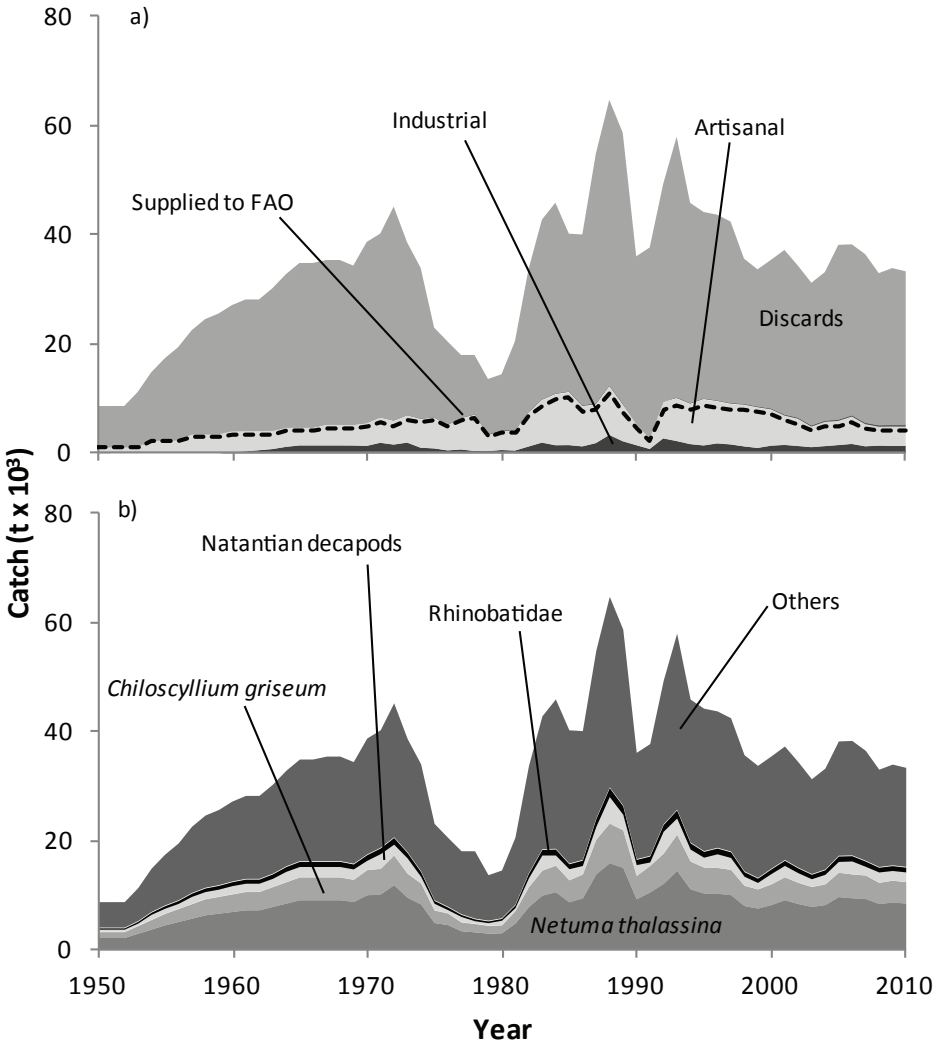

Figure 2. Total reconstructed catch for Kuwait by a) sector (with comparison to FAO data), and b) major taxa, 1950-2010.

Results and discussion

Catch data for Kuwait as reported by the FAO suggest a gradual increase in reported landings from 1,000 t in 1950 to a peak of 10,788 t in 1988, before declining to an average of around 4,700 t per year in the 2000s (Figure 2a; Appendix Table A1). In contrast, the reconstructed total marine fisheries catches suggest a rapid increase in catches at the start of the industrialized shrimp fishery in 1960, peaking at 45,000 t in 1972, with a second peak of 64,600 t occurring in 1988 (Figure 2a). A final peak is present in 1993 (57,800 t) before declining to a final tonnage of 33,200 t in 2010 (Figure 2a). Trends in catch series often reflect political events that impacted the fishery sector in a country; in this case, the decline in catches from 1972 to 1979 is most likely a result of the Iran-Iraq war. Similarly, the decline in catches in 1990 is reflective of the first Gulf War and the occupation of Kuwait by Iraqi forces.

Total reconstructed catch for Kuwait fisheries was estimated to be 1,997,000 t which is 6.4 times the amount reported by the FAO (312,250 t) on behalf of Kuwait (Figure 2a). Kuwait's fisheries were estimated to be 42.8% industrial, 56.8% artisanal, 0.01% subsistence and 0.45% recreational. Although it appears that non-commerical sectors are fairly insignificant, these estimates were made with limited information and therefore were made to be conservative. This is an area that requires further study.

The main taxa caught in Kuwait are *Netuma thalassina* (25%), *Chiloscyllium griseum* (11%), natantian decapods (5%) and Rhinobatidae (3%) (Figure 2b; Appendix Table A2). The three non-shrimp categories mostly consist of dicards. If we look only at retained catch the top taxa include natantian decapods (29%), *Pampus* spp. (7%), Serranidae (6%), Sciaenidae (6%), Mugilidae (5%) and *Tenualosa ilisha* (5%).

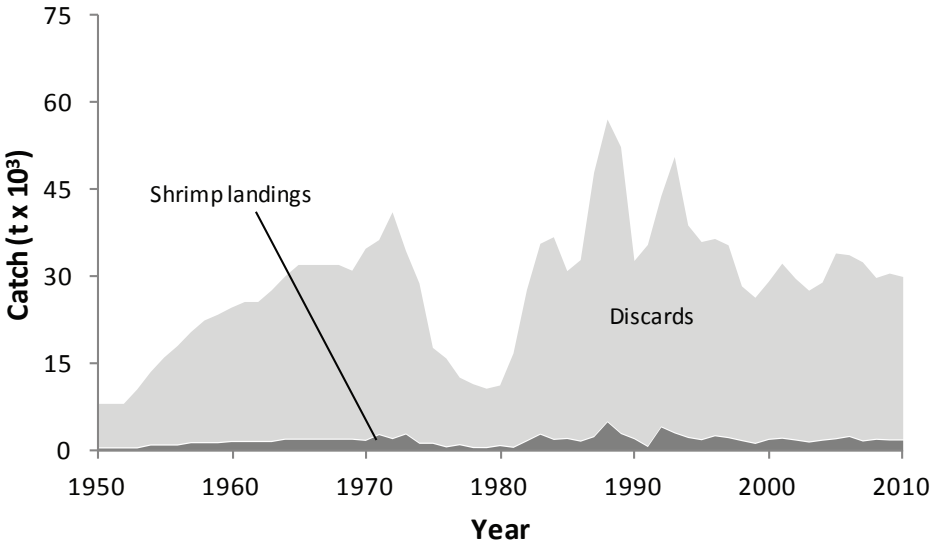

Figure 3. Estimated discards from Kuwait's shrimp fishery in comparison to shrimp landings (includes data from legal and illegal shrimp fishery).

As seen from the values above, the estimated time series also illustrates the magnitude and importance of discards (Figure 3). In terms of tonnage, discards amounted to almost 10 times the amount of reported, landed finfish. The non-reporting of discards is particularly problematic. In some countries, such as Kuwait, good estimates of discards are available. Yet in most other cases, particularly in developing countries, there is a general lack of quantitative information on discards or discard rates (Kelleher *et al.* 2005). This is partly because several different fishing gears may be used, different species may be targeted on a single fishing trip or vessel, and because fisheries change over time (Kelleher *et al.* 2005). Therefore, attributing a single discard rate to a particular fishery may lead to large errors. Globally, discards are reported to be to 8% of reported landings (Kelleher *et al.* 2005).

The catch reconstruction supports concerns over the status of fisheries in Kuwait. Sharp declines in all sectors, coupled with other indicators of overexploitation such as the reduced mean size of landed fish (Dadzie *et al.* 2005; Al-Sabbagh and Dashti 2009) and a decline of catch per effort suggest that the fisheries are suffering from overcapacity. Additionally, population pressure also occurs, as a 'youth bulge,' a common demographic characteristic in the Middle East, is certain to cause further strain on resources. Combined, unregulated fishing practices and population pressure suggest that 'Malthusian overfishing' occurs in Kuwait, a situation where declining yield coupled with socio-economic conditions drive fishers to over-exploit and destroy their resource base (Pauly 2006).

The overall reported catches for Kuwait's artisanal and industrial fisheries potentially underestimate total catches by a factor of 6.4 over the 1950-2010 time period. Such substantial differences between reported landings and reconstructed total catches illustrate the magnitude of the data reporting problems faced by Kuwait, and, by inference, other countries (e.g., Zeller *et al.* 2007; Zeller *et al.* 2011a; Zeller *et al.* 2011b). It also points at a fundamental problem of fisheries catch data being viewed purely from a commercial, market perspective, which accounts only for what is landed and utilized for commercial sale or export (Pauly and Zeller 2003; Zeller and Pauly 2004). In contrast, given the global move towards viewing and managing fisheries on an ecosystem scale (Pikitch *et al.* 2004), fisheries data collection, and hence catch accounting, needs to account for total catches, notably to be able to maintain important ecosystem processes (Pauly 1985a, b; Pauly and Matthew 1986; Pauly and Palomares 1987). This requires comprehensive accounting for all extractions of fish and invertebrates during fishing operations, including the recording (or estimation) and reporting of discarded catch, and the estimation and reporting of catches from unregulated sectors such as the recreational fishery and the traditional stake net fishery. Given the high costs of monitoring such sectors using traditional catch monitoring approaches, alternative methods such as utilizing national surveys and census opportunities have been suggested (Zeller *et al.* 2007) for the more widely dispersed and hard to monitor small-scale and recreational fisheries sectors.

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Appendix Table A1. FAO landings vs. total reconstructed catch (t) for Kuwait, 1950-2010, as well as catch by sector.

Year	FAO landings	Total reconstructed catch	Industrial	Artisanal	Subsistence	Recreational	Discards
1950	1,000	8,700	-	1,180	-	19	7,500
1951	1,000	8,700	-	1,180	-	21	7,500
1952	1,000	8,700	-	1,180	-	22	7,500
1953	1,000	11,300	-	1,230	-	23	10,000
1954	2,000	14,800	-	2,310	-	24	12,500
1955	2,000	17,400	-	2,360	-	25	15,000
1956	2,000	19,400	-	2,400	-	26	17,000
1957	3,000	22,500	-	3,470	-	26	19,000
1958	3,000	24,600	-	3,510	-	29	21,000
1959	3,000	25,600	-	3,530	-	32	22,000
1960	3,500	27,100	190	3,880	1	33	23,000
1961	3,500	28,100	380	3,700	1	37	24,000
1962	3,500	28,200	570	3,510	1	42	24,000
1963	3,500	30,200	780	3,340	1	48	26,000
1964	4,000	32,800	1,180	3,490	2	54	28,000
1965	4,000	34,800	1,440	3,280	2	60	30,000
1966	4,000	34,800	1,440	3,280	2	67	30,000
1967	4,500	35,300	1,440	3,800	2	73	30,000
1968	4,500	35,300	1,440	3,800	3	80	30,000
1969	4,500	34,300	1,430	3,790	3	87	29,000
1970	4,700	38,600	1,360	4,160	3	94	33,000
1971	5,700	40,200	1,920	4,610	3	101	33,500
1972	5,000	45,100	1,590	4,350	3	109	39,000
1973	6,101	38,600	1,950	4,960	4	116	31,500
1974	5,502	33,900	1,020	5,250	4	124	27,500
1975	5,934	23,000	900	5,600	4	132	16,400
1976	4,648	20,500	540	4,610	4	139	15,200
1977	5,913	18,000	710	5,680	5	147	11,500
1978	6,489	18,000	430	6,580	5	155	10,800
1979	3,065	13,600	420	2,980	5	163	10,100
1980	3,689	14,500	610	3,430	5	172	10,300
1981	3,714	20,500	510	3,690	6	180	16,100
1982	6,628	33,600	1,240	6,170	6	189	26,000
1983	8,722	42,700	1,950	7,740	6	198	32,800
1984	9,639	45,800	1,470	9,260	6	207	34,900
1985	10,116	40,200	1,490	9,610	7	217	28,800
1986	7,630	40,000	1,270	7,300	7	229	31,200
1987	7,699	54,700	1,860	7,040	8	242	45,600
1988	10,788	64,600	3,340	8,810	8	253	52,200
1989	7,643	58,600	2,200	6,690	8	260	49,400
1990	4,454	36,000	1,490	3,910	-	-	30,600
1991	2,034	37,600	800	2,080	-	-	34,800
1992	7,871	49,200	2,710	6,680	-	-	39,800
1993	8,466	57,800	2,230	7,770	7	228	47,600
1994	7,752	45,800	1,680	7,310	7	216	36,600
1995	8,616	44,100	1,430	8,390	6	203	34,100
1996	8,255	43,600	1,810	7,670	6	203	33,900
1997	7,827	42,400	1,620	7,380	7	210	33,200
1998	7,798	35,600	1,260	7,540	7	220	26,600
1999	7,398	33,600	980	7,350	7	232	25,100
2000	6,977	35,400	1,390	6,580	8	242	27,200
2001	5,846	37,200	1,530	5,320	8	251	30,100
2002	5,360	34,300	1,340	4,940	8	258	27,800
2003	4,059	31,200	1,120	3,740	8	265	26,100
2004	4,833	33,100	1,310	4,400	9	273	27,200
2005	4,895	38,100	1,500	4,380	9	283	31,900
2006	5,635	38,200	1,710	4,960	9	293	31,200
2007	4,373	36,400	1,280	4,020	10	305	30,800
2008	3,979	32,900	1,410	3,430	10	318	27,800
2009	4,000	33,900	1,350	3,520	10	330	28,700
2010	4,000	33,300	1,340	3,510	11	342	28,100

Appendix Table A2. Total reconstructed catch (t) for Kuwait by major taxa, 1950-2010.

Year	*Netuma thalassina*	*Chiloscyllium griseum*	Natantian decapods	Rhinobatidae	Others[a]
1950	2,270	1,050	500	230	4,700
1951	2,270	1,050	500	230	4,700
1952	2,270	1,050	500	230	4,700
1953	3,030	1,400	500	310	6,000
1954	3,790	1,740	1,000	390	7,900
1955	4,550	2,090	1,000	470	9,300
1956	5,150	2,370	1,000	530	10,400
1957	5,760	2,650	1,400	590	12,100
1958	6,370	2,930	1,400	650	13,200
1959	6,670	3,070	1,400	690	13,800
1960	6,970	3,210	1,600	720	14,600
1961	7,280	3,350	1,600	750	15,200
1962	7,280	3,350	1,600	750	15,200
1963	7,880	3,630	1,600	810	16,300
1964	8,490	3,910	2,000	870	17,500
1965	9,090	4,190	2,000	930	18,600
1966	9,090	4,190	2,000	930	18,600
1967	9,090	4,190	2,000	930	19,100
1968	9,090	4,190	2,000	930	19,100
1969	8,790	4,050	2,000	900	18,600
1970	10,000	4,600	1,800	1,030	21,200
1971	10,160	4,670	2,800	1,040	21,500
1972	11,820	5,440	2,100	1,210	24,500
1973	9,550	4,400	2,900	980	20,700
1974	8,340	3,840	1,300	860	19,600
1975	4,970	2,290	1,300	510	14,000
1976	4,600	2,120	680	470	12,600
1977	3,480	1,600	1,060	360	11,500
1978	3,290	1,510	560	340	12,300
1979	3,050	1,400	550	310	8,300
1980	3,110	1,430	900	320	8,700
1981	4,890	2,250	600	500	12,300
1982	7,870	3,620	1,720	810	19,600
1983	9,940	4,570	2,870	1,020	24,300
1984	10,560	4,860	1,970	1,090	27,300
1985	8,730	4,020	2,130	900	24,400
1986	9,450	4,350	1,660	970	23,600
1987	13,800	6,350	2,440	1,420	30,700
1988	15,810	7,270	5,000	1,620	34,900
1989	14,970	6,890	2,990	1,540	32,200
1990	9,280	4,270	2,080	950	19,400
1991	10,520	4,840	740	1,080	20,400
1992	12,060	5,550	4,120	1,240	26,200
1993	14,420	6,640	3,090	1,480	32,200
1994	11,080	5,100	2,300	1,140	26,200
1995	10,320	4,750	1,910	1,060	26,100
1996	10,280	4,730	2,590	1,060	25,000
1997	10,040	4,620	2,270	1,030	24,400
1998	8,050	3,700	1,760	830	21,300
1999	7,590	3,500	1,280	780	20,500
2000	8,230	3,790	1,970	850	20,500
2001	9,110	4,190	2,170	940	20,800
2002	8,410	3,870	1,860	860	19,300
2003	7,900	3,630	1,510	810	17,300
2004	8,230	3,790	1,830	850	18,500
2005	9,670	4,450	2,080	990	20,900
2006	9,460	4,360	2,470	970	20,900
2007	9,330	4,290	1,690	960	20,100
2008	8,420	3,870	1,990	860	17,800
2009	8,680	4,000	1,870	890	18,400
2010	8,510	3,910	1,870	870	18,100

[a] Others category includes 22 additional taxonomic groups.